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1.0 SUMMARY SHEET

FISHERY MANAGEMENT PLAN FOR THE GROUNDFISH FISHERY IN THE BERING SEA/ALEUTIAN ISLANDS AREA

(X) Final ( ) Draft Environmental Impact Statement

Responsible Agencies: North Pacific Fishery Management Council
Contact: Clarence G. Pautzke, Executive Director
P.O. Box 103136
Anchorage, Alaska 99510

National Marine Fisheries Service
Contact: Regional Director
P.O. Box 1668
Juneau, Alaska 99802

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: The proposed action is to adopt and implement a fishery management plan for the groundfish fishery in the Bering Sea/Aleutian Islands area under the provisions of Title III of the Magnuson Fishery Conservation and Management Act of 1976 (P.L. 94-265). This act extends jurisdiction over fishery resources and establishes a program for their management. The purpose of the plan is to manage the groundfish fishery in the Bering Sea/Aleutian Islands area for the optimum yield and to allocate harvest between domestic and foreign fishermen.

3. Summary:
Environmental Impacts. Implementation of this fishery management plan within the limit of its constraints is presumed not to cause adverse impacts on the environment. Conservation measures are provided for species for which they are deemed necessary. Those measures and the conduct of the fishery as outlined will be beneficial to the ocean environment affected, to demersal and pelagic fishes and to the human environment.

4. Alternatives: The following alternatives are considered:
   (a) No action.
   (b) Regulation of foreign fishery only.
   (c) Continuation of present management regime.

5. Comments Requested: Comments have been requested, received, and considered in conformance with P.L. 94-265 and other applicable law.

6. Hearings: Hearings were held in conformance with P.L. 94-265 and other applicable law.

7. Draft Statement to CEQ: September 6, 1978

8. Final Statement to CEQ: November 20, 1981

1.1 History and Summary of Amendments

Amendment 1, approved by the Secretary of Commerce July 26, 1983. Implemented January 1, 1984, supersedes Amendments 2 and 4:

(1) Established a multi-year, multi-species optimum yield for the groundfish complex (Section 11).

(2) Established a framework procedure for determining and apportioning TAC, Reserves, and DAH (Sections 11 and 12).

(3) Eliminated the "Misty Moon" grounds south of the Pribilof Islands from the Winter Halibut Savings Area (Section 14).

(4) Allowed experimental year-round domestic trawling in the Winter Halibut Savings Area that will be closely monitored to the extent possible (Section 14).

(5) Allowed year-round domestic trawling in the Bristol Bay Pot Sanctuary and year-round domestic longlining in the Winter Halibut Savings Area (Section 14).

(6) Closed the Petrel Bank area to foreign trawling from July 1 through June 30.

(7) Established the Resource Assessment Document as the biological information source for management purposes (Section 11 and Annex I).

(8) Specified that the fishing and FMP year is the calendar year.

Amendment 1a, implemented January 2, 1982:

Set a chinook salmon prohibited species catch 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 JVP 25,000 mt from 850 mt, and decreased TALFF by 24,150 mt.

(2) 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.

(3) For Pacific Cod, decreased MSY to 55,000 mt from 58,700 mt, increased EY to 160,000 mt from 58,700 mt, increased ABC to 160,000 mt from 58,700 mt, increased OY to 78,700 mt from 58,700 mt, increased Reserves to 3,935 mt from 2,935 mt, increased 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 (Section 14).

(2) Established a Council policy on the domestic groundfish fisheries and their incidental catch of prohibited species (Section 14).

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.

(2) 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.

(3) 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.

(4) 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.

(5) 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 ABC to 79,714 mt, OY to 77,314 mt, and reserves to 3,866 mt.

(6) For Pacific Cod, increased EY and ABC to 168,000 mt from 160,000 mt, increased OY 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.

(7) 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.)

(8) 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.)

(9) 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 MSY to 11,600 mt in Bering Sea and 1,900 mt in Aleutians to eliminate inconsistencies with annexes.

(10) Changed foreign fisheries restrictions to allow trawling outside 3 miles north of the Aleutians between 170°30'W and 172°W and south of the Aleutians between 170°W and 172°W; and to allow longlining outside 3 miles west of 170°W.

(11) Established the authority of the Secretary of Commerce to issue field orders for conservation reasons. (Disapproved by Secretary of Commerce.)

Amendment 5, withdrawn from Secretarial review:

Decreased chinook salmon PSC from 55,250 fish to 45,500 fish for 1983. This amendment was withdrawn from Secretarial review because Amendment 3 was implemented in time to protect chinook salmon in 1983.

Amendment 6, disapproved by NMFS on December 8, 1983:

Establishes 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 (Section 14).

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 purvue of Amendment 3 and did not require formal Secretarial approval.

Amendment 9, implemented December 1, 1985:

(1) Closed areas west of 170°W within 20 miles to foreign trawling year-round. Disapproved by NMFS.)

(2) 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.

(3) Incorporated habitat protection policy. (A proposed regulation authorized by this part of Amendment 9 is reserved until an analysis of the measure is prepared.)

(4) Established definition for directed fishing as 20% 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 Prohibited Species Catch (PSC) limits for DAH yellowfin sole/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.

(2) Revised the weekly reporting requirement for catcher/processors and mothership/processors.

(3) Established explicit authority for reapportionment between DAP and JVP fisheries.

(4) 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 (ABC) 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 prohibited species catch (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:

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;

(2) divided the pollock TAC into two seasonal allowances: roe-bearing and non roe-bearing. 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:

(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:

(1) Extended the effective data of Amendment 12a (originally scheduled to expire December 31, 1990) with the following three changes:

- Prohibit species catch (PSC) apportionments would be established for the DAP rock sole and deep water turbot/arrowtooth founder fisheries;
- PSC limits could be seasonally apportioned; and
- An interim incentive program established to encourage vessels to avoid excessive bycatch rates.

(2) Established a definition of overfishing;

(3) Established procedures for interim TAC specifications; and

(4) Provided for fishing gear restrictions to be modified by regulatory amendments.

Amendment 16a implemented on 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 Director, 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% of the estimated herring biomass, attainment of which triggers trawl closures in three Herring Savings Areas.

Amendment 17 on April 24, 1992:

(1) Authorize the NMFS Regional Director to approve experimental fishing permits after consultation with the Council.

(2) Establish permanently the Walrus Islands seasonal groundfish fishery closures in the Bering Sea and Aleutians groundfish plan, including 12-mile buffer zones around three haul-out sites in northern Bristol Bay. Closures occur April 1 - September 30. It is the Council's intent to review these closures after five years.

(3) Establish a unique Bogoslof District (new Area 518) for which a pollock harvest quota would be annually specified. Fishing for pollock in new Area 519 and other reporting areas of the Bering Sea will be unaffected by any closure of the Bogoslof District.

(4) Require groundfish pots to be identified by some form of tag (regulatory amendment).

Amendment 18 on June 1, 1992 and revised Amendment 18 on December 18, 1992:

(1) The Pollock TAC in the BS/AI, 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° 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 BS/AI pollock assigned to the nonspecific reserve (7.5 percent of the BS/AI TAC) is allocated as Western Alaska Community Development Quota (CDQ).

Amendment 19 on September 23, 1992:

(1) Revise time/area closure (hotspot) authority in the BS/AI to authorize, by regulatory amendment, the establishment of time/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 (VIP) to include all trawl fisheries in the BS/AI.

(3) Delay opening of all trawl fisheries in the BS/AI 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 BS/AI 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 $\geq$ to 95% of the total catch.

B. Other targets determined by the dominate species in terms of retained catch.

C. For the BS/AI, 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 BS/AI 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.

Amendment 20 on January 19, 1992:

(1) Prohibit trawling year round in the BS/AI 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.

Amendment 21 implemented on March 17, 1993:

(1) Established FMP authority to specify trawl and non-trawl gear halibut bycatch mortality limits by regulatory amendment.

Amendment 21a implemented on January 20, 1995:

(1) Established a Pribilof Islands Habitat Conservation Area.

Amendment 21b implemented on November 29, 1995:

(1) Established trawl closure areas called the Chinook Salmon Savings Areas.

Amendment 22 on December 22, 1992:

(1) 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 GOA or BSAI would otherwise be closed to trawling. The one test area in the BSAI is bounded by straight lines connecting the following coordinates:

W. longitude	N. latitude
167 degrees 00 minutes	55 degrees 00 min
166 degrees 00 minutes	55 degrees 00 min
166 degrees 00 minutes	54 degrees 00 min
167 degrees 00 minutes	54 degrees 00 min
167 degrees 00 minutes	55 degrees 00 min

Amendment 23, implemented on 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 on 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 on May 20, 1994:

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 on 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 approved by the Secretary on August 15, 1994:

Implemented language changes to the Fishery Management Plans to indicate that observer requirements under the FMP's are contained in the North Pacific Fisheries Research Plan.

Amendment 28 approved by the Secretary on June 24, 1994:

Established three districts in the Aleutian Islands management area (540) for purposes of distributing the groundfish TACs spatially.

Amendment 29 not submitted

Amendment 30 implemented on September 23, 1994:

Raised the community development quota (CDQ) allocation limit for qualified applicants from 12 percent to 33 percent.

Amendment 31 implemented on November 7, 1994:

Implemented the Modified Block plan to prevent excessive consolidation of the halibut and sablefish fisheries, and clarifies the transfer process for the Individual Fishing Quota (IFQ) program.

Amendment 32 implemented on January 24, 1996:

Established a one-time transfer of halibut and sablefish IFQ for CDQ.

Amendment 33 implemented on June 27, 1996:

Allowed freezing of non-IFQ species when fishing sablefish IFQ.

Amendment 34 implemented on December 31, 1997:

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 on July 5, 1995:

Established a trawl closure area called the Chum Salmon Savings Area.

Amendment 36 implemented on March 17, 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 on December 16, 1996

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 prohibited species catch limits.

Amendment 38 implemented on December 12, 1995:

Extended provision of Amendment 18, inshore/offshore allocation and modified the Catcher Vessel Operating Area.

Amendment 39, implemented on October 1, 1998:

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. It also allocated 7.5% of groundfish TACs to CDQ programs.

Amendment 40 implemented on December 22, 1997:

Established Prohibited Species Catch Limits for C. opilio crab in trawl fisheries and a snow crab bycatch limitation zone.

Amendment 41 implemented on March 24, 1997

Revised the C. bairdi Tanner crab prohibited species catch limit in Zones 1 and 2.

Amendment 42 implemented on August 22, 1996

Increased sweep-up levels for small quota share blocks for sablefish managed under the sablefish and halibut Individual Fishing Quota program.

Amendment 43 implemented on December 26, 1996:

Established sweep-up provisions to consolidate very small quota share blocks for halibut and sablefish.

Amendment 44 implemented on January 17, 1997:

Established a more conservative definition of overfishing.

Amendment 45 implemented on January 26, 1999:

Reauthorized the pollock Community Development Quota allocation.

Amendment 46 implemented on November 20, 1996:

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% to catcher vessels and 50% to catcher processors. These allocations as well as the seasonal apportionment authority established in Amendment 24 will remain in effect until amended.

Amendment 47 implemented on November 1, 1996:

Authorized an interim North Pacific groundfish observer program, maintained the current groundfish observer coverage requirements through, and removed references to the North Pacific Fisheries Research Plan.

Amendment 49 implemented on December 3, 1997:

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 on June 12, 1998:

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 was partially implemented on January 25, 1999:

Restricted catcher vessel operations in the CVOA delivering to the inshore sector. Proposed revisions to the inshore/offshore allocations of pollock were superceded by the American Fisheries Act of 1998.

Amendment 53 implemented July 29, 1998:

Allocates shortraker and rougheye rockfish TAC 70 percent to trawl fisheries and 30 percent to non-trawl fisheries.

Amendment 55 implemented on 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 on March 8, 1999:

Revised the overfishing definition.

Amendment 59 implemented on January 25, 1999:

Extended the vessel moratorium through December 31, 1999.

2.0 EXECUTIVE SUMMARY

Management Objectives to be Attained

1. Promote conservation while providing for optimum yield from the region's groundfish resources in terms of:

   (a) Providing the greatest overall benefit to the nation with particular reference to food production and recreational opportunities;
   (b) Avoiding long-term or irreversible adverse effects on fishery resources and the marine environment;
   (c) Insuring availability of a multiplicity of options with respect to future uses of these resources.

2. Promote, where possible, efficient use of the fishery resources but not solely for economic purposes.

3. Promote fair and equitable allocation of identified available resources in a manner that no particular group acquires an excessive share of the privileges.

4. Base the plan on the best scientific information available.

Ecological, Economic and Social Impacts

Ecological Impacts

In the context of long-term relationships, fishery managers are just now beginning to find out, understand and quantify the complex relations among species and between the biota and the environment of the ecosystem in the Bering Sea/Aleutian Islands area. Until that understanding is more fully developed, it is not possible to predict the long-term effect on the ecosystem of the current, single species management strategies (as opposed to the integrated ecosystem method) or of subtle environmental changes.

The quantitative processes in the marine ecosystem are beginning to be simulated and studied with numerical, dynamic, deterministic marine ecosystem reproduction models.

It is generally recognized by fisheries scientists that the existing theories and models pertaining to fishery resources management suffer some fundamental inadequacies; concepts and theories must be developed to answer present and future management decisions. Until such new concepts supercede the old, the latter can still serve as a useful basis for deriving management decisions, providing their limited and underlying assumptions are recognized and evaluated with the best available information. This is the philosophy and approach used throughout this plan.

Economic Impacts

The number of vessels operating in this fishery management area has been so small that specific information cannot be disclosed without violating the confidentiality of individual reports. There is a slightly larger groundfish fishery for bait used by crabbers operating in the fishery.

In all, the total domestic commercial groundfish catch in the Bering Sea/Aleutians region (excluding halibut) is thought to be no more than 1,500 mt in any recent year.

Although substantial freezing and transshipping facilities are located at Dutch Harbor (Unalaska), with the exception of very small amounts of groundfish frozen for crab bait, no groundfish processing (except halibut) has occurred in this region in recent years.

The viability of a domestic Bering Sea groundfish fishery will ultimately depend on the ability of U.S. industry to market products at prices which cover their production costs.

The impact of this FMP on the domestic socioeconomic climate will be in direct proportion to the participation of Americans in the fishery. It is presumed that any financially sound participation in the future will result in increased employment opportunities and the benefits associated with development above the present low level.

Social Impacts

The relatively undeveloped nature of this fishery makes obvious the fact that any development will immediately impact the social climate. Employment is in direct proportion to plant development and processing capabilities. Certainly, initial efforts will be at least tentative and exploratory in nature. The single vessel now (spring, 1979) participating in a joint venture is being used by prospective fishermen as a bellwether. The reader is referred to a fact sheet contained in the comment section of this plan for a precis of conditions in the fishery.

3.0 INTRODUCTION TO THE PLAN

This Fishery Management Plan (FMP) has been developed by the North Pacific Fishery Management Council and is for the groundfish fishery, excluding halibut and herring, of the Bering Sea/Aleutian Islands area. It is intended to replace all of the current Preliminary Fishery Management Plan (PFMP) for the Trawl and Herring Gillnet Fisheries of the Bering Sea and Aleutians except that portion dealing with herring. Both of those PFMPs were developed by the National Marine Fisheries Service and implemented by the Secretary of Commerce in early 1977.

One feature of the format of this FMP is that such items as Allowable Biological Catch, Expected Domestic Annual Harvest, Total Allowable Level of Foreign Fishing, and annual catch statistics which are likely to change from time to time have been arranged in Annexes. This should facilitate both the drafting and review process when such changes are made in the future.

3.1 Description of the Management Unit

The geographical extent of this Management Unit is the entire Exclusive Economic Zone (EEZ) of the Bering Sea, including Bristol Bay and Norton Sound, and that portion of the EEZ of the North Pacific Ocean which is adjacent to the Aleutian Islands west of 170°W.

In terms of both the fishery and the groundfish resource, the Bering Sea/ Aleutians groundfish fishery (excluding halibut) forms a distinct management unit. The history of fishery development, target species and species composition of the commercial catch, bathemetry, and oceanography are all much different in that Region than in the adjacent Gulf of Alaska. Although many species occur over a broader range than the Bering Sea/Aleutians Region, with only a few exceptions (e.g. halibut and perhaps sablefish) stocks of common species in this Region are believed different from those in the adjacent Gulf of Alaska.

Even though the International Pacific Halibut Commission is responsible for management of the North American Pacific halibut fishery, the potential adverse impact on halibut of a fishery for other groundfish species is so great that it must be taken into account in the management of the groundfish fishery. Therefore, certain pertinent aspects of the halibut resource and the directed fishery it supports are described in this Fishery Management Plan. Throughout this document, the terms "groundfish" and "bottomfish" exclude Pacific halibut unless otherwise noted.

This Fishery Management Plan follows almost exactly the "Outline for Fishery Management Plans" adopted by the North Pacific Council and forms the major component of an Environmental Impact Statement which assesses the effect that implementation of this Plan is expected to have on the environment of the region which encompasses the eastern Bering Sea and Aleutian Islands archipelago.

3.2 Goals for Management Plan

The North Pacific Fishery Management Council has determined that all its fishery management plans should, in order to meet the requirements of its constituency, the resources and FCMA, achieve the following goals:

1. Promote conservation while providing for the optimum yield from the Region's groundfish resource in terms of: providing the greatest overall benefit to the nation with particular reference to food production and recreational opportunities; avoiding irreversible or long-term adverse effects on fishery resources and the marine environment; and insuring availability of a multiplicity of options with respect to the future uses of these resources.

2. Promote, where possible, efficient use of the fishery resources but not solely for economic purposes.

3. Promote fair and equitable allocation of identified available resources in a manner such that no particular group acquires an excessive share of the privileges.

4. Base the plan on the best scientific information available.

In accomplishing these broad objectives a number of secondary objectives have been considered:

1. Conservation and management measures have taken into account the unpredictable characteristics of future resource availability and socioeconomic factors influencing the viability of the industry.

2. Where possible, individual stocks of fish are managed as a unit throughout their range, but such management is in due consideration of other impacted resources.

3. In such instances when stocks have declined to a level below that capable of producing MSY, management measures promote rebuilding the stocks. In considering the rate of rebuilding, factors other than biological considerations have been taken into account.

4. Management measures, while promoting efficiency where practicable, are designed to avoid disruption of existing social and economic structures where fisheries appear to be operating in reasonable conformance with the Act and have evolved over a period of years as reflected in community characteristics, processing capability, fleet size and distribution. These systems and the resources upon which they are based are not static, but change in the existing regulatory regime should be the result of considered action based on data and public input.

5. Management measures should contain a margin of safety in recommending allowable biological catches when the quality of information concerning the resource and ecosystem is questionable. Management plans should provide for accessing biological and socioeconomic data in such instances where the information base is inadequate to effectively establish the biological parameters of the resource or to reasonably establish optimum yield. This plan has identified information and research required for further plan development.

6. Fishing strategy has been designed in such a manner as to have minimal impact on other fisheries and the environment.

3.3 Operational Definitions of Terms

1. Determinants of catch levels.

   a. Maximum sustainable yield (MSY) is an average over a reasonable length of time of the largest catch which can be taken continuously from a stock under current environmental conditions. It should normally be presented with a range of values around its point estimate.

      Where sufficient scientific data as to the biological characteristics of the stock do not exist or the period of exploitation or investigation has not been long enough for adequate understanding of stock dynamics, the MSY will be estimated from the best information available.

b. Equilibrium yield (EY) is the annual or seasonal harvest which allows the stock to be maintained at approximately the same level of abundance (apart from the effects of environmental variation) in successive seasons or years.

c. Acceptable Biological Catch is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under "overfishing" below.

d. 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 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 (1-2), 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 (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient a is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) 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 SPR 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:* $B/B_{MSY} \leq a$

$F_{OFL} = 0$

$F_{ABC} = 0$

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:* $B/B_{MSY} \leq a$

$F_{OFL} = 0$

$F_{ABC} = 0$

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:* $B/B_{40\%} \leq a$

$F_{OFL} = 0$

$F_{ABC} = 0$

4) *Information available: Reliable point estimates of B,* $F_{35\%}$, and $F_{40\%}$.

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

5) *Information available: Reliable point estimates of B and natural mortality rate M.*

$F_{OFL} = M$

$F_{ABC} \leq 0.75 \times M$

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 $\leq$ 0.75 $\times$ OFL

e. Optimum yield (OY) may be obtained by a plus or minus deviation from ABC for purposes of promoting economic, social or ecological objectives as established by law and public participation processes. Ecological objectives, where they primarily relate to biological purposes and factors, are included in the determination of ABC. Where biological objectives relate to resolving conflicts and accommodating competing uses and values, they are included as appropriate with economic and/or social objectives. OY may be set higher than ABC in order to produce higher yields from other more desirable species in a multispecies fishery. It might be set lower than ABC in order to provide larger sized individuals or a higher average catch per unit effort, or to rebuild overfished stocks.

The OY of the groundfish complex is 1.4 to 2.0 million mt to the extent that this can be harvested consistently with the management measures specified in this FMP.

2. Determination of domestic annual fishing capacity, expected harvest, and fishing capacity.

a. Domestic annual fishing capacity (DAC) is the total potential physical capacity of the fleets, modified by logistic factors. The components of the concept are:

(1) An inventory of total potential physical capacity, defined in terms of appropriate vessel and gear characteristics (e.g. size, horsepower, hold capacity, gear design, etc.).

(2) Logistic factors determining total annual fishing capacity (e.g., variations in vessel and gear performance, trip length between fishing locations and landing points, weather constraints, etc.).

b. Domestic annual harvest (DAH) is the estimated total harvest of groundfish by U.S. fishermen. It is delivered to U.S. or foreign processors or nonprocessed markets such as for bait for crab pots.

c. Domestic annual processing (DAP) is the estimated portion of the U.S. groundfish catch delivered to U.S. shorebased or floating processors or U.S. nonprocessed bait markets.

d. Joint venture processing (JVP) is the estimated portion of the U.S. groundfish catch that exceeds the capacity and intent of U.S. processors to utilize, or for which domestic markets are unavailable, that is expected to be delivered to foreign processors in the Fishery Conservation Zone.

These concepts should be placed in a dynamic context of past trends and future projections. For example, physical fleet capacity should not simply be last season's inventory of vessels and hold measurements (although this is appropriate for present interim planning), but also next year's projected movement into and out of the fishery. Vessels under construction should be included and attrition should be estimated.

The determination of domestic annual fishing capacity, expected harvest and processing capacity and intent should be made on the best available information.

3. The foreign allowable catch is determined by deducting the expected domestic annual harvest and the reserves from the total allowable catch, as described in Section 11.4.

4.0 DESCRIPTION OF FISHERY

4.1 Areas and Stocks Involved

4.1.1 Description of Areas

The Bering Sea/Aleutian Islands region with respect to U.S. extended jurisdiction is defined as those waters lying south of the Bering Strait, east of the U.S.-U.S.S.R. convention line of 1867, and extending south of the Aleutian Islands for 200 miles between the convention line and 170°W (Figures 1 and 2). Waters lying south of lines joining headlands in the eastern Aleutian Islands, east of 170°W, are considered a part of the Gulf of Alaska management area. The most prominent and unique feature of the Bering Sea is the extensive continental shelf in the eastern and northern portion of the sea. It constitutes approximately 80% of the total shelf area in the Bering Sea (Hood and Kelly 1974) and is one of the world's largest. For the Bering Sea as a whole, 44% of its 2.3 million km2 area is continental shelf, 13% continental slope, and 43% deepwater basin. A number of large bays, including Bristol and Kuskokwim Bays and Norton Sound on the Alaska coast, makes the coast line of the Bering Sea highly irregular. The area of all bays in the Bering Sea makes up 11.1% of the total area of the sea (Gershanovich 1963).

The broad eastern Bering Sea shelf is extremely smooth and has a gentle uniform gradient resulting from sediment deposits (Sharma 1974). The sediments, originating along the coast and transported offshore in graded suspension by storm waves, are predominantly sands over the inner shelf and silt and clay sediments on the other shelf and slope.

The continental slope bordering the eastern Bering Sea shelf is abrupt and very steep and is scoured with valleys and large submarine canyons (Sharma 1974).

Forming a partial barrier to the exchange of Bering Sea and Pacific Ocean water is the Aleutian-Commander Islands arc. This chain is made up of more than 150 islands and has a total length of approximately 2260 km (Gershanovich 1963). Shelf areas throughout most of the Aleutians portion of the chain are narrow (and frequently discontinuous between islands) ranging in width on the north and south sides of the island from about 4 km or less to 42-46 km. The shelf broadens in the eastern Aleutians.

An additional geographical feature of the Aleutian Islands region of fishery interest is Bowers Ridge. The submerged ridge, forming an arc off the west-central Aleutian Islands, is about 550 km long and 75-110 km wide, becoming even wider in the vicinity of the Rat Islands (Gershanovich 1963). The southern portion of the ridge summit is 150-200 m deep, the central portion is 600-700 m deep, and the northern portion 800-1000 m deep.

Exchange of water between the Bering Sea and the Pacific Ocean occurs through the various Aleutian Island passes with an estimated 14% of the Pacific water remaining in the Bering Sea (Sharma 1974). The net gain from Pacific water and surface runoff from rivers is lost to the Arctic Ocean through the Bering Strait, creating a net movement of water northward.

The dominant water movement on the eastern Bering Sea continental shelf originates from Pacific waters entering the Bering Sea in the vicinity of Unimak Island. These waters move northward toward St. Matthews Islands and eastward toward Bristol Bay. The northward stream divides near St. Matthews Island before joining again and passing through the Bering Strait.

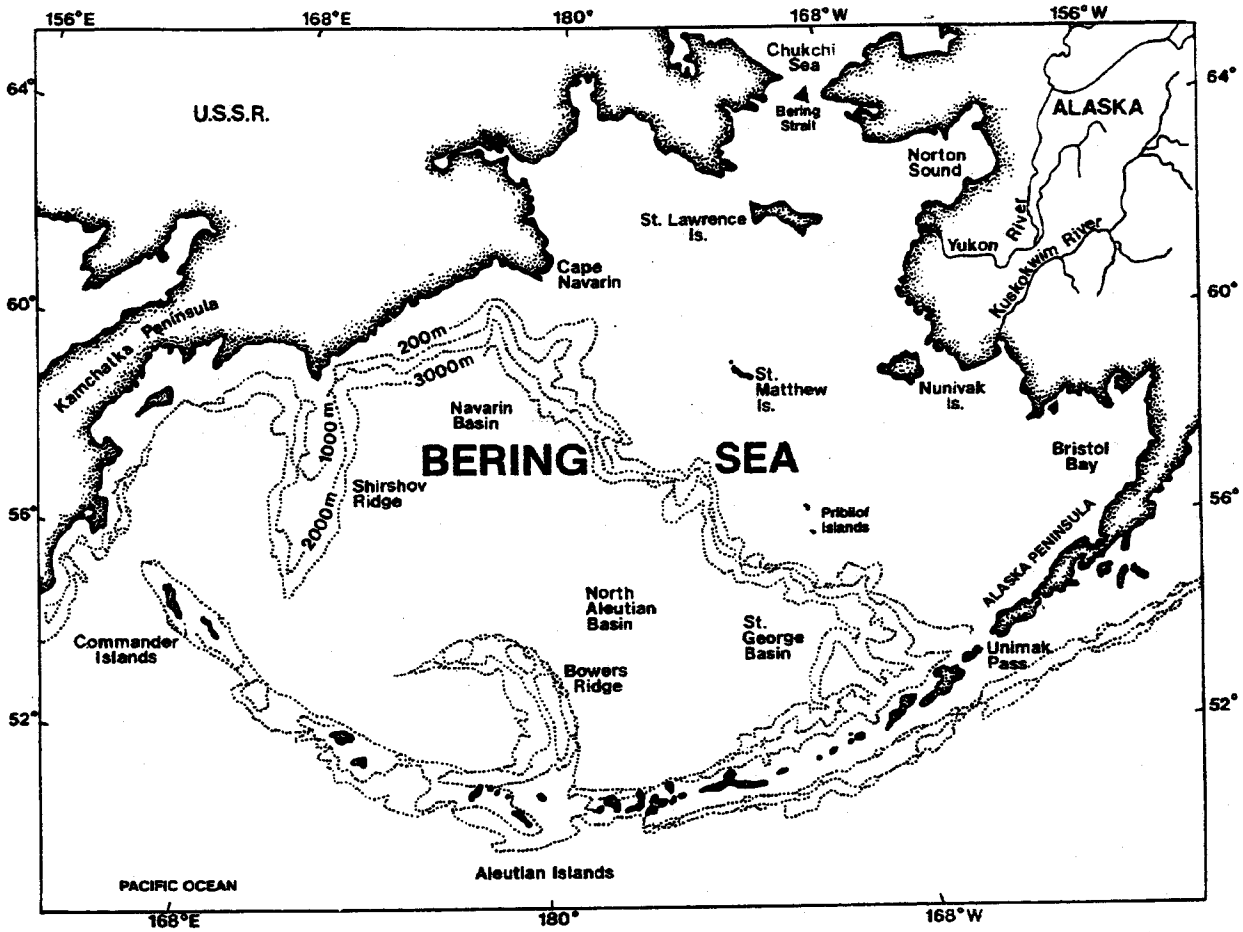

FIG. 1. The Bering Sea (from Sayles et al. 1979).

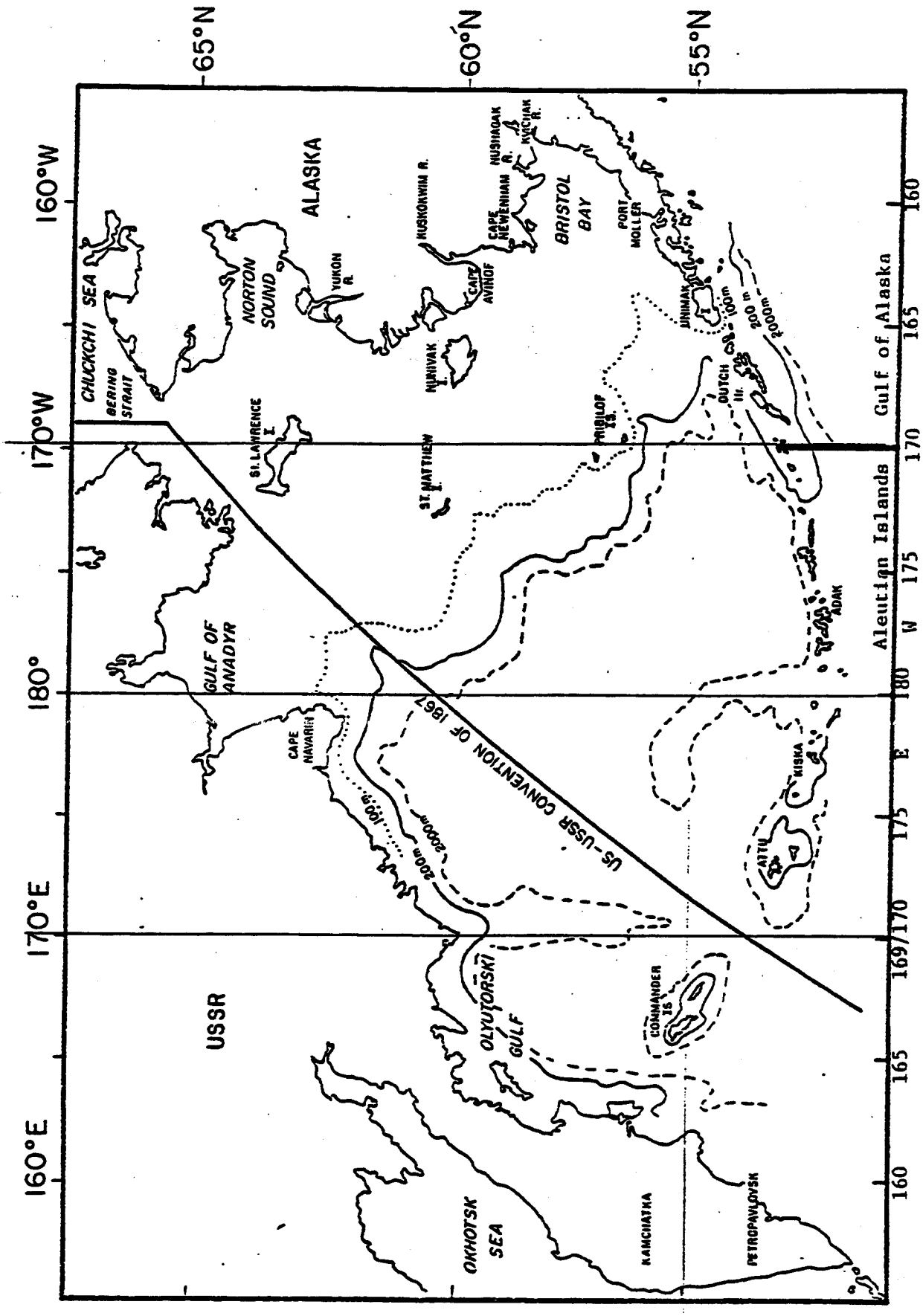

Figure 2.--Geographical locations in the eastern Bering Sea and Aleutian Islands.

The eastward flowing current along the Alaska Peninsula upon reaching the head of Bristol Bay is deflected westward by waters from the Kvichak and Nushagak Rivers (Sharma 1974). These westward flowing waters are mixed with Kuskokwim River water near the mouth of Kuskokwim Bay and directed southward, forming a cyclonic gyre in the southeastern Bering Sea.

The Bering Sea is influenced mainly by subarctic climate, except for the southernmost part, which can be included in the temperate zone (Sharma 1974). It lies in a region of moderate to strong atmospheric pressure gradients and is subject to numerous storms. A major environmental feature of the Bering Sea is the pack ice which covers most of the continental shelf in the eastern and northern sections of the sea in winter and spring. The ice edge begins to intrude into the northern Bering Sea in November, and normally reaches it maximum in late March (Potocsky 1975). At its maximum the ice pack may cover the continental shelf south to the Pribilof Islands and extend from the Pribilof Islands eastward to the vicinity of Port Moller. The areas of the outer shelf between the Pribilof Islands and Unimak Island and deeper waters of the Bering Sea are generally ice free throughout the year because of the intrusion of warmer Pacific Ocean water. In April and May the ice edge begins to retreat and by early summer the Bering Sea is normally free of ice.

The physical, climatic, and oceanographic features in the eastern Bering Sea combine to create conditions highly favorable for primary biological productivity. These conditions are only surpassed by some of the upwelling regions in the eastern Pacific and Atlantic Oceans (Hood and Kelly 1974). This productivity supports some of the largest fish, marine mammal, and bird populations in the world. Although the processes for this high productivity are not fully understood, they probably originate from the upwelling of nutrient-rich water along the Aleutian Islands chain (Sharma 1974), the mixing of Pacific Ocean and Bering Sea waters, the seasonable extremes in climate with a buildup of nutrients during the winter months (Gershanovich, et al 1974) and the expansive nature of the continental shelf.

4.1.2 Description of Stocks

The Bering Sea supports about 300 species of fishes, the majority of which are found near or on the bottom (Wilimovsky 1974). Among the pelagic species are the commercially important, or potentially important groups such as the salmon (Oncorhynchus), herring (Clupea), smelts (Osmerus), and capelin (Mallotus). The fish groups of primary concern in this plan are the bottom or near-bottom dwelling forms--the flounders, rockfish, sablefish, cod, pollock, and Atka mackerel. Although not bottom-dwelling, squids (Cephalopoda) are also included in the plan.

There is a general simplification in the diversity of bottomfish species in the Bering Sea compared to the more southern regions of the Gulf of Alaska and Washington to California. As a result, certain species inhabiting the Bering Sea are some of the largest bottomfish resources found anywhere in the world. In terms of biomass, the bottomfish community in the Bering Sea is much larger than its counterparts in other areas of the northeastern Pacific. The commercial production by all nations from the eastern Bering Sea/Aleutians has ranged from 1.6 to 2.3 million mt during the five-year period of 1971-1975, representing 69-86% of the groundfish catch for the entire region from the Bering Sea to California.

Relatively few roundfishes form aggregations in the eastern Bering Sea and Aleutian Islands areas large enough to attract target, or occasional target fisheries: Pacific cod, Pacific ocean perch, sablefish, Atka mackerel, and rattails (Table 1). A number of other rockfishes are taken while fishing for Pacific ocean perch, the most common of which are listed in Table 1.

Table 1. Commercially utilized demersal fishes in the eastern Bering Sea and Aleutian Island regions.

Common Name	Scientific name
TARGET SPECIES	
Pollock	Theragra chalcogramma
Pacific ocean perch	Sebastes alutus
Atka mackerel	Pleurogammus monopterygius
Sablefish	Anoplopoma fimbria
Yellowfin sole	Limanda aspera
Greenland turbot	Reinhardtius hippoglossoides
Pacific halibut	Hippoglossus stenolepis
OCCASIONAL TARGET SPECIES	
Pacific cod	Gadus Morhua Macrocephalus
Rock sole	Lepidopsetta bilineata
Flathead sole	Hippoglossoides elassodon
Arrowtooth flounder	Atheresthes stomias
Rattails	Coryphaenoides sp.
MINOR COMMERCIAL SPECIES 1/	
Rougheye rockfish	Sebastes aleutianus
Dusky rockfish	Sebastes ciliatus
Northern rockfish	Sebastes polyspinus
Shortspine rockfish	Sebastolobus alascanus
Shortraker rockfish	Sebastes borealis
Dark botched rockfish	Sebastes crameri
Yelloweye rockfish	Sebastes ruberrimus
Blue rockfish	Sebastes mystinus
Alaska plaice	Pleuronectes quadrituberculatus
Rex sole	Glytocephalus zachirus
Butter sole	Isopsetta isolepis
Longhead dab	Limanda proboscidea
Dover sole	Microstomus pacificus
Starry Flounder	Platichthys stellatus
Skates	Rajidae

1/ Includes species that may be marketable, but have low abundance.

In contrast to the relatively few species of commercially exploited roundfishes, the flatfish community of the Bering Sea is very diverse. Yellowfin sole dominates this group and has the longest history of intense exploitation by foreign fisheries. Other flounder species that are known to occur in aggregations large enough to form target species or occasional target species are Greenland turbot, Pacific halibut, rock sole, flathead sole, and arrowtooth flounder. Alaska plaice is also relatively abundant, but has not been intensively fished, apparently because of their low market value. A number of other flounders having commercial importance in regions to the south, also occur in the eastern Bering Sea (Table 1), but their abundance is low.

Elasmobranches (sharks and rays) which commonly occur off Washington to California, are relatively scarce in the eastern Bering Sea. Only skates (Rajidae) occur in significant quantities, but less so than in waters south of the Bering Sea.

Commercial catches illustrate the much greater magnitude of groundfish stocks in the eastern Bering Sea compared to the Aleutian Islands region (Figure 3). For the five-year period of 1971 to 1975, the all-nation commercial catch in the eastern Bering Sea averaged 2.0 million mt compared to only 59,000 mt in the Aleutian Islands. The major share of the catch in the eastern Bering Sea from 1971 to 1975 (1.6 million mt or 81%) was made up of pollock. Other roundfish contributed 8% to the average catch and flounders 11%. Roundfish also contributed the major share of the catch in the Aleutian Islands area (84%), but the principal roundfish species in the Aleutians region was Pacific ocean perch rather than pollock. Pollock catches in the Aleutians averaged only about 10,000 mt annually in 1971-1975.

The species make-up of catches in the two regions exclusive of pollock are illustrated in Figure 4. The data demonstrate that catches of both roundfish (other than pollock) and flounders were much greater in the eastern Bering Sea than in the Aleutians. Catches of flounders in the eastern Bering Sea were predominated by yellowfin sole (79,000 mt), but catches of Greenland turbot (71,000 mt) in this recent period has approached those of yellowfin sole. Rock sole, flathead sole, and arrowtooth flounders were other principal species of flounders taken in the eastern Bering Sea. Flounders form only an incidental part of the catch in the Aleutian Islands area with Greenland turbot the principal species in that area.

The principal roundfish in eastern Bering Sea catches after pollock was Pacific cod with an annual average catch in 1971-75 of 55,000 mt. The next most abundant species were Pacific ocean perch (17,000 mt) and sablefish (9,000 mt). The catch of "other groundfish" was also relatively high, averaging 69,000 mt annually, and forming 5.6% of the overall catch in the eastern Bering Sea. Although the species in this category were not identified, they most likely consist primarily of sculpins (Cottidae), eelpouts (Zoarcidae), skates (Rajidae), poachers (Agonidae) and rattails.

Pacific ocean perch have been the principal species of roundfish in Aleutian Islands catches and in 1971-75 annual catches have averaged 22,000 mt. Other than pollock (10,000 mt), the next most abundant species in catches were Atka mackerel (4,000 mt), sablefish (2,700 mt), and cod (1,500 mt).

Little is known about the extent of the squid resource in the eastern Bering Sea and Aleutian Islands area. The Japanese apparently target on squid to a limited degree. They took 4,300 mt and 5,900 mt in 1975 and 1976. Fishing was mainly in the Aleutian Islands area in 1975 and mainly in the eastern Bering Sea in 1976.

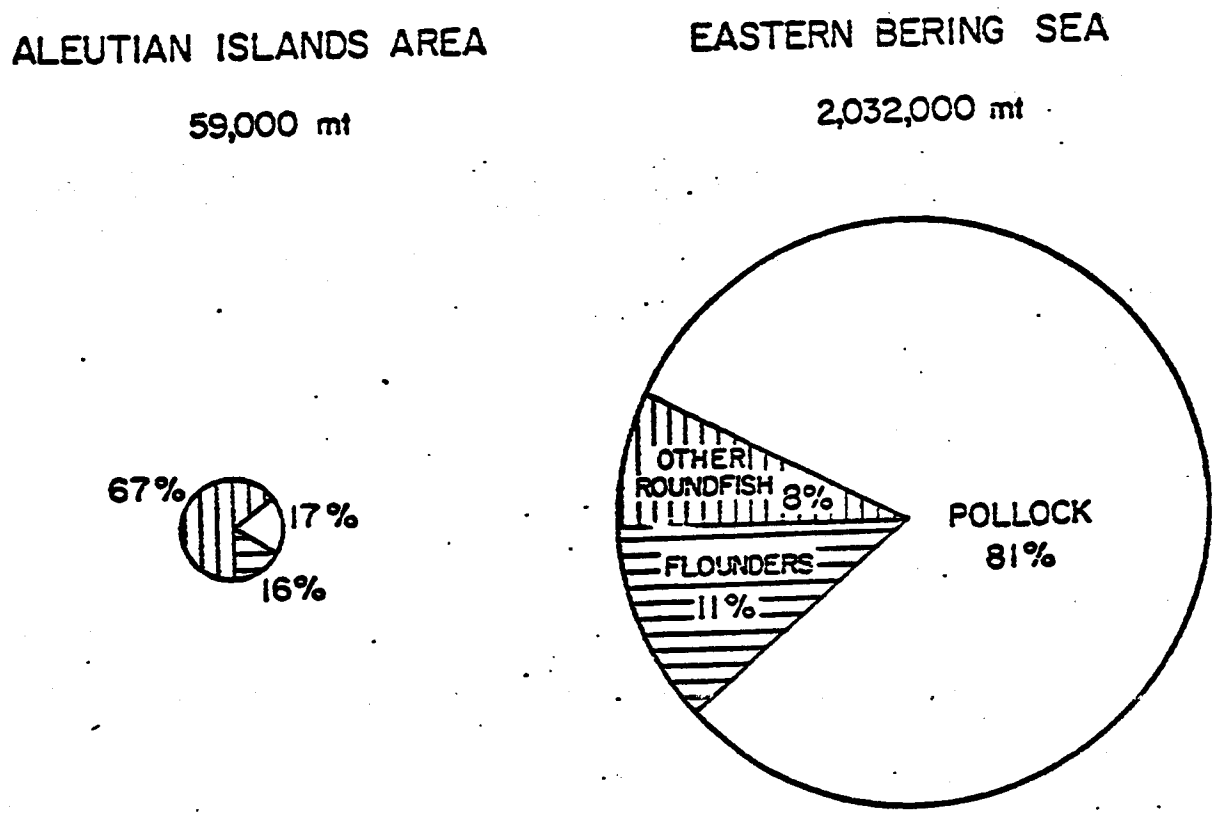

Figure 3.--Average annual catches of groundfish in the Aleutian Island area and the eastern Bering Sea, 1971-75.

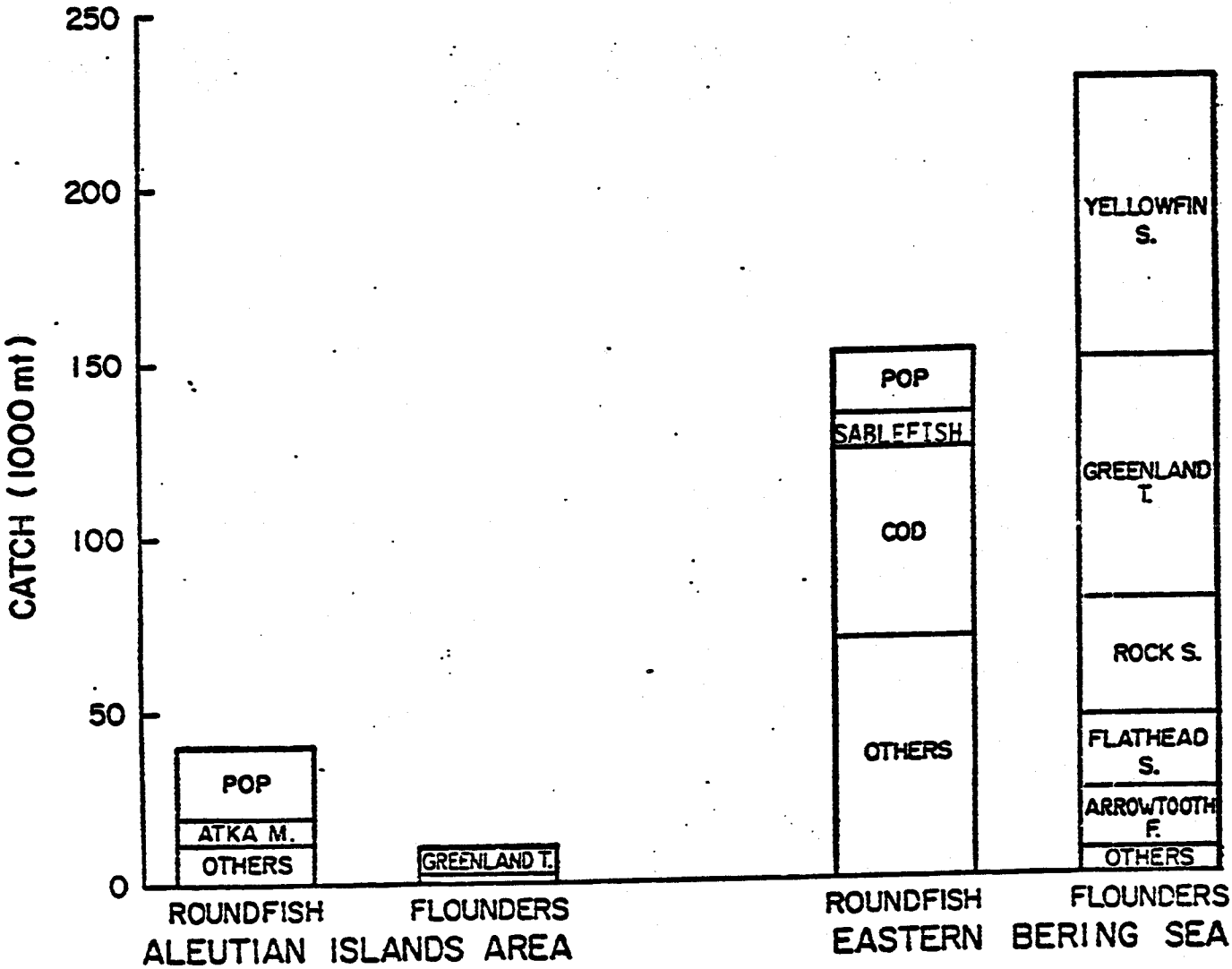

Figure 4.—Average annual catches of groundfish (excluding pollock) in the Aleutian Island area and eastern Bering Sea, 1971-75.

The depth distribution of principal commercial species varies by species and by season. Species of flounders that occupy the shallowest depths on the continental shelf (generally shallower than 100 m during summer) are yellowfin sole, Pacific halibut, rock sole, and Alaska plaice. The distribution of flathead sole is centered in deeper water than the above species, mainly occupying waters on the outer shelf (100-200 m), but also ranging onto the continental slope. The large flounders (Greenland turbot and arrowtooth flounder) occupy the deepest water with adults mainly located on the continental slope; they also occupy shelf waters, but mainly only the juvenile portion of the population.

In winter most of the flounders retreat to waters of the outer shelf and upper slope to avoid the sub-zero temperatures that extend over much of the eastern Bering Sea shelf in winter and early spring. These bathymetric migrations are most extensive for those flounders occupying the inner shelf in summer such as yellowfin sole, rock sole, Alaska plaice, and Pacific halibut. The migrations of Pacific halibut result in their occupying the greatest depth range of all flounders, extending from shallow bays to slope waters of over 500 m in depth.

Major commercial species of roundfish are mainly found on the outer shelf and slope. The distributions of pollock and Pacific cod are centered on the outer shelf in summer with some shifting to upper slope water in winter. Pacific ocean perch and other rockfishes are residents of the relatively deep water of the outer shelf and upper continental slope. Sablefish inhabit the deepest waters occurring to depths of perhaps over 1000 m.

4.2 History of Exploitation

4.2.1 Domestic Fishery

4.2.1.1 General Description of Fishery

The earliest fisheries for groundfish in the eastern Bering Sea and Aleutian Islands were the native subsistence fisheries. There were 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 in near-shore 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 bottomfish occurred in 1864 when a single schooner fished for Pacific cod in the Bering Sea (Cobb 1927). The cod fishery did not commence on a regular annual basis until 1882. This domestic fishery continued until 1950 when demand for cod declined and economic conditions caused the fishery to be discontinued (Alverson et al. 1964). Fishing areas in the eastern Bering Sea were from north of Unimak Island and the Alaska Peninsula to Bristol Bay (Cobb 1927). Vessels operated from home ports in Washington and California and from shore stations in the eastern Aleutian Islands. Canadian vessels also participated in the cod fishery to a limited extent.

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 from 1-16 up to 1914 and increased to 13-24 in the period 1915-20. Estimated catches during the peak of the fishery ranged annually from 12,000-14,000 mt (Pereyra et al. 1976). Numbers of vessels in the fishery declined following 1920 until the fishery was terminated in 1950.

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 (Thompson and Freeman 1930). 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 (Dunlop et al. 1964). The catch by North American setline vessels increased sharply between 1958 and 1963 and then declined steadily until

1972. Since 1972, the catch has remained stable at a relatively low level. The decline in the catch was a result of reduced abundance which led to severe restriction on the fleet. The reduction in abundance was caused by a combination of factors: the North American setline fishery, the Japanese setline fishery, incidental catches of juvenile halibut in foreign trawl fisheries, and adverse environmental conditions. The relative importance of each of these factors is not clear at this time.

In the Aleutians, exploitation by the North American setline fishery is relatively low. There was no fishing before 1960 and since then catches have been less than 200 mt. However, stocks in this area are relatively small, and tagging studies indicate that they are an intermingling component of stocks in the Gulf of Alaska. Consequently, fish from this area should not be considered unexploited.

The number of Canadian and U.S. vessels is shown in Table 2, and the units of fishing effort have been summarized by Myhre et al. (1977) and IPHC (1977). In general, fishing effort in the Bering Sea was meager before 1958, increased sharply during the late 1950s and early 1960s, and then declined steadily until the early 1970s. Effort during the 1970s has been relatively low although a modest increase did occur in 1976 and 1977. The low effort during the 1970s is the result of reduced abundance and restrictions on the North American fleet.

Fishing effort in the Aleutians is very low because halibut stocks are relatively small and the distance to major ports is long.

Present participation by North American nationals in commercial fisheries for bottomfish in the Bering Sea and Aleutian Islands is confined mainly to the relatively small longline fishery for halibut by United States and Canadian fishermen. Some crab vessels may also fish bottomfish occasionally for use as crab bait. A brief, one-vessel exploratory effort occurred for sablefish in the southeastern Bering Sea in 1977. The native subsistence fishery mainly utilizes non-demersal species such as herring and salmon.

4.2.1.2 Description of Vessels and Gear

The domestic cod fishery was carried out mainly to sailing schooners ranging in length from 30-46 m and equipped for dory fishing (Alverson et al. 1964). The dories were approximately 4 m in length and operated by a single fisherman using handlines to take cod.

Most of the halibut fishing vessels are schooners or seine-type vessels that are over 30 net tons and land their catch in major ports. Smaller vessels out of Unalaska and Adak also fish halibut but these vessels account for less than 10% of the total landings. There is also a small subsistence fishery in the Pribilof Islands and a few other locations, but little is known about the vessels or catch involved.

The halibut vessels use setline gear which consists of a longline on which branchlines (gangions), each with a hook, are attached at regular intervals, usually about every 6-8 meters. A unit of setline gear is called a "skate" and is about 550 m in length. The gear is left on the bottom for periods from 4 to 30 hours (soaking time). Fishing usually is conducted at depths between 90 and 275 m.

The vessels and gear used in the Aleutians are similar to those in the Bering Sea although the amount of effort is much less.

Table 2. Number of U.S. and Canadian vessels over 5 net tons that fished halibut in the Bering Sea, 1930-1977.

Year	United States	Canada
1930	3	-
1931	8	-
-	-	-
1933	1	-
-	-	-
1945	1	-
-	-	-
1950	1	-
-	-	-
1952	9	-
1953	6	-
1954	2	-
1955	1	-
1956	3	2
1957	1	-
1958	7	14
1959	19	20
1960	35	31
1961	34	27
1962	43	33
1963	51	53
1964	36	32
1965	19	15
1966	4	11
1967	17	19
1968	11	17
1969	7	16
1970	6	13
1971	4	13
1972	6	9
1973	7	3
1974	6	1
1975	8	3
1976	10	1
1977	19	1

4.2.1.3 Catch Trends

The numbers of vessels used and estimated catches in the eastern Bering Sea during the history of the domestic cod fishery are given in Table 3. The catches shown in Table 3 are estimates for the Bering Sea in metric tons roundweight as given by Pereyra et al. (1976). The estimates are based on weights of processed products from Cobb (1927) and Bower (1927-53). As indicated by Pereyra et al. (1974) the catches should be considered as approximations because of some uncertainty about the conversion factors used and some portion of the catches may have originated from the Gulf of Alaska.

Numbers of vessels in the cod fishery and estimated catches reached their peak during World War I when the demand for cod was high. During the period of 1915-19, estimated catches ranged from about 12,000 to 14,000 mt. Following this period, catches declined until termination of the fishery in 1950.

Estimated peak catches of cod in the domestic fishery are relatively small when contrasted with those from the recent foreign fisheries in the eastern Bering Sea which have ranged over 50,000 mt in some years.

Table 4 shows the annual catch of halibut in the Bering Sea and Aleutian areas by Canadian and U.S. fishermen from 1930 to 1977. In the Bering Sea, the annual catch was less than 200 mt before 1958, but then rose sharply to about 4,900 mt in 1963. The catch then declined steadily to a low of 173 mt in 1973. Since then, the catch has increased slightly and was about 450 mt in 1977. The decline in catch since 1963 was the result of reduced abundance and restrictions on the fishery. In years of high production, the catch was split about evenly between Canadian and U.S. vessels although since 1972 the U.S. share has been larger.

There was no catch reported in the Aleutian area before 1960. Until 1976, annual catches fluctuated between 1 and 67 mt; in 1977 preliminary data indicate a catch of 178 mt.

4.2.2 Foreign Fishery

4.2.2.1 General Description of Fisheries

Nationals from six foreign countries have conducted groundfish fisheries in the eastern Bering Sea and Aleutian Islands. One of these, the Canadian halibut fishery, was previously described under the domestic fishery because of its small size and similarity to the U.S. fishery for halibut. Of the other foreign fisheries, Japan has had the longest history of exploitation in the region and has mounted the greatest effort over the years. The first documented fishery for demersal species by the Japanese in the eastern Bering Sea dates back to an exploratory effort in 1930. This was followed by a relatively small-scale fishery which had its origin in 1954. Excluding Canada, the second foreign nation to send demersal fishing fleets to the eastern Bering Sea and the nation having the second largest removals of groundfish in the region has been the USSR. Their fisheries commenced in 1958.

In 1966 a trawler from the Republic of Korean (ROK) explored fishing grounds in the eastern Bering Sea and Aleutian Islands. A commercial operation followed in 1967 but the number of vessels and magnitude of the catch by ROK fishermen has remained much smaller than that by Japan and the USSR. The Republic of China (Taiwan) has also had a fishery in the eastern Bering Sea since late 1974, but involving only one or two trawlers.

Table 3. Estimated catches of Pacific cod in the eastern Bering Sea, 1864, 1882-1950 1/ (from Pereyra et al. 1976).

Year	Number Vessels	Estimated 2/ Catch	Year	Number Vessels	Estimated 2/ Catch
		(mt)			(mt)
1864	1	23	1915	13	12,016
			1916	13	13,947
1882	2	673	1917	16	13,946
1883	5	1,944	1918	17	12,719
1884	3	1,867	1919	17	12,140
1885	3	1,510	1920	24	8,567
1886	2	1,219	1921	6	3,102
1887	1	944	1922	10	5,923
1888	2	1,500	1923	17	8,951
1889	0	0	1924	15	9,889
1890	1	245	1925	14	10,489
1891	6	2,102	1926	7	9,924
1892	6	3,316	1927	7	6,887
1893	4	1,658	1928	8	7,083
1894	5	2,699	1929	9	7,851
1895	5	2,638	1930	8	7,647
1896	7	3,633	1931	4	4,314
1897	8	4,337	1932	5	4,692
1898	4	1,745	1933	5	5,779
1899	7	3,995	1934	7	6,361
1900	8	4,168	1935	5	5,713
1901	7	4,015	1936	5	5,008
1902	12	6,270	1937	4	4,885
1903	10	6,116	1938	3	3,963
1904	11	6,400	1939	3	3,960
1905	16	8,654	1940	4	4,129
1906	11	7,758	1941	3	2,940
1907	9	6,216	1942	1	814
1908	11	7,643	1943	0	0
1909	12	8,511	1944	1	656
1910	9	6,589	1945	1	639
1911	10	7,867	1946	2	997
1912	9	5,485	1947	2	1,041
1913	9	6,180	1948	1	1,006
1914	13	9,817	1949	1	950
			1950	1	668

1/ Original catch data in numbers of fish for 1864, 1882-1925 from Cobb (1927) and weight of cured products for 1926-1950 from Bower (1927, 1953) are converted to round weight in metric tons from conversion factors provided by Cobb (1927).

2/ Catches for 1916 to 1925 also include offshore catches from the North Pacific Ocean.

Table 4. Catch of halibut by Canadian and U.S. vessels in the Bering Sea and Aleutian areas, 1930-1977. Catch in metric tons, round weight.

Year	Bering Sea Canada	Bering Sea U.S.	Bering Sea Total	Aleutian Canada	Aleutian U.S.	Aleutian Total
1930	-	62	62	-	-	-
1931	-	62	62	-	-	-
-	-	-	-	-	-	-
1933	-	11	11	-	-	-
-	-	-	-	-	-	-
1945	-	3	3	-	-	-
-	-	-	-	-	-	-
1952	-	152	152	-	-	-
1953	-	137	137	-	-	-
1954	-	24	24	-	-	-
1955	-	27	27	-	-	-
1956	51	107	158	-	-	-
1957	-	24	24	-	-	-
1958	731	582	1,313	-	-	-
1959	1,442	1,065	2,507	-	-	-
1960	2,016	1,392	3,408	10	-	10
1961	1,163	1,231	2,394	-	-	-
1962	2,113	2,304	4,417	-	12	12
1963	2,886	2,022	4,908	38	-	38
1964	758	647	1,605	-	1	1
1965	356	449	805	-	-	-
1966	385	336	721	45	-	45
1967	668	776	1,444	-	9	9
1968	402	395	797	5	-	5
1969	404	340	744	-	53	53
1970	536	148	684	33	32	65
1971	440	83	523	-	1	1
1972	149	293	442	7	12	19
1973	58	115	173	28	-	28
1974	101	162	263	60	3	63
1975	102	215	317	3	-	3
1976	37	278	315	56	11	67
1977*	84	366	450	162	16	178

*preliminary

Polish vessels fished briefly in the eastern Bering Sea in 1973 (Law Enforcement Division 1975). Since then, Poland has agreed to abstain from further fishing in the eastern Bering Sea. Although allowed to fish in certain waters of the Aleutian Islands, Polish vessels have not operated there.

4.2.2.1.1 Japanese Fishery

Following the initial exploratory effort by two trawlers in 1930, the Japanese returned to the eastern Bering Sea with a mothership-catcher boat operation in 1933 (Forrester, et al. 1974). The fleet was composed of an 8,000 ton mothership and several catcher boats including 400 gross ton side-trawlers and 88 gross ton pair trawlers. Fishing was off Bristol Bay with the emphasis on pollock for the production of fish meal. The catch was processed aboard the mothership and transported back to Japan aboard transport vessels. This fishery continued to operate until 1937 when prices of fish meal declined causing the fisheries to terminate. Catches in this period ranged up to 43,000 mt with pollock the major species taken.

A second mothership-type operation was conducted in the eastern Bering Sea by Japan in 1940-41 (Forrester, et al. 1974). Target species was yellowfin sole that were frozen for human consumption. Catches in the two-year period ranged from 9,600 to 12,200 mt (Table 5).

With the signing of the peace treaty between the United States and Japan in 1952, restrictions on Japanese distant-water fisheries were removed, and in 1954, fishing in the eastern Bering Sea was resumed. The Japanese post-war fishery for groundfish developed into several components, the four principal ones being the mothership fishery, North Pacific trawl fishery, North Pacific longline-gillnet fishery, and the landbased trawl fishery.

The number of mothership fleets and number of vessels in the other fisheries are given in Table 6 along with a description of each type of fishery in the accompanying footnotes. As shown in Table 6, the mothership fishery can be divided into four additional types depending on the target species and processing methods. These are the freezing fleets which targeted on flounders in the period 1954-60; the freezing fleets operating since 1960 that continued to target on flounders, but also targeted on other species, the meal and minced fish fleets which originally took flounders for fish meal, but since 1964 have targeted on pollock for the production of minced fish, as well as fish meal and the longline-gillnet fleet which took halibut, cod, sablefish and herring for freezing.

The mothership fishery has accounted for the largest share of the Japanese catch in the Bering Sea since 1954. In the recent period of 1971-76 the mothership fishery took 64% of the total catch, the North Pacific trawl fishery 31%, the land-based fishery 5%, and North Pacific longline-gillnet fishery 0.3% (Sasaki 1977).

Mothership fishery.--Forrester et al. (1974) divided the history of the mothership fishery into three periods based on target species, methods of processing catches, and expansion of fishing grounds.

In the first period (1954-57), the fishery was relatively small involving two to four 8,000 gross ton motherships of the freezer-factory ship type and trawlers of the 200-300 ton class as catcher boats. The fleets operated for about one month between August and October between the salmon driftnet and Antarctic whaling seasons. Fishing was off Bristol Bay and the catch, consisting of flounders (primarily yellowfin sole) was frozen.

Table 5. Number of Japanese vessels operating in the eastern Bering Sea and their catches, 1933-37 and 1940-41 (from Forrester et al., 1974).

Year	Number of fleets	No. of catcher boats			Catch (metric tons)			
		Total	Trawl	Pair trawl	Total	Flat fishes	Pacific pollock	Other fishes
1933	1	5	5	-	3,300	?	?	?
1934	1	5	5	-	14,953	1,385	11,645	1,923
1935	1	11	3	8	28,629	2,869	23,553	2,207
1936	1	8	4	4	26,622	1,003	23,000	2,610
1937	1	13	3	10	43,383	9,310	31,316	2,757
1940	1	8	-	8	9,577	6,941	24	2,612
1941	1	12	4	8	12,226	9,839	1,287	1,100

Table 6. Number of fleets in the Japanese mothership fishery and number of vessels in the Japanese North Pacific Trawl and longline-gillnet fisheries and landbased trawl fishery (data from Forrester et al. 1974; Yamaguchi 1974, 1975; Saski 1977).

Year	fleet[1/] for flounders only	fleet[2/] (including other than flounders)	Meal and mince-fleet[3/]	line-gill-net fleet[4/]	Total	Pacific trawl Fishery[5/]	North Pacific longline-gillnet Fishery[6/]	Land-based trawl Fishery[7/]
1954	2	--	--	--	2	2	--	--
1955	2	--	--	--	2	3	--	--
1956	4	--	--	--	4	1	--	--
1957	4	--	--	--	4	--	--	--
1958	2	--	1	1	4	--	--	--
1959	4	--	1	1	6	2	--	--
1960	3	1	5	4	13	--	--	--
1961	--	13	5	14	32	3	--	54
1962	--	11	5	5	21	2	--	70
1963	--	10	2	5	17	2	--	93
1964	--	6	4	2	12	2	--	103
1965	--	6	4	2	12	2	--	126
1966	--	8	4	1	13	2	--	172
1967	--	7	5	2	14	42	22	173
1968	--	6	5	1	12	42	22	184
1969	--	5	5	1	11	42	21	182
1970	--	3	6	1	10	42	22	182
1971	--	5	6	1	12	42	22	182
1972	--	4	6	8/	10	42	22	182
1973	--	4	6	--	10	42	26	182
1974	--	4	6	--	10	42	30	182
1975	--	3	5	--	8	35	27	182
1976	--	3	5	--	8	54	32	182

1/ Flounder fleet: The fleets, each composed of a mothership of 7,000-9,000 tons, equipped with freezing facilities and having several 300-ton class trawlers attached to it, caught mainly yellowfin sole for freezing off Bristol Bay.

Table 6 continued

2/ Freezing fleet: The fleets, each composed of a mothership of 5,000-10,000 tons with freezing equipment, accompanied by trawlers as well as Danish seiners, which also fished longlines and gillnets, caught halibut, blackcod, herring, Pacific ocean perch, Navarin, in the Gulf of Olyutorskii, and in Aleutian waters.

3/ Fish meal (minced fish fleet): The fleets, each composed of a mothership of 9,000-14,000 tons, equipped with fish-meal plants, accompanied by 2-30 pair trawlers and Danish seiners, caught yellowfin sole on the eastern Bering Sea flats, and turbot along the continental slope in the eastern Bering Sea for production of fish meal. From 1964, the fleet switched to production of minced fish with a minced-fish plant, utilizing pollock caught in the eastern Bering Sea. The fleet also has freezing facilities and produces frozen fish.

4/ Longline-gillnet fleet: The fleets, each composed of a small mothership of 200-2,500 tons, accompanied by gillnetters and longliners, caught halibut, cod, blackcod, and herring to be frozen. The fishing grounds were along the continental slope from the Pribilof Islands and Cape Navarin-Gulf of Olyutorskii.

5/ North Pacific trawl fishery: This fishery is conducted by independent large trawlers, and the catch is frozen on board. The number of trawlers larger than 3,000 tons engaged in this fishery, on board which minced fish and fish meal are produced, has increased since 1968/ Transport vessels were not used in this fishery until 1966. However, since 1967 a considerable number of transport ships have been used to carry products of this fishery. The figures for 1967 and thereafter indicate the numbers of vessels licensed for this fishery.

6/ North Pacific longline-gillnet fishery: This fishery is conducted by independent longline-gillnetters, and the catch is processed on board. When filled with frozen products they return to their based in Japan. The numbers of vessels in this table are the numbers licensed annually for this fishery.

7/ Landbased trawl fishery: This fishery consists of independent operations by Danish seiners and stern trawlers of 100-350 tons. The vessels process the catch on board, produce frozen goods, and return to Japan when they are filled. Extensive areas, including the Okhotsk Sea and waters around the northern Kurile Islands, are permitted for their operation. The number of vessels operated in the Bering Sea is not known. The figures in this table indicate the number of vessels licensed.

8/ From 1972-76 these fleets are included in the freezing fleets.

In the second period (1958-63), the fishery expanded throughout the Bering Sea with diversification of fishing methods and target species (Table 6). Fish meal operations were initiated in 1958 utilizing flounders in the eastern Bering Sea which were processed by 9,000 gross ton motherships operating from April to September. Each mothership was supplied with fish by 20 Danish seiners and pair trawlers. The freezing fleets described in the previous period also continued to fish and catches of yellowfin sole reached their peak in this period, ranging between 420,000 and 554,000 mt annually in 1960-62 including catches by the USSR.

Another mothership operation beginning in the 1958-63 period was the longline-gillnet fishery consisting of 500 gross ton motherships and 100 gross ton longliners. These vessels fished for halibut and sablefish for freezing along the continental slope off Cape Navarin starting in 1958. In 1960 they began fishing operations for Pacific ocean perch along the continental slope between the Pribilof Islands and Cape Navarin and in 1963 expanded their area of operations to Bowers Banks off the Aleutian Islands.

The fleets involved in the yellowfin sole fishery for freezing also extended their operations to include halibut, sablefish, and Pacific ocean perch and together with the longline-gillnet fleets expanded their area of operations to the continental slope in the central and northern Bering Sea and to Aleutian Islands waters. The fishing season which had previously been about one month was lengthened to four to nine months and winter fishing was initiated in 1961-62.

The third period (1964 to present) is characterized by the development of the pollock fishery. With the decline in abundance of yellowfin sole (due to overfishing in the early 1960s), and the development in 1964 of techniques for processing minced fish (surimi) on-board motherships, the main Japanese effort shifted to pollock. Fish meal and frozen products became a by-product of these operations. Pollock has dominated Japanese catches since 1962 and from 1971-76 has formed over 80% of the total Japanese groundfish catch in the eastern Bering Sea and Aleutian Islands area. The pollock fishery has become a year-round effort while the flounder fishery principally for yellowfin sole became a winter fishery in 1969-70 with the season generally lasting from October to March. Catcher boats in the mothership fishery have been pair trawlers, Danish seiners, side-trawlers, and stern trawlers. Side-trawlers have been phased out of the fishery and the number of Danish seiners has declined with pair trawlers becoming the mainstay of the fleet.

The winter fishing grounds for flounders were mainly north of Unimak Island and occasionally west and east of the Pribilof Islands. The major fishing grounds for pollock have been along the outer continental slope and upper slope from Unimak Pass northwestward toward Cape Navarin. Typical fishing areas of the mothership fishery are shown in Figure 5.

North Pacific trawl fishery.--This second major type of Japanese fishery consists of independent factory trawlers larger than 500 tons that both fish and process their own catch (Forrester et al. 1974). Products are minced fish, frozen fish, and fish meal. The products are transshipped to Japan by refrigerated transport.

In the initial period of this fishery (1954-59), one to three independent trawlers fished in the eastern Bering Sea for yellowfin sole. Since 1961 they have also exploited (for freezing) halibut, sablefish, Pacific ocean perch, and other species along the continental slope in the central and northern Bering Sea and in Aleutian Island waters. In 1967 the number of licenses issued for independent trawlers was increased to 42 and has ranged from 35 to 54 in later years (Table 6). Greater numbers of larger trawlers in the 3,000-5,000 ton class (equipped with machinery for producing surimi) resulted in a rapid increase in the pollock catch by this fishery. By 1970, 80% of the total groundfish catch by these vessels was pollock.

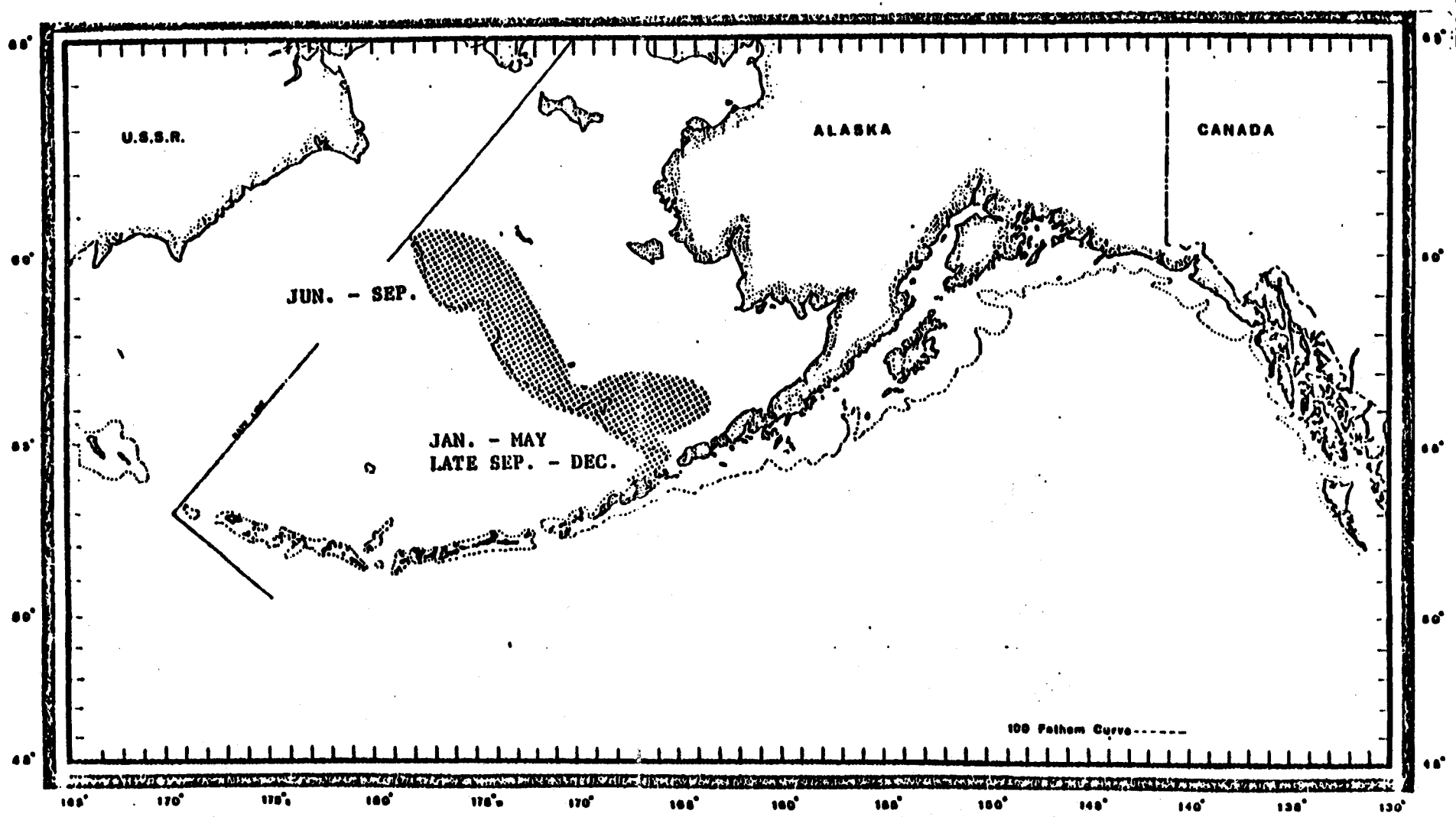

Figure 5.--Areas fished by the Japanese mothership fleets in 1972 (from Law Enforcement Division 1974).

The main effort by the independent trawlers is in the eastern Bering Sea where year-round operations are conducted for pollock. Other species taken are cod and various flounders. The number of vessels generally increase from a low in mid-winter to a peak in summer involving from 20 to 40 trawlers (Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

In the Aleutian Islands the trawlers target on Pacific ocean perch and take lesser amounts of pollock and various other groundfish. Fishing in the Aleutians is concentrated along the shelf edge in the central and western part of the chain with some effort in the eastern Islands. Maximum effort is in summer or early fall with the number of vessels reaching 7 to 18 in peak months (Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

Areas of the fishery are illustrated in Figure 6.

North Pacific longline-gillnet fishery.--Herring and sablefish are the principal species taken by this fishery. The vessels operate independently, and when filled with fresh fish or frozen products, return to Japan. From 1963 to 1966 there were 18-19 vessels licensed in this fishery to operate north of 50°N and between 170°E and 170°W, but records of the number of vessels actually operating, the areas of operation, and the species taken are not available (Forrester et al. 1974).

In 1967 the number of longline-gillnet vessels licensed was increased to 22. Fishing by these 200-500 gross ton vessels has mainly been in the northeastern Pacific ocean where the catch was almost exclusively sablefish with some rockfish taken. The vessels operate year-round and normally remain on the grounds for two to four month periods until their hold capacity of about 400 mt is reached (Law Enforcement Division 1974).

Fishing for sablefish in the eastern Bering Sea and along the Aleutian Islands by the North Pacific longline vessels has been sporadic with only a few vessels fishing briefly each year. The areas of fishing in these regions as well as in the Gulf of Alaska in 1974 are shown in Figure 7.

Landbased trawl fishery.--This fishery, conducted by independent trawlers of 100-350 tons are prohibited by regulation from transshipping their catch in offshore waters (Forrester et al. 1974) and therefore return to Japan when storage capacity is filled. Their catches are chiefly flounders, Pacific ocean perch, and sablefish. When initiated in the early 1960's, the fishery was restricted to waters north of 48°N and between 153°E and 170°E. In June 1963 the area was expanded eastward to 175°W and in September 1967 to 170°W. Major fishing grounds are along the continental slope from Cape Olyutorskii to Cape Navarin and off the Pribilof Islands. Gear consisted mainly of Danish seines early in the fishery but stern trawls became the major gear in later years. From the 54 vessels licensed to operate in the fishery in 1961, the number grew to 184 in 1968 and has been 182 since 1969 (Table 6). The number of licensed vessels actually operating in this fishery is unknown.

4.2.2.1.2 Soviet Fishery

The first commercial-scale operations by the USSR off Alaska, following exploratory work in 1957-58, was a fishery for flounders in the eastern Bering Sea starting in 1959 (Chitwood 1969). Like the Japanese, the Soviets have expanded their fisheries since its inception in terms of effort, target species, and fishing areas. There have been three major groundfish fisheries in the eastern Bering Sea and Aleutian Islands: a flounder fishery in the southeastern Bering Sea, a rockfish fishery primarily in the Aleutian Islands, and a pollock fishery along the outer continental shelf from Unimak Pass to northwest of the Pribilof Islands. In describing these fisheries, information is used from Chitwood (1969), Forrester et al. (1974), Haskell (1964), Office of Enforcement and Surveillance (1965, 1967-70), Enforcement and Surveillance Division (1971, 1973), and Law Enforcement Division (1974, 1975, 1977).

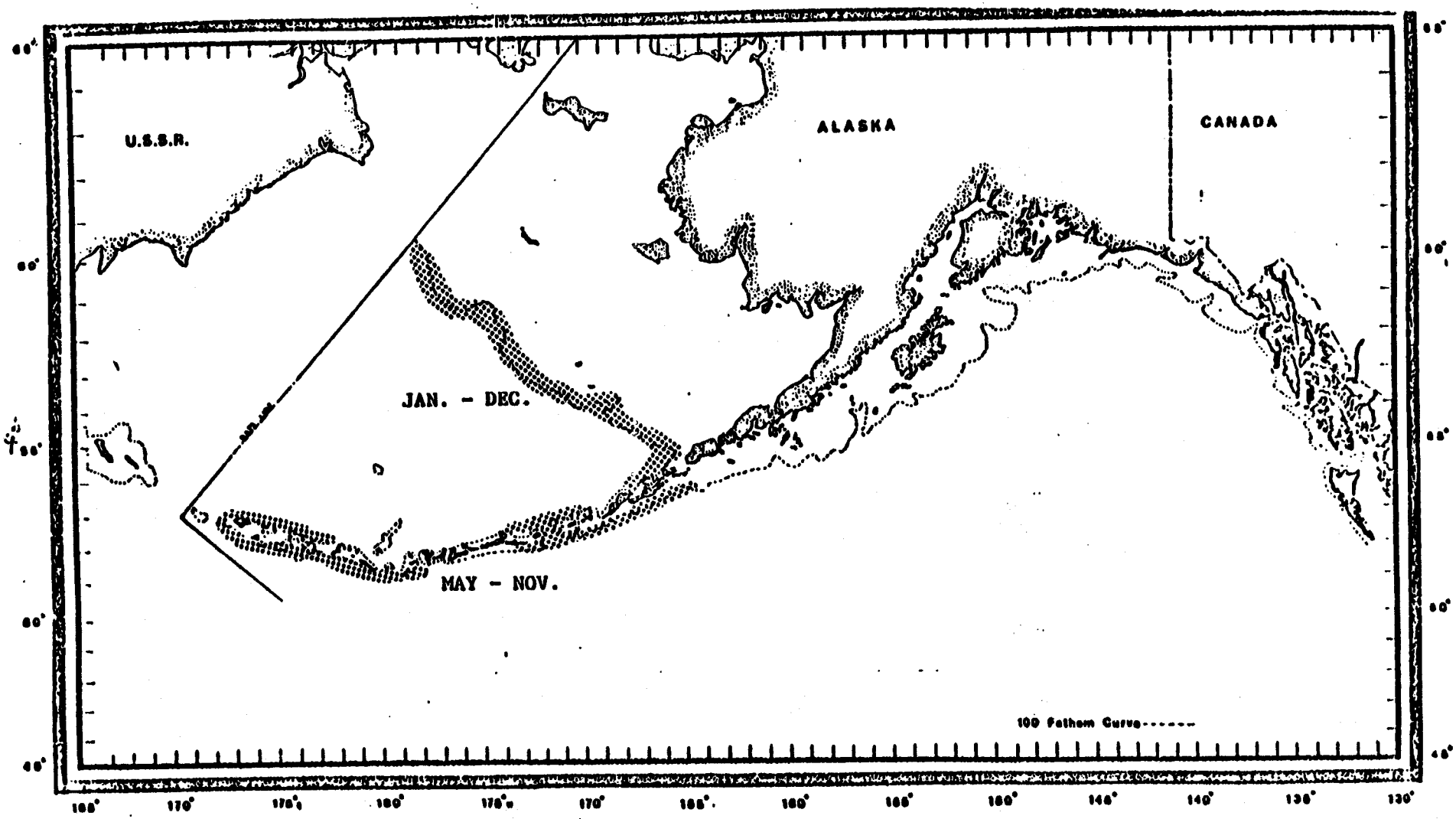

Figure 6.--Areas of the eastern Bering Sea and Aleutian Islands fished by the Japanese North Pacific trawl fishery (Law Enforcement Division 1974).

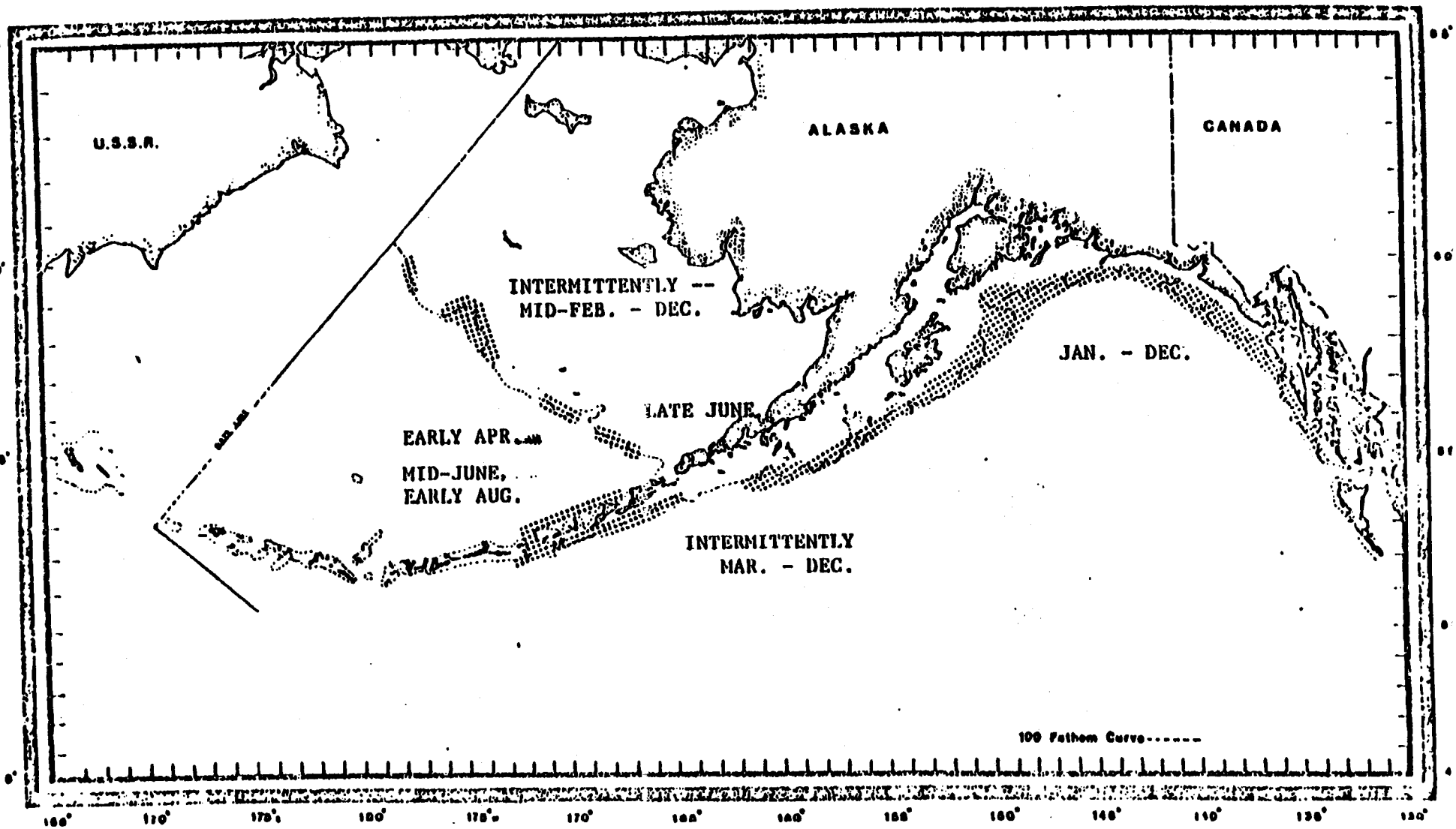

Figure 7.--Areas fished by Japanese North Pacific longline vessels in 1974 (Law Enforcement Division 1977).

Flounder fishery.--The Soviet flounder fishery was a winter operation throughout its history extending usually from November to April and peaking in February or March. The fishing grounds (Figure 8) were in areas where aggregations of yellowfin sole and other flounders form in winter after migrations from shallower waters of the inner shelf. The primary target species was yellowfin sole which comprised a high proportion of the catches with other flounders such as rock sole, flathead sole, Alaska plaice, starry flounder, and arrowtooth flounder making up most of the remainder. Vessels participating in this fishery have ranged from smaller side trawlers (SRT) to medium (SRTM) and large independent stern trawlers (BMRT) and support vessels (see Section 4.2.2.2 for description of vessel types). Side trawlers delivered this catches to factory ships or processing refrigerated transports, which froze the fish for later transport to the Soviet Union. The larger trawlers freeze their own catches.

The first few years of the Soviet flounder fishery (1959-63) involved about 30 trawlers supported by a factory ship and refrigerated transport vessels. Catches in that period probably ranged between 60,000 and 155,000 mt. In the next three years effort was increased in this fishery with the number of trawlers rising to 40 in 1964, 50-60 in 1965, and 70-100 in 1966. The fishery peaked in terms of numbers of trawlers from 1966 and 1968 with the maximum number reaching 70-100 in the peak months of fishing in January, February or March. In those peak years, the flounder fishery represented the largest effort by the Soviets in Alaskan waters.

Starting in 1969, the Soviet effort for flounders generally declined, presumably because abundance of yellowfin sole was lower than in previous years. The numbers of vessels in peak months decreased to between 50 and 80 in 1969-72. Although a peak of 70 vessels fished in 1972, there was a sharp drop in catches of flounders to about 13,000 mt from over 70,000 mt or more in the previous three years. In 1973 the flounder fishery failed to develop. Effort was limited to a two-week period by four trawlers. The Soviets have not resumed this fishery to the present time.

Pacific ocean perch fishery.--The Soviet fishery for Pacific ocean perch and other rockfish began in 1960 when 25 to 30 trawlers fished along the edge of the continental shelf in the eastern and central Bering Sea. In subsequent years the fishery became centered in the Aleutian Islands and Gulf of Alaska (Figure 9). The Aleutian Islands fishery has been mainly by larger BMRT factory trawlers fishing along the continental shelf edge at depths of about 15-280 m. Catches were headed, eviscerated, and frozen until transferred to refrigerated transport vessels for delivery to the Soviet Union.

Following concentration of effort for Pacific ocean perch in the Aleutians and Gulf of Alaska in 1963, directed effort to Pacific ocean perch in the eastern Bering Sea decreased and was eventually eliminated. Catches from this region in later years were a by-catch of the pollock fishery. The early years of the Aleutian Islands fishery were the most productive with reported catches of 61,000 mt in 1974 and 71,000 in 1965. Although the catch increased in 1965, the catch per trawler declined and search time for concentrations of perch increased substantially.

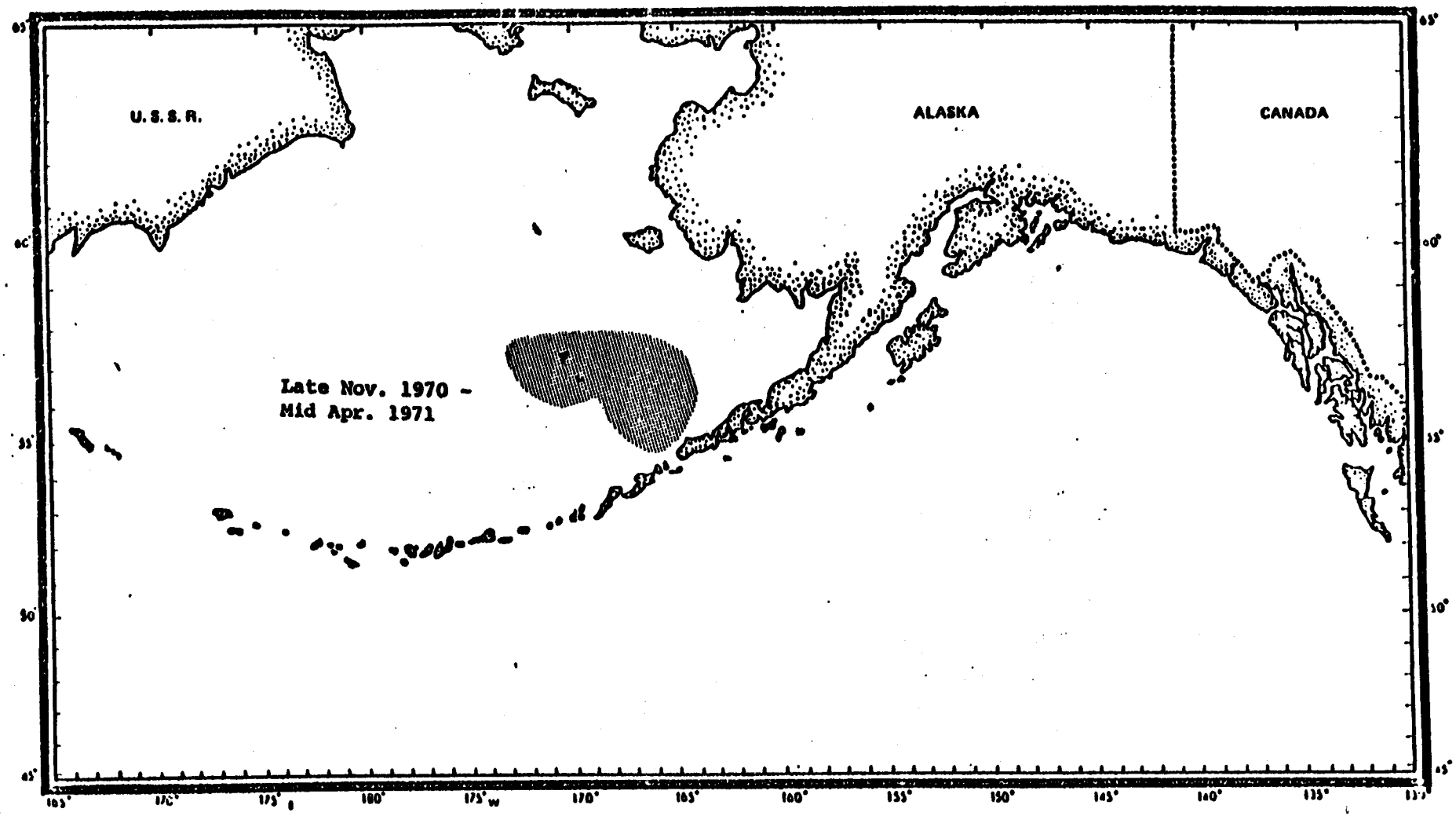

Figure 8.--USSR fishing area for flounders in the eastern Bering Sea in 1971 (Enforcement and Surveillance Division 1973).

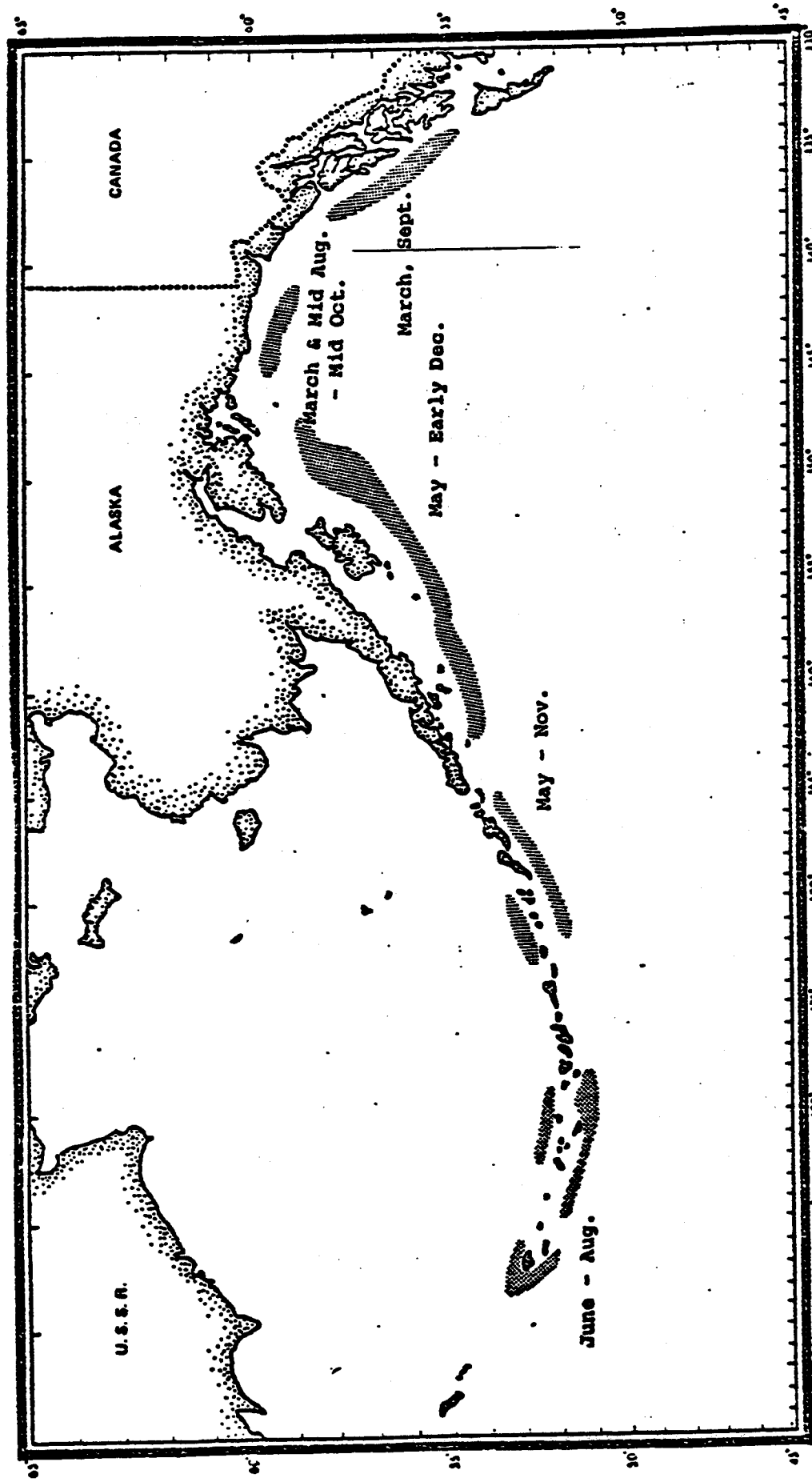

Figure 9 .--Areas fished for Pacific ocean perch by the USSR in 1971 (Enforcement and Surveillance Division, 1973).

Whereas the fishery was continuous through 1965, effort in 1966 was sporadic, apparently because of reduced abundance of rockfish. The effort in 1967 and 1968 was approximately the same as in 1966 with fishing starting in spring months and continuing through the end of the year. In 1969 there was further reduction in effort with only one-half to two-thirds the number of vessels fishing compared to 1968. This level of effort generally continued in the next few years with relatively few vessels targeting on Pacific ocean perch, and then for relatively short periods in widely separated areas of the Aleutian Islands. By 1973 and 1974 the fishery was at an extremely low level with catches of only about 3,000 mt in 1973 and 800 mt in 1974. Catches in 1975 and 1976 were somewhat higher, ranging from 7,000-8,000 mt.

Pollock fishery.--The fishery that eventually developed into the pollock fishery began in 1967, but initially targeted on sablefish and large flounders (arrowtooth flounder and Greenland turbot) in the region immediately north of the eastern Aleutian Islands. Fishing was at depths of about 550 to 730 m on the fairly extensive deep-water plateau in the area immediately north of Dutch Harbor in the eastern Aleutian Islands. This fishery was continued in 1968, but the area of fishing was extended north along the edge of the continental shelf to the central Bering Sea. Sablefish and arrowtooth flounder were the principal species taken just north of Dutch Harbor, but farther north, pollock, cod, rockfish, and various flatfish were principal species. In 1969, this fishery became a year-round operation and took on the general appearance that has characterized the fishery to the present time. Vessels utilized in the fishery changed from primarily medium-sized SRTM trawlers to also include the smaller SRT trawlers and large BMRT trawlers. The two larger type trawlers processed their own catches and periodically off-loaded to refrigerated transports for shipment to the USSR. The SRT side trawlers off-loaded their catches to factory ships and other support ships for processing. The fishing area became relatively standardized (Figure 10) with two principal areas used, the first immediately north of the eastern Aleutian Islands and the other northwest of the Pribilof Islands. Effort normally peaked in late winter when fishing vessels from the herring and flounder fishery joined the pollock fleet.

In 1969 and 1970 the fishery targeted on arrowtooth flounder, sablefish, and pollock with incidental catches of cod, rockfish, and other bottomfish. Emphasis of the fishery shifted mainly to pollock in 1971 with catches rising from about 36,000 mt in 1970 to 234,000 mt in 1971. Pollock has remained the predominant species in the catch to the present time. Peak catches of pollock occurred in 1974 when almost 310,000 mt was taken. Catches of other species since 1972 have not exceeded 20,000 mt annually with the exception of rockfish in 1974 at 32,000 mt and rattails at 48,000 in 1972. Large catches of rattails were taken in 1972.

The USSR has continued to trawl along the Aleutians in recent years, but at a relatively low level of effort. Major species in the catches besides rockfish have been pollock and Atka mackerel. Atka mackerel has become a target species of this fishery in winter and spring months.

The monthly range in numbers of vessels employed in the USSR fishery in the eastern Bering Sea and Aleutian Islands is given in Table 7. Peak periods of fishing in the eastern Bering Sea have been in winter, usually in February. In the Aleutian Islands the peak period of fishing has varied, reflecting apparent changes in target species or other factors.

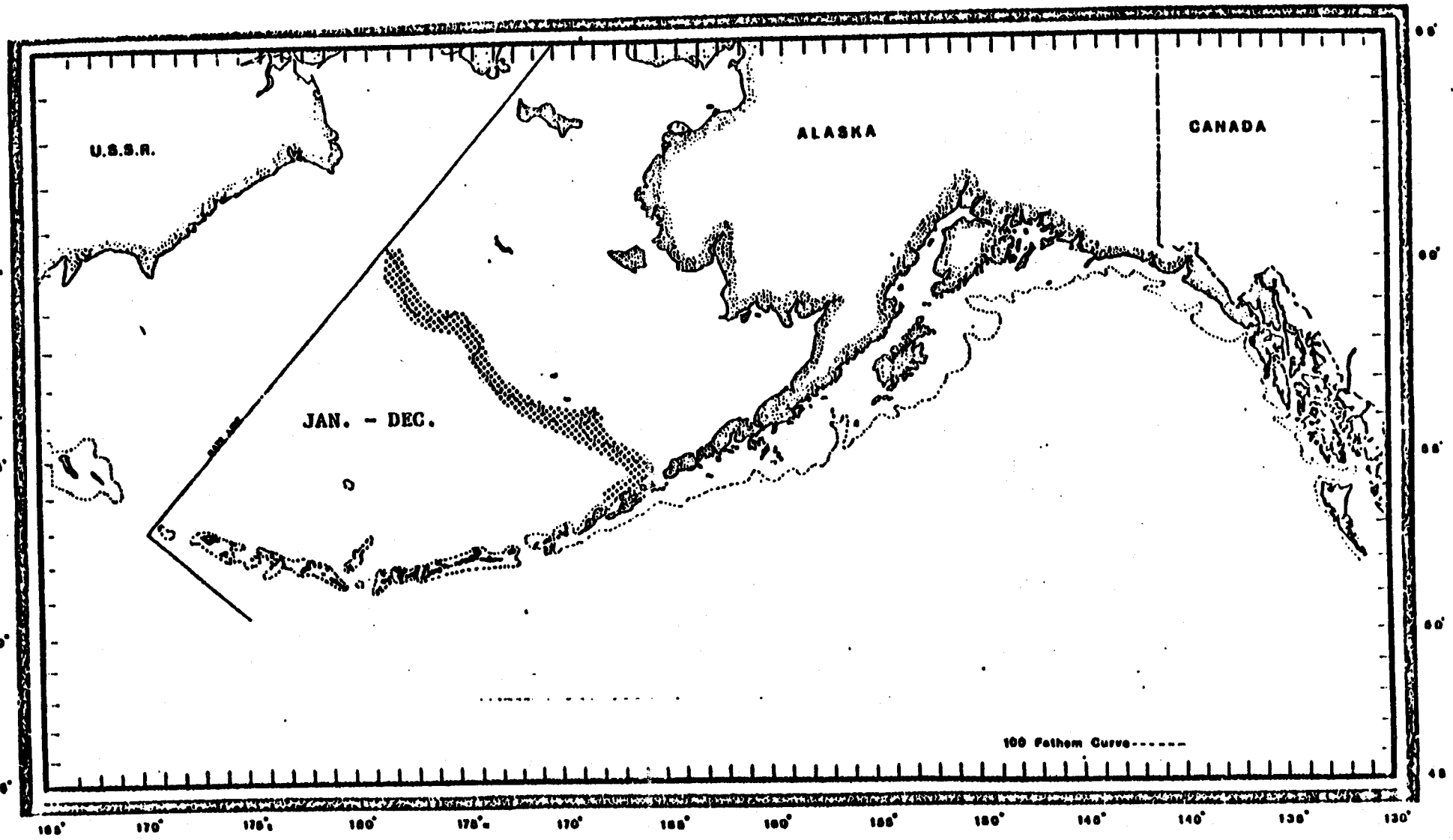

Figure 10.--Fishing areas in the eastern Bering Sea for the USSR fishery targeting mainly on pollock (Law Enforcement Division 1974).

Table 7. Monthly range in number of USSR vessels operating in the eastern Bering Sea and Aleutian Islands in 1966-77 (Office of Environment and Surveillance 1967-70; Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

	Range in monthly number					
Year	Month of Factory ships[1/]	Factory stern trawlers	Other trawlers	Support[2/]	Total	maximum number
Eastern Bering Sea						
1966	0-14	0-15	0-40	0-3	0-72	March
1967	0-15	0-12	0-60	0-3	0-90	Feb. - Mar.
1968	0-13	0-25	2-60	0-2	2-99	February
1969	0-8	0-50	6-67	1-23	7-147	February
1970	0-7	0-52	8-92	0-22	9-173	February
1971	0-8	0-65	5-87	0-21	6-171	February
1972	0-8	0-39	1-89	0-21	3-155	February
1973	0-6	1-27	6-60	0-6	7-82	February
1974	0-5	4-30	6-51	1-10	14-79	Feb. and Apr.
1975	0-4	4-13	5-36	1-7	13-51	June
1976	0-5	2-30	7-48	0-6	13-86	April
Aleutian Islands						
1966	0-3	0-10	0-10	0-1	0-24	August
1967	0-6	0-12	0-21	0-3	0-42	June
1968	0-4	0-14	0-23	0-1	7-28	March
1969	0	0-7	0-13	0-1	3-14	Jan. and Dec.
1970	0	0-5	0-14	0-1	1-15	January
1971	0	0-6	2-15	0-1	6-17	May
1972	0-1	0-5	3-19	0-1	4-21	December
1973	0	0-4	6-17	0-3	6-20	April
1974	0	0-2	0-19	0-5	0-24	March
1975	0-1	0-30	0-10	0-4	2-33	September
1976	0	0-27	0-4	0-5	0-32	May

1/ Including all processing and refrigerated transport vessels.

2/ Including tanker, tugs, cargo, and repair ships.

4.2.2.1.3 Korean (ROK) Fishery

Fisheries by the Republic of Korea in the eastern Bering Sea and Aleutian Islands have been much smaller than those of Japan and the USSR (Office of Enforcement and Surveillance 1968, 1969 and 1970; Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975 and 1977). Following exploratory fishing in these regions in 1966, an ROK fleet returned to Alaskan waters in September-November 1967 with a commercial operation consisting of a refrigerated transport vessel and eight pair trawlers. The operation was plagued by bad weather and tragedy. Crew members and two of the pair trawlers were lost enroute to the fishing grounds in a storm south of the Aleutian Islands. Continued stormy weather permitted only five days of fishing, two of which were south of Unimak Island and the remainder in the Gulf of Alaska.

The ROK expedition was more successful in 1968 conducting operations around the eastern Aleutian Islands and west of the Pribilof Islands from May to July. The fleet, targeting on pollock, consisted of a processor, six pair trawlers, and a refrigerated transport vessel. An independent stern trawler also operated in the eastern Bering Sea in 1968, but the purpose of their fishing activity is not known; it may have been exploratory in nature.

In later years the ROK fishing fleet was enlarged to include factory ships and additional pair trawlers and independent stern trawlers, and eventually longliners and a Danish seiner (Table 8). Based on the number of vessels in the fishery, ROK effort reached its maximum in 1976. The number of vessels shown in Table 8 includes those fishing for herring in the eastern Bering Sea and for other species in the Gulf of Alaska. The principal target species along the edge of the continental shelf in the eastern Bering Sea has continued to be pollock. Some of the trawlers have also fished in the Aleutian Islands for rockfish and pollock. Until 1972, fishing was limited to spring and summer months, but by 1973 the independent stern trawlers had begun to fish in winter months as well. By 1974 the areas of fishing by the trawl fleet had become fairly extensive (Figure 11). Estimates by U.S. surveillance of the ROK fishery indicated that pollock catches ranged between 1,200 and 26,000 mt from 1968 to 1975. The pollock catch reported by the Koreans for 1976 was 85,000 mt in the eastern Bering Sea and 500 mt in the Aleutian Islands area.

An ROK longline fleet, which has mainly fished sablefish in the Gulf of Alaska, began fishing sablefish for brief periods in the Aleutian Islands in 1974. The effort by longliners in Aleutian waters has apparently increased in more recent years.

4.2.2.1.4 Taiwanese (ROC) Fishery

The Taiwanese fishery, which began in December 1974, has involved only one or two independent stern trawlers. The trawlers have fished in winter and spring months along the continental shelf edge west and southwest of the Pribilof Islands. The vessels are believed to have targeted on pollock and flounders.

4.2.2.2 Description of Vessels and Gear

4.2.2.2.1 Japanese Fishery

As outlined in Section 4.2.2.1, the Japanese employ two types of operations in their groundfish fishery, fleet operations involving a factory mothership and catcher boats and vessels that operate independently and process their own catch. Vessels used in each of these fisheries are discussed separately.

Table 8. Number of vessels operating in the Korean groundfish fishery in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, 1968-74 (Office of Enforcement and Surveillance 1969, 1970; Enforcement and Surveillance Division 1971, 1973; Law Enforcement Division 1974, 1975, and 1977).

Year	Pair Trawlers	Stern trawlers	Long-liners	Danish seiners	Factory ships	Processors and/or transport vessels	Total
1968	6	1	0	0	0	2	9
1969	7	4	0	0	1	3	15
1970	11	2	0	0	2	2	17
1971	10	3	0	0	1	3	17
1972	0	6	0	0	0	0	6
1973	8	10	1	0	3	0	22
1974	22	5	8	1	2	3	41
1975	0	13	9	1	0	0	23
1976	29	16	12	0	1	0	58

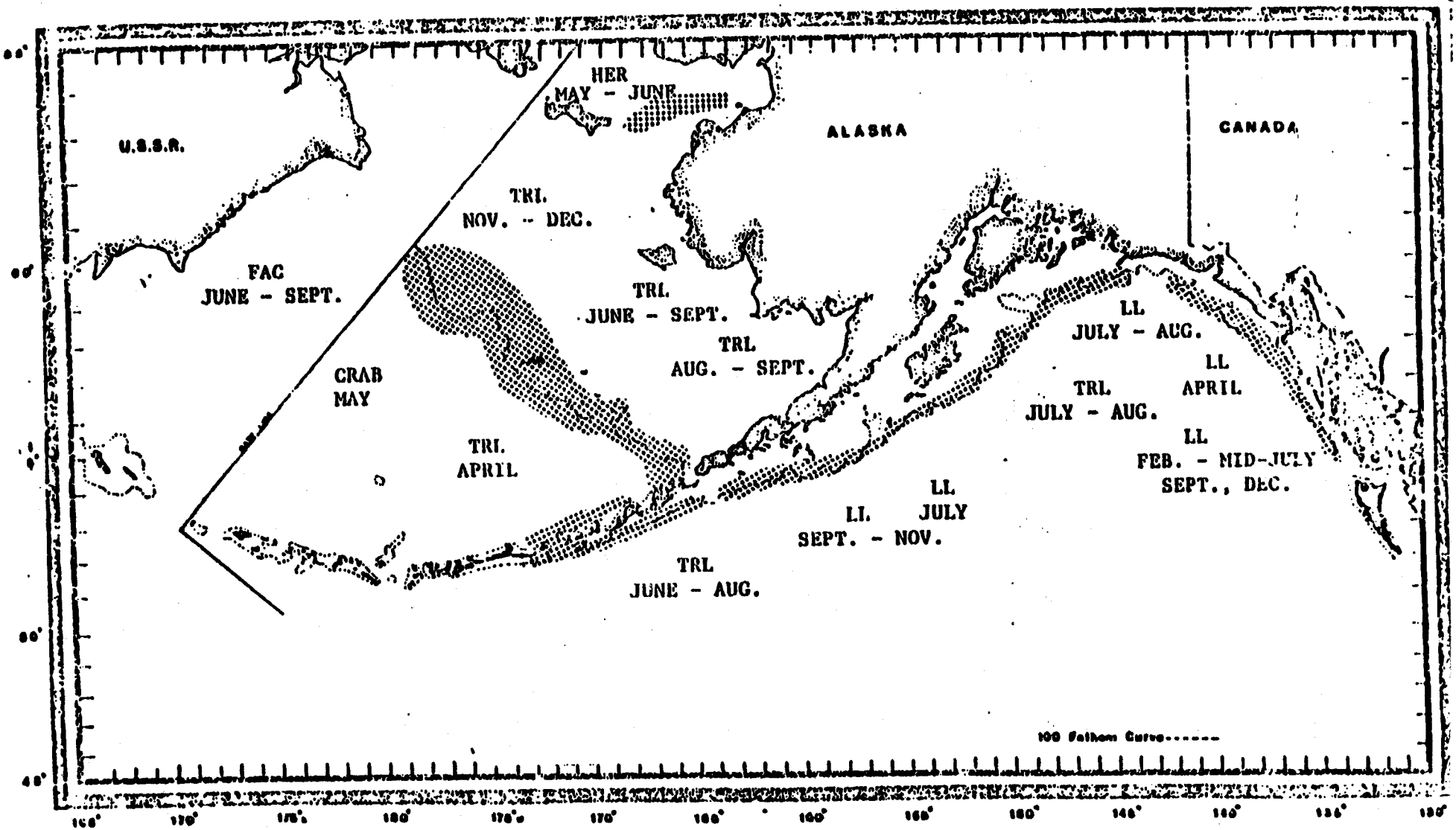

Figure 11.--Fishing areas of the Republic of Korea fisheries in 1974 (Law Enforcement Division 1977).

Types of mothership fleets and the range in size of motherships as reported by Forrester et al. 1974 are as follows:

Type of fleet	Size of Motherships (gross tons)
Flounder freezing fleets	7,000 - 9,000
General freezing fleets	5,000 - 10,000
Minced fish and fish-meal fleets	9,000 - 27,000
Longline-gillnet fleets	200 - 2,500

The motherships are equipped to process catches into such products as frozen fish for human consumption, minced fish (surimi), and meal and oil. Catcher boats supplying the motherships with fish have been of five major types: longline-gillnetters, side trawlers, pair trawlers, Danish seiners, and stern trawlers. Side trawlers have been phased out of the fishery and the number of Danish seiners have declined. Pair trawlers have become the principal vessel type in the freezing and minced fish and fishmeal fleet.

Side trawlers that operated in the fishery were 30 to 52 m long, 150 to 370 gross tons, and had crews of 20 to 30 (Dickinson 1973). The side trawlers usually set and retrieved the trawl from the starboard side, but some were rigged to set from the stern and retrieve to the side. The trawlers usually operated within 55 km of the mothership and used detachable codends so that a number of tows could be made prior to returning to the mothership.

Danish seiners are generally 27 to 46 m in length and 100 to 150 gross tons with crews of 18 to 20 (Dickinson 1973). Danish seiners set the net over the stern and usually retrieve on the port side. The catch is normally brailed aboard, but some newer seiners have stern ramps to haul the catch aboard. Typical gear dimensions of the Danish seiners as determined from a sample of the Japanese fleet are given in Table 9.

Pair trawlers work in two-boat teams, one vessel setting the trawl and the second vessel securing its warp to one wing of the net. When the tow is completed, the net is hauled until one wing can be passed to the other vessel to complete the haul. Detachable cod-ends are used on pair trawlers. Older pair trawlers are 27 to 46 m in length and 100 to 150 gross tons with crews of 15 to 20 (Dickinson 1973). Newer pair trawlers are 37 m in length and 185 gross tons with crews of 14 to 16 men. Typical trawl dimensions used by pair trawlers are observed from sampling the fleet in 1970 and 1975 are shown in Table 9. These data indicate that the average size of vessels and gear increased between 1970 and 1975.

Stern trawlers operating as catcher boats in the mothership fishery are mainly of the 300-350 ton class (Table 9). These smaller stern trawlers average 43 to 50 m in length and carry 20 to 30 men (Dickinson 1973).

Vessels in the Japanese groundfish fishery operating independently of the motherships and processing their own catches consist of stern trawlers and longliners. The independent stern trawlers range in size from about 350 gross tons to over 5,000 gross tons (Table 10). The smaller of these trawlers have operated in the flounder and rockfish fisheries while those targeting on pollock in 1974 and 1976 were larger than 2,000 gross tons. Trawl dimensions were greatest for the larger vessels operating in the pollock fishery (Table 10).

Table 9. Range in size of catcher boats in the Japanese mothership fishery and typical trawl gear used based on a sample of the fleets inb 1970 and 1975 (Data for 1969 from Forrester et at., 1974 and for 1975 from Fisheries Agency of Japan 1975).

		Vessels		Typical gear type			
Year	Type	Range in gross tons	Range in horse power	Head rope length (m)	Ground rope length (m)	Cod-end mesh size (cm)	Otter board size (m)
1970	Danish Seine	85 - 300	440 - 850	93	101	7.3	--
1975	Danish Seine	96 - 125	450 - 1350	115	130	9.0	--
1970	Pair trawler	88 - 195	310 - 1200	139	152	9.1	--
1975	Pair trawler	115 - 215	650 - 1400	146	162	9.0	--
1975	Stern trawl	297 - 349	1200 - 2500	48	57	9.0	1.9 x 3.2

Table 10. Range in size of vessels in the North Pacific trawl fishery and typical gear used for principal target species from a sample of the fleet in 1974 and 1976 (Fisheries Agency of Japan 1974 and 1976).

Target Species	Year	Range in vessel size: gross tons	Range in vessel size: horse power	Gear: Head rope length (m)	Gear: Ground rope length (m)	Cod-end mesh size (cm)	Otter board size (m)
Pollock	1974	3037-5460	4000-5950	66	65	10	3.2 x 5.0
	1976	2455-5470	3500-5700	66	89	10	2.6 - 4.3
Yellowfin sole	1974	349-499	2100-2500	53	60	9	2.1 - 3.3
	1976	349-3500	1600-4000	57	69	10	2.4 x 3.0
Rockfish	1974	499-3608	1500-4400	50	64	9	2.4 x 3.8
	1976	349-3914	1420-4400	60	73	10	2.2 x 3.3

An example of a smaller independent stern trawler is a 500 gross ton vessel averaging 52 to 58 m in length and carrying a crew of 20 to 35 men (Dickinson 1973). The vessels are usually equipped with limited processing equipment, ship freezing units, and refrigerated holds. A medium sized independent stern trawler is 1,500 gross tons, averages 70 to 82 m in length, and carries 70 to 90 men. They normally have a large processing area with modern machinery for washing, heading, gutting and filleting the catch. Plate freezers and refrigerated holds are standard equipment along with reduction plants for producing fish meal. The larger stern trawlers of 2,500 to over 5,000 gross tons range in length from 88 m to over 120 m and carry crews of from 90 to 135. These vessels have equipment for heading, gutting, filleting, and skinning the catch and freezing facilities. Most have reduction plants for producing meal and oil and the larger vessels have equipment for producing minced fish. Independent longline vessels are 36 to 52 m long and 200 to 500 gross tons with crews of 25 to 30 (Dickinson 1973). Their primary target species is sablefish. Some rockfish are taken incidentally. Individual vessels fish about 23 km of longline with approximately 8,000 hooks. The gear is allowed to soak for 12 hours. Frozen squid is used for bait. Typical dimensions of fishing gear is given in Table 11. The vessels are equipped with sharp freezers and refrigerated holds. The longlines remain on the fishing grounds from two to four months until the maximum hold capacities of about 400 mt is reached, after which they return to home ports (Law Enforcement Division 1974).

4.2.2.2.2 Soviet Fishery

Similar to the Japanese groundfish operations, the USSR fishery also employ catcher boats that deliver their catches to factory ships or to processing and freezing transport vessels and vessels that operate independently of factory ships and process their own catches. The USSR has perhaps utilized the flotilla concept of fishing operations to a greater degree than any other nation (Pruter 1976). To allow the fishing vessels to operate at sea for long periods, they are closely supported by numerous other types of vessels including base ships that carry fleet administrators and staff and provide logistic support, factory ships for processing catches, refrigerator transports to replenish stores on the catcher vessels and to receive, freeze, and transport their catches to home ports, and oil tankers, passenger ships, tugs, patrol vessels and occasionally even hospital ships. Refrigerated transports are the mainstays of the support operations. They are of various sizes ranging from 46 to 151 m and from 650 to almost 9,700 gross tons (Law Enforcement Division 1977). Base and factory ships are 110 to 174 m and 5,000 to 18,000 gross tons.

Two basic kinds of fishing vessels have been used by the Soviets, side trawlers and factory stern trawlers (Pruter 1976). Three size classes of side trawlers have been used. Smallest and oldest of the side trawlers is the SRT of 265-335 gross tons, 38 m in length with crews of 22-26 men. The next larger of the side trawlers is the SRTR class of refrigerated medium trawlers of 505-630 gross tons and about 52 m, carrying crews of 26-28. Largest of the refrigerated side trawlers is the SRTM class of about 700 gross tons and 54 m with a crew of about 30. The larger of the side trawlers, particularly the SRTMs, frequently operate independently processing and freezing their own catches, but some may transship their catches to factory ships for processing. A new class of trawler designated as SRTKs have appeared in the fishery in more recent years and are apparently an improvement on the SRTMs. The SRTKs are about 775 gross tons, have stern ramps for more efficient trawling over the stern.

The largest of the Soviet fishing vessels are the factory stern trawlers, the most common of which is the BMRT of 3,170 gross tons, 85 m in length, and carrying a crew of about 90 (Pruter 1976). The factory trawlers usually process and freeze their own catch. A newer class of factory stern trawler, the RTM has come into increasing use in recent years. They are somewhat smaller than the BMRTs, the most common of which is 2,657 gross tons and 82 m long, but has the advantage of a larger deck area aft for handling gear and fish.

Table 11. Range in size of longline vessels and typical fishing gear used in the North Pacific longline-gillnet fishery from a sample of the fleet in 1969, 1972 and 1976 (Fishery Agency of Japan 1969, 1983 and 1976).

	Vessels		Groundline		Gangion				
	Range in gross tons	Range in horsepower	Length of hachi (m)	Gear diameter (mm)	Number hooks per hachi	Length (m)	Size of Diameter (mm)	hook (mm) or size number	Bait
1969	275-499	510-1230	75	9.0	40	1.5	2.0	63 x 14	Frozen squid
1972	300-500	710-1800	75	8.0	35	1.3	---	20	Frozen squid
1976	382-500	540-1110	75	8.0	42	1.3	---	20	Frozen squid

Dimensions of typical gear used on Soviet BMRT trawlers fishing for pollock and Atka mackerel are given in Table 12. Data from U.S. observer reports indicate that vertical openings on trawls used for pollock may range from 5-30 m.

4.2.2.2.3 Korean and Taiwanese Fisheries

Information on vessels and gear used in the ROK groundfish fisheries is not as well documented as that for the Japanese and the USSR fisheries. Methods of operation are similar to those of the Japanese and Soviets in that they also use factory ship-catcher boat operations as well as stern trawlers, longliners and Danish seiners operating independent of factory ships. The number and size of vessels has increased since the fishery began. Initially, the Koreans used pair trawlers of about 33 m and 133 gross tons and processed the catch aboard vessels ranging in size from 828-957 gross tons (Office of Enforcement and Surveillance 1969). In 1969 they employed a 9,400 gross ton factory ship, 142 m long to process catches of the pair trawl fleet. Independent stern trawlers also entered the fishery in 1969 ranging in size from 131-1,518 gross tons and 35 to 77 m in length (Office of Enforcement and Surveillance 1970).

The subsequent modernization of the Korean fleet is illustrated by information from U.S. Observer reports in 1977 (Table 13). These data indicate that independent stern trawlers in the ROK fleet are comparable in size to the largest trawlers in the Japanese and Soviet fleets with some exceeding 5,000 gross tons. The three vessels observed were targeting on pollock and gear dimensions given in Table 13 may be representative of trawls used by ROK independent trawlers in the pollock fishery.

The Taiwanese have used 1 or 2 independent stern trawlers in their small scale fishery in the eastern Bering Sea. The size of the vessels and dimensions of the gear used are unknown.

4.2.2.3 Catch Trends

Complete catch statistics for groundfish taken by foreign fisheries in the eastern Bering Sea and Aleutian Islands regions have not been available throughout the history of the fishery. Japan has provided the longest and most detailed series of catch data. However, even the Japanese have not always identified some of the flounders to species in their catch data (INPFC 1976). Beginning in 1964, Japan has submitted detailed statistics for their groundfish fisheries to the United States and Canada through INPFC. The identification of catches and reporting of all principal commercial species has probably improved since then. The USSR began to report catch statistics to the United States through bilateral agreement in 1967. Not until 1972 was there a reasonably good breakdown of catches to individual species and even then a detailed area breakdown of their catches was not available. The ROK did not report their catch statistics in detail until 1976. Prior to the reporting of statistics by the USSR and the ROK, their catches have been estimated through U.S. surveillance of the fisheries.

Because of the lack of statistics from some nations and the irregular method of reporting certain species, available catch data for foreign fisheries may not reflect actual exploitation of all species. Statistics for primary target species such as pollock, yellowfin sole, rockfish and sablefish are assumed to be relatively accurate. Since 1970 the catch data for most other commercially important species has probably improved.

Table 12. Typical trawl dimensions used on Soviet BMRT factory stern trawlers for pollock and Atka mackerel based on data of U.S. Observers in 1976 and 1977.

	Range in vessel size		Typical gear dimensions					
Target Species	Length (m)	gross tons	length Horsepower	Ground-Headrope length (m)	rope mesh size (m)	Cod-end Cod-end mesh size (cm)	liner Otter (cm)	Boards
Pollock	78-87	2657-3837	2000-2320	77.4	77.4	5.0 - 6.0	3	Round to oval variable in size 1600-1800 kgs.
Atka mackerel	78-87	2581-3510	2000	31.0	44.0	5.0	3	Round to oval 1200 kgs.

Table 13. Vessel size and fishing gear dimensions of three ROK independent stern trawlers boarded by U.S. Observers in 1977.

	Vessels			Gear					
Name	Length (m)	Gross tons	Horse-power	Headrope Number in crew	Rope length (m)	Ground-Vertical length (m)	Cod-end opening (m)	Board mesh size (cm)	Otter size (m)
Salvia	84	2285	3200	58	59	78	6	10	2.5 x 3.8
Shin An Ho	106	5680	6000	157	80	75	7	10	3.0 x 5.0
Heung Yang Ho	104	5377	5800	92	74	105	38	10	3.0 x 4.8

Eastern Bering Sea.--Historical trends in total groundfish catches by foreign fisheries in the eastern Bering Sea since 1954 are illustrated in Figure 12; catch statistics by individual species and nation are given in Annex IV. Total catches of groundfish in the eastern Bering Sea have reached two peaks. The first and smaller of these peaks occurred between 1959 and 1963 when Japan and the USSR were targeting on yellowfin sole. Total estimated catches of yellowfin sole and other species reached a maximum of 715,000 mt in 1961. Catches dropped sharply in the succeeding two years, because of a decline in abundance of yellowfin sole, ranging between 300,000 and 400,000 mt during 1963-65.

With the development of the Japanese pollock fishery, total groundfish catches rose rapidly after 1965 and by 1971 exceeded 2 million mt. The total catches of groundfish peaked at 2.2 million mt in 1972 and then declined as catch restrictions were placed on pollock and other species through bilateral agreements between the United States and Japan and the USSR. These catch restrictions stemmed from evidence of deterioration of the various resources. By 1976 total catches had been reduced to less than 1.5 million mt. Throughout the history of foreign exploitation of groundfish in the eastern Bering Sea, Japan has been by far the major user nation (Figure 12). In the early years of the fishery, when yellowfin sole was the major target species, Japan accounted for 68-90% of the total annual groundfish catch in the eastern Bering Sea. This proportion has remained high in later years as pollock became the major target species, ranging from 76-89% annually. Japanese catches peaked at 1.8 million mt in 1972.

Through 1970, the USSR fished primarily for flounders in the eastern Bering Sea and until that year their total catches of groundfish remained less than 200,000 mt (Figure 12). In subsequent years, as their pollock fishery developed, catches of groundfish increased, peaking at 410,000 mt in 1974.

Catches by the ROK have apparently been relatively small. Estimated catches based on U.S. surveillance of their fisheries were no larger than 26,000 mt through 1975 (Annex III). In 1976, however, the ROK reported a total groundfish catch in the eastern Bering Sea of 88,000 mt. Pollock accounted for 85,000 mt of this total.

Flounders (primarily yellowfin sole) were the major species in the eastern Bering Sea catches until 1964, after which pollock predominated (Figure 12). The proportions of pollock in foreign catches generally increased between 1965 and 1970 ranging from 57-79%. From 1971 to 1976 they formed 81-85% of the total groundfish catch. Species of roundfish, other than pollock, have been less abundant than pollock and flounders in catches.

Catch trends of individual species of flounders in the eastern Bering Sea are illustrated in Figure 13. Catches of yellowfin sole reached extremely high levels from 1960 to 1962 with removals of over 1.4 million mt by Japan and the USSR. Catches of this magnitude were more than the stock could sustain and abundance of yellowfin sole declined. Following this deterioration of the resource, catches fell to about 100,000 mt or less, but increased again to reach the 160,000-170,000 mt level in some years between 1967 and 1971. Since 1971, catches have fallen well below 100,000 mt, in part due to the absence of a directed fishery on flounders by the USSR and perhaps to winter area closures in the southeastern Bering Sea which may have reduced catches of yellowfin sole by Japan.

As discussed previously, rock sole, flathead sole, and Alaska plaice have not always been identified in catches, particularly prior to about 1970. Reported catch statistics may therefore inaccurately reflect actual catch trends for these species. Catches of flathead sole apparently peaked in 1971 at 51,000 mt and those for rock sole in 1972 at 61,000 mt (Figure 13). Catches have declined substantially in more recent years which may have resulted to some degree from the reduction in the yellowfin sole fishery where these species are taken incidental to yellowfin sole. There have been no indications of recent substantial reductions in abundance of these species (Bakkala and Wakabayashi 1977).

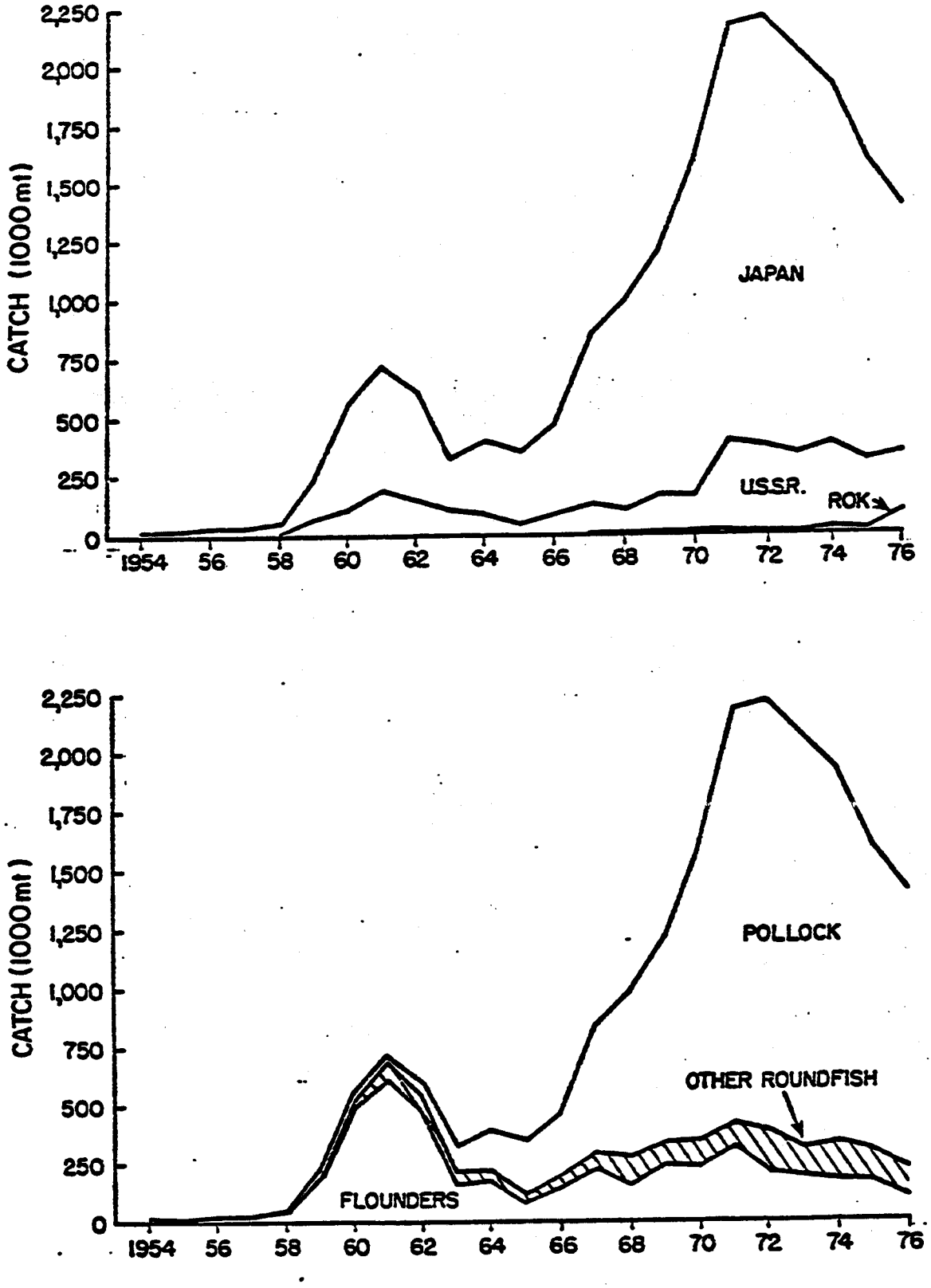

Figure 12.—Foreign catches of groundfish in the eastern Bering Sea (east of 180°) by nation (upper panel) and by species or species group (lower panel), 1954-76.

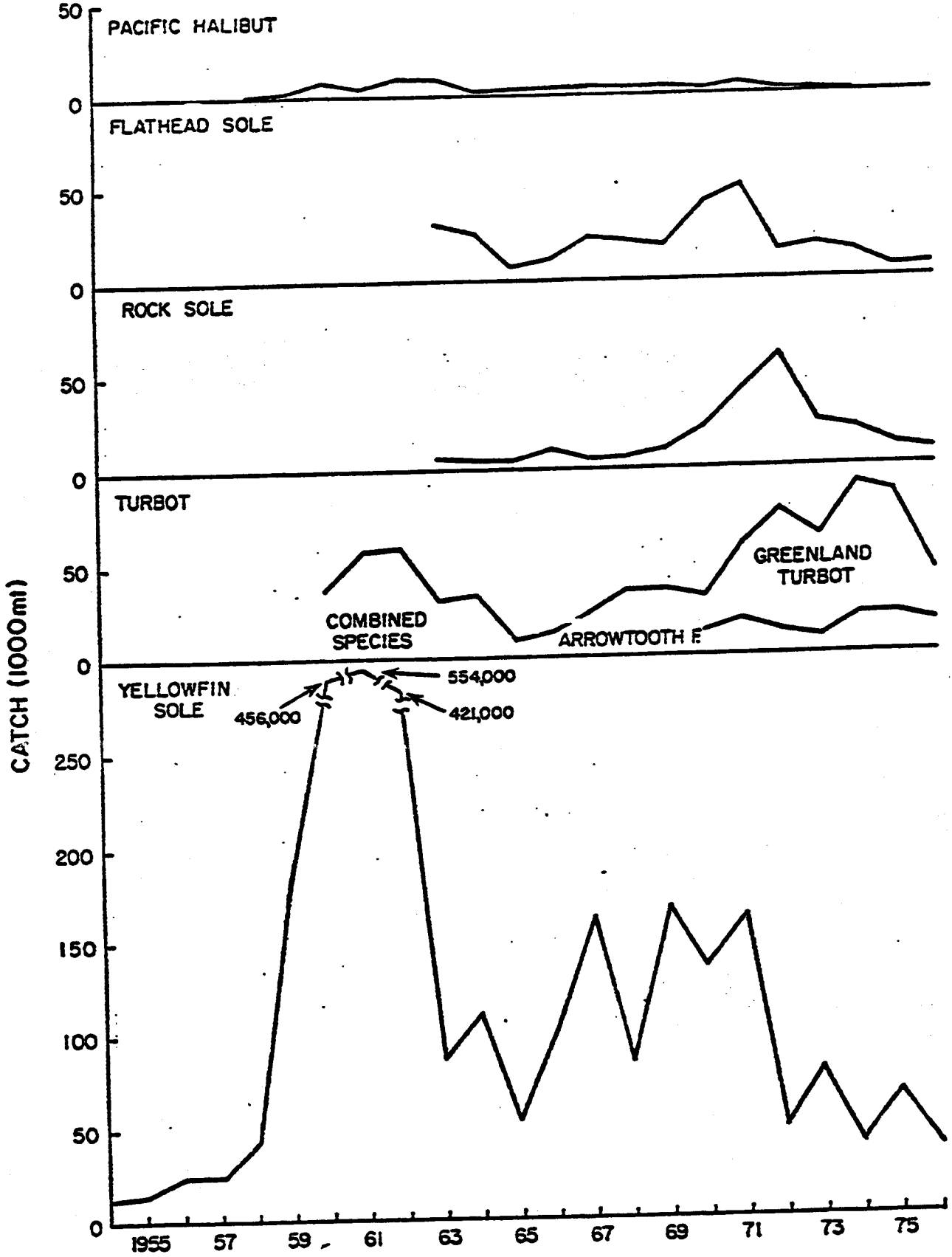

Figure 13.--Catch trends of flounders by foreign fisheries in the eastern Bering Sea, 1954-76.

Catches of Alaska plaice have not shown major fluctuations (Annex III). This species is also taken incidentally in the yellowfin sole fishery and may not always have been identified in catches. The largest reported catch for this species was about 6,900 mt in 1969. Catches since 1969 have ranged from about 300 mt to 3,400 mt.

Catches of turbot (arrowtooth flounder and Greenland turbot) were relatively high in early years of the eastern Bering Sea fishery ranging over 50,000 mt in 1961 and 1962. Japanese fisheries targeted on arrowtooth flounder in this period for the production of fishmeal (Takahashi 1976). Catches dropped below 40,000 mt in 1963-70 as these species were only taken incidentally in the pollock and other directed fisheries. Catches of Greenland turbot increased markedly after 1970 in both the Japanese and the USSR fisheries (Annex III). Total catches of Greenland turbot reached almost 70,000 mt in 1974 and since 1972 have approached or exceeded catches of yellowfin sole.

Reported catches of Pacific halibut in the eastern Bering Sea were relatively small compared to those of other principal flounders. Largest annual catches were made in 1960 (6,900 mt), 1962 (7,900 mt), and 1963 (7,500 mt), and 1971 (4,900 mt). Catches have declined in subsequent years reaching a low of 145 mt in 1976.

Not shown in Annex III are incidental catches of halibut taken by Japanese trawl fisheries targeting on other species. Japan is prohibited from retaining trawl-caught halibut in the eastern Bering Sea, but most released fish die from injuries received during capture. Estimates from observer data indicate that the incidental catch in the eastern Bering Sea increased from about 50 mt in 1954 to over 2,000 mt in 1961; after declining during 1962-63, the catch again increased and peaked at about 3,000 mt in 1971-72 (Hoag and French 1976). Since then, the incidental catch has declined as a result of reduced fishing effort and time/area closures, designed to protect halibut.

Before 1977, Soviet trawlers retained trawl-caught halibut in the Bering Sea. Their catch of halibut, however, was included with other species and not reported separately until 1972. The reported catch since then declined from 490 mt in 1972 to 58 mt in 1976 (Annex III). The reported catch, however, may be too low. Hoag and French (1976) estimated that the Soviet halibut catch averaged about 750 mt during 1959-1970 and then increased sharply to about 2,000 mt during 1971-1974. The catch has probably declined since then due to restrictions on the Soviet fishery.

With the concentration of Japanese fishing effort on pollock starting in 1964, catches of this species rose rapidly to reach 700,000 mt in 1968 (Figure 12). With the entry of the USSR and the ROK into the pollock fishery and greater effort by the Japanese, catches continued to increase reaching a peak of over 1.8 million mt in 1972. With the implementation of catch limitations stemming from evidence of overfishing on pollock, catches declined, falling to about 1.2 million mt in 1976.

Catch trends of demersal roundfish, other than pollock, are illustrated in Figure 14. Peak catches of sablefish and Pacific ocean perch were taken rather early in the fishery. Maximum harvests of sablefish occurred in 1961 and 1962 when 26,000 and 28,500 mt were taken. Catches were relatively stable at a lower level of 9,500-16,000 mt from 1966 to 1972, but declined thereafter falling to 2,700 mt in 1976. Following the peak catch of Pacific ocean perch in 1961 of 47,000 mt, catches dropped to a level of 17,000-29,000 mt from 1962 to 1968 and then declined to 3,600 mt in 1973. A second peak of 39,000 mt was reached in 1974 which was followed by another decline to 16,000 mt in 1976.

Catches of Pacific cod increased steadily in earlier years of the fishery to reach levels of more than 50,000 mt by 1968. Annual catches have been relatively stable since then, ranging around 50,000 mt with the largest catch of 70,000 mt taken in 1970.

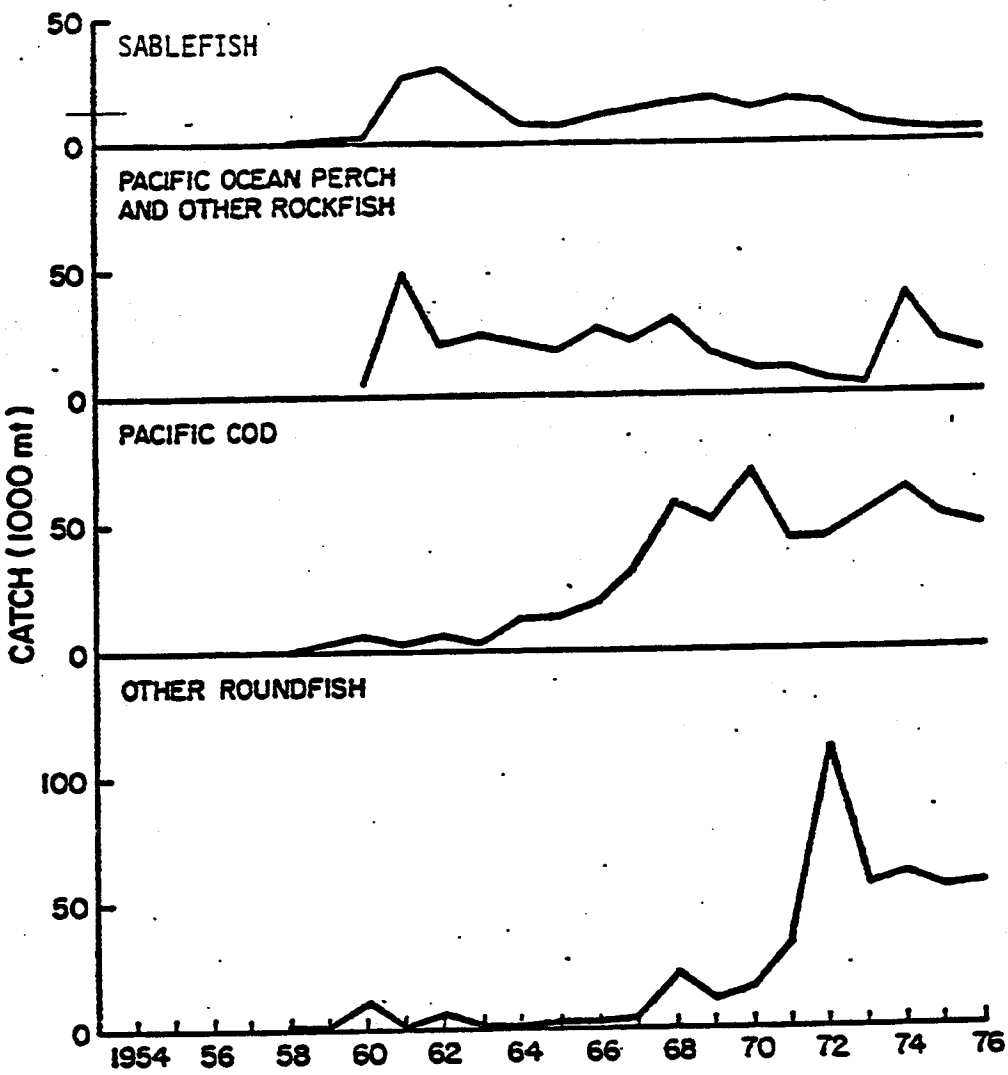

Figure 14.—Catch trends of roundfish (other than pollock) by foreign fisheries in the eastern Bering Sea, 1954-76.

The "other groundfish" category represents catches of various species of non- or low commercial value that are taken incidental to target species. Major species groups in this category are probably sculpins, poachers, eelpouts, skates and rattails. Reported catches of this group increased sharply after 1970. A large catch of rattails (48,500 mt) by the USSR mainly accounted for the exceptionally large total catch of "other groundfish" in 1972. The recent general increase in catches of this species category may stem from better reporting rather than an actual increase in catches.

Aleutian Islands.--Characteristics of the foreign fisheries in the Aleutian Islands region differ from those in the eastern Bering Sea in a number of respects. Overall catches have been much lower in the Aleutians, trends in catches and major species in catches have differed in the two regions, and the USSR rather than Japan has taken the greatest share of the catches in the Aleutians (Figure 15, Annex III). Total catches of groundfish reached their peak early in the history of foreign exploitation of the Aleutian Islands resources (Figure 15). Due almost entirely to catches of Pacific ocean perch and other rockfish, catches of all groundfish reached a peak of 114,000 mt in 1965. Since then, total catches have fluctuated at a lower level and shown a general overall decline. In 1975 and 1976, catches were in the range of 55,000-60,000 mt. The USSR has taken the largest share of the catches in the Aleutians with the exception of some recent years. Rockfish (mainly Pacific ocean perch) has been the primary target species in the Aleutians of both Japan and the USSR. Catches of demersal roundfish have increased markedly since 1973, perhaps due in part to better reporting of these species, but also because the USSR has had a target fishery on Atka mackerel in this period. Catches of Atka mackerel reached 20,000 mt in 1976. Catches of "other roundfish" have exceeded those of rockfish since 1973 because of the decline in abundance of Pacific ocean perch (Low et al. 1977) and the increase in catches of Atka mackerel and better reporting or actual increases in catches of such species as pollock and Pacific cod.

Flounders have formed a relatively small proportion of the total catches in the Aleutians. The small flounders (yellowfin sole, rock sole, flathead sole, and Alaska plaice) occupy this region in low abundance based on catch statistics (Annex III). The main species of flounders taken have been Greenland turbot and arrowtooth flounder.

Catches of Pacific ocean perch and other rockfish reached their peak in 1965 at 109,000 mt (Figure 15). Since then they have shown an almost continual decline with minor increases in 1970, 1972, and 1974. Catches fell again following 1974 to range from about 17,000-18,000 mt in 1975 and 1976.

Catch trends for individual species of roundfish, other than rockfish, are illustrated in Figure 16. Catches of Pacific cod have been small, showing some increases in recent years with a peak catch of 3,800 mt in 1976. This increase may simply reflect better identification and reporting of cod in the fisheries. Catches of sablefish have remained relatively stable at a low level throughout the period of foreign fishing in the Aleutians. The largest catch of 3,600 mt was taken in 1972. Sablefish have been a target species of longline fisheries by Japan and the ROK in Aleutian Island waters.

The USSR began to report significant catches of Atka mackerel in 1972. From 1974 to 1976 catches rose rapidly as the Soviets concentrated effort on this species, reaching 20,000 mt in 1976 and exceeding catches of any other groundfish species in the Aleutians in that year. Reported catches of pollock have also increased in recent years reaching a peak of 23,000 mt in 1974. Almost all of the catch in 1973-76 was taken by USSR fisheries. It is unknown whether the Soviets directed some effort to pollock in the Aleutians region in these years or whether they were an incidental part of catches in other fisheries.

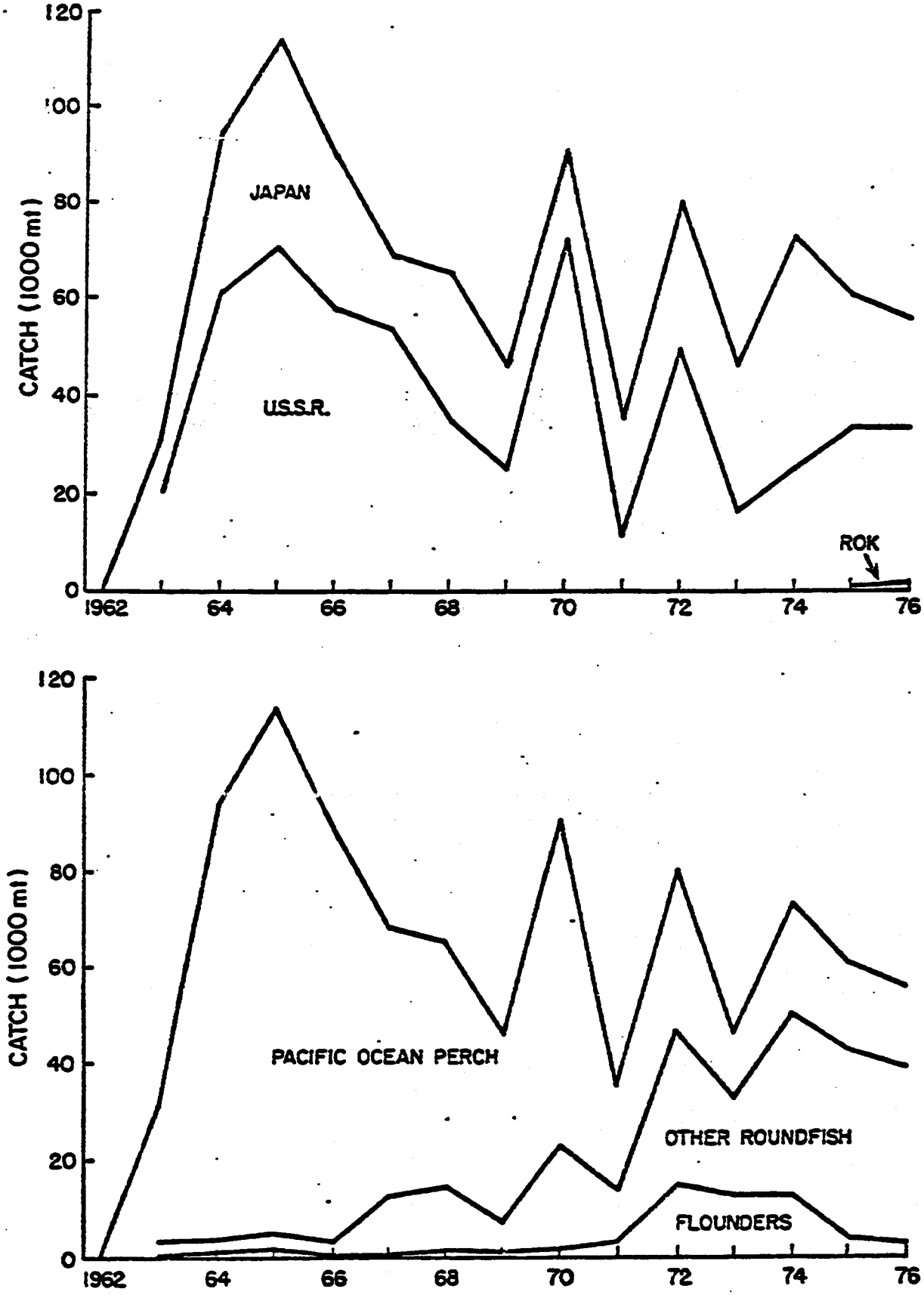

Figure 15.—Foreign catches of groundfish in the Aleutian Island area (170°W - 170°E) by nation (upper panel) and by species or species group (lower panel), 1962-76.

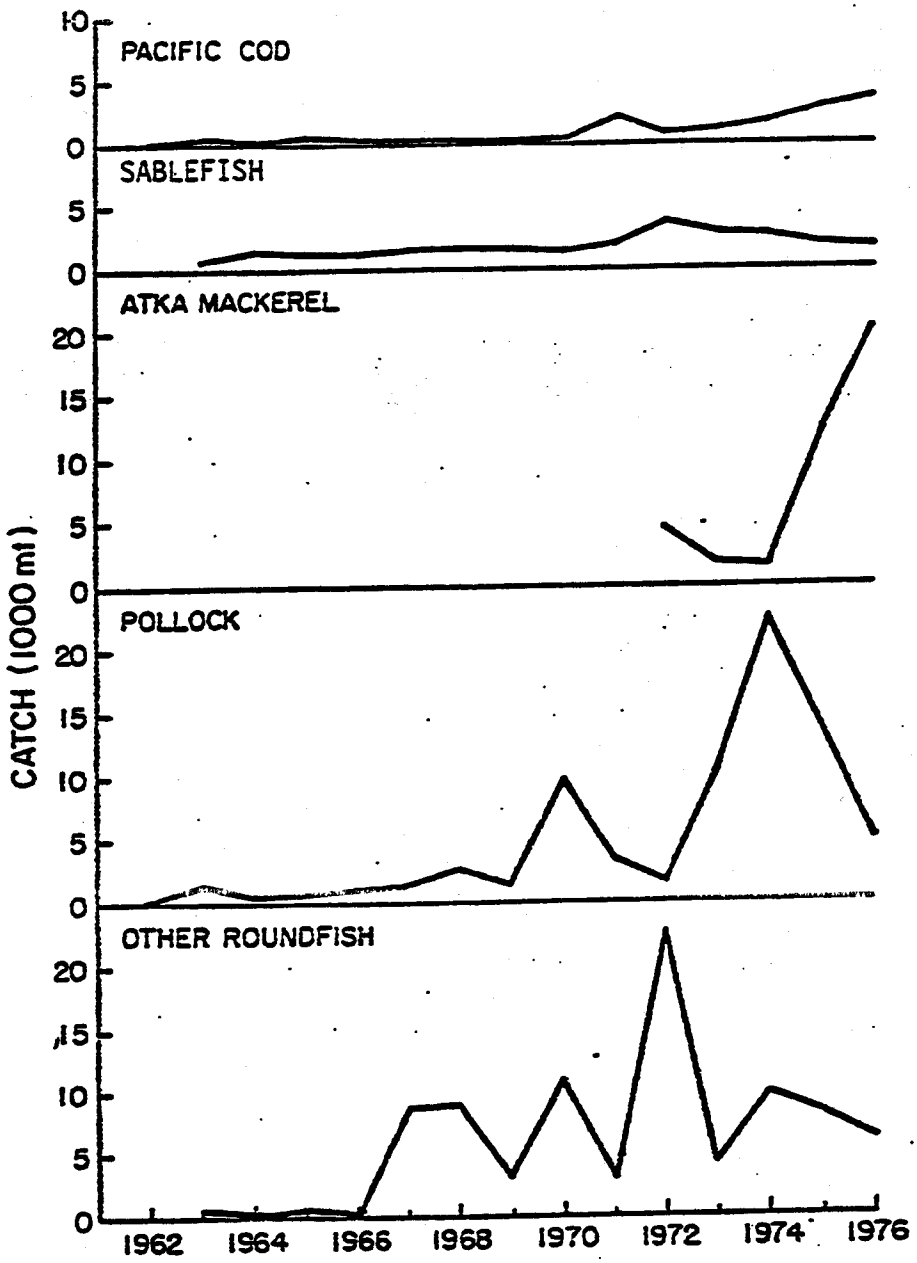

Figure 16.—Foreign catches of commercially-important species of roundfish (other than Pacific ocean perch) in the Aleutian Island area, 1962-76.

Catches of "other groundfish" have shown fluctuations from year to year, but no definite trend. This category probably consists mainly of non-commercial species or species of low commercial value such as sculpins and rattails. Fluctuations in this catch category may result partially from methods of recording and reporting these species. In 1972, when the largest catch of "other groundfish" occurred, the USSR reported 5,300 mt of rattails and 9,700 mt of sculpins. In later years the Soviets did not identify these species in their catch statistics and their total annual catches of "other roundfish" ranged from only about 200-1,600 mt. The reported Japanese catches of "other groundfish" increased from 1968 reaching 8,000 mt in 1974 and 1975.

Flounders have in most years formed only a minor part of the total groundfish catch in the Aleutian Islands area (Figure 17). Reported annual catches of small flounders have usually been less than 100 mt. After reaching a peak of almost 1,300 mt in 1975, annual catches of Pacific halibut have ranged from about 400 mt to less than 150 mt. Reported catches of arrowtooth flounder and Greenland turbot were also low until 1970, after which they increased sharply, with Greenland turbot the primary species taken. Catches in 1972-75 ranged from about 12,000 to 14,000 mt. Japanese fisheries were responsible for this rise in catches of turbot (Annex III).

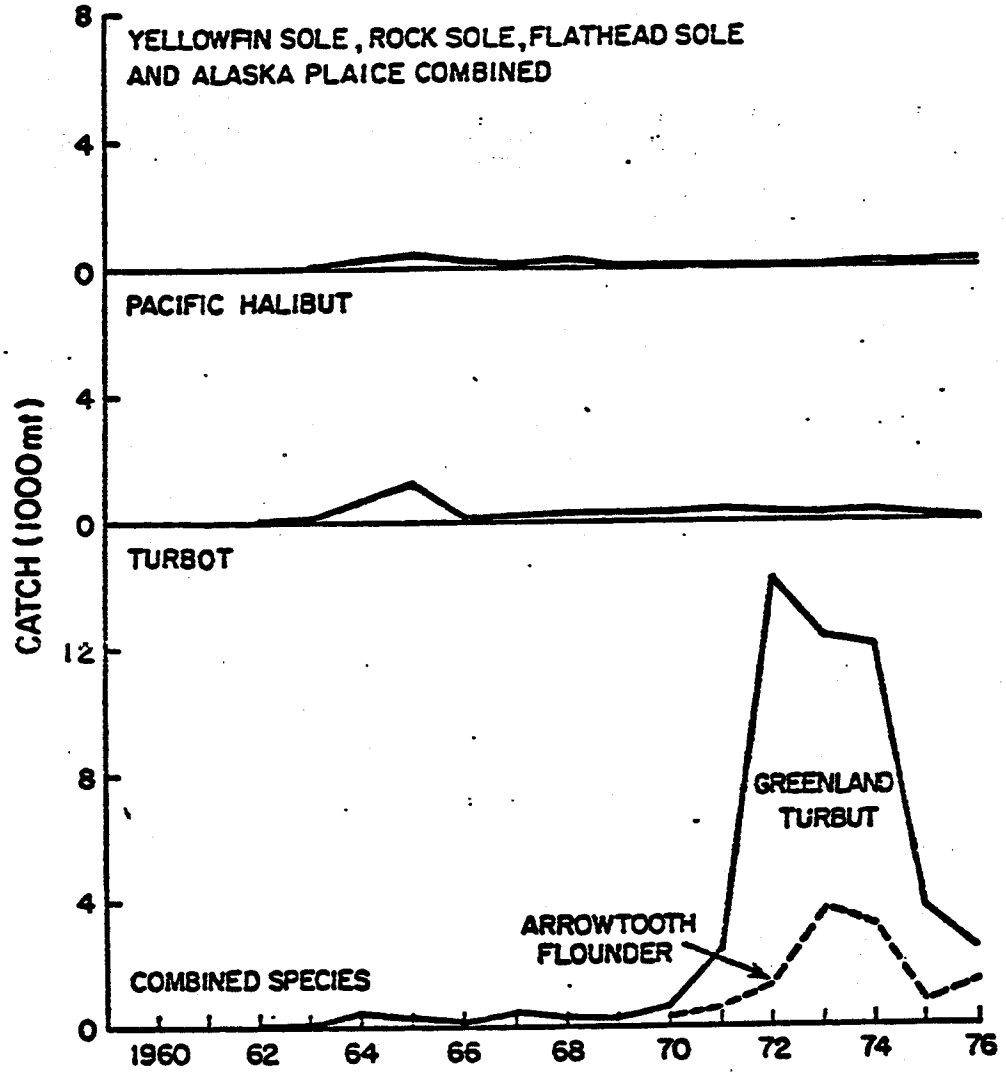

Figure 17.--Catch trends of flounders by foreign fisheries in the Aleutian Island area, 1962-76.

5.0 HISTORY OF MANAGEMENT

5.1 Domestic

5.1.1 Measures Employed to Regulate Fishery

Fishery restrictions on U.S. Nationals have been established by the U.S. Bureau of Commercial Fisheries (the predecessor of the National Marine Fisheries Service), the State of Alaska and the International Pacific Halibut Commission. The BCF was responsible for both research and management of domestic fisheries in Alaska before statehood in 1958. The BCF imposed restrictions on the size, character, and operation of trawls to be used to capture groundfish (Table 14). In 1959 the State of Alaska assumed responsibility for regulating the groundfish fisheries of Alaska. A history of the state's groundfish regulations is included in Table 14. Many of the regulations were specific to the Gulf of Alaska where domestic fisheries have been more active.

In addition to regulations given in Table 14, the State of Alaska requires all commercial fishermen landing any species of fish or shellfish in Alaska to possess a commercial fishing license, and the captain or owner of all fishing vessels are required to license their vessels and the fishing gear employed. Buyers are required to keep records of each purchase and show the number and name of the vessel, the State license number of the vessel, date of landing, pounds purchased of each species, statistical area in which the fish was caught, and the kind of gear used in taking the fish.

The chronology of different regulatory measures for the Pacific halibut fishery as well as their rationale are discussed by Dunlop et al. (1964), Bell (1967) and Skud (1977). Before 1963, the North American halibut fishery in the Bering Sea was managed by the International Pacific Halibut Commission (IPHC). From 1963 to 1977, IPHC recommended regulations, but these had to be approved by the International North Pacific Fisheries Commission (INPFC). Since the onset of regulations in 1932, several changes have occurred in the boundaries defining regulatory areas in the Bering Sea and Aleutians. Some of the changes were in response to tagging studies that indicated a relationship between halibut stocks in the Aleutians and the Gulf of Alaska. However, most of the changes were designed to obtain a desired distribution of fishing effort and to facilitate enforcement.

Except for a period in the late 1940s and early 1950s and again in 1963-64, quotas have not been used to manage Bering Sea halibut stocks. Instead, restrictions have been based on the length of the season. Until the late 1950s, the Bering Sea season coincided with that of IPHC Area 3 (the Gulf of Alaska west of Cape Spencer), but by the early 1960s, the opening of the Bering Sea often was a month earlier than in Area 3. The earlier opening was established to encourage fishermen to exploit Bering Sea stocks. Since 1965, the fishing time has been limited to three weeks or less in the spring and fall or both. This curtailment was necessary because of the drastic decline in abundance of halibut.

Other regulations include licensing requirements, gear restrictions, minimum size limits, and closed areas. IPHC requires that all setline vessels over 5 net tons be licensed; there is no fee and annual renewal is not required. Licensed vessels must maintain a log book showing the daily catch, effort, and the fishing area. From 1932 to 1973, vessels also were required to "clear" for fishing a particular area and submit a "statistical return" at the completion of each trip. These requirements have since been deleted.

In 1938, the regulations prohibited the use of set nets for catching halibut. Nets of any kind were prohibited in 1944, and this restriction has continued to the present day. The definition of nets was expanded to include pots in 1972. IPHC's justification of trawl prohibition was based on evidence that halibut caught by trawls usually are below the optimum harvesting size.

The size limit of halibut was introduced into the regulations in 1940. The minimum size that time was 5 pounds, head-off, dressed. The purpose of the size limit was to reduce the catch of halibut that were below the optimum harvest size, but there also was an economic reason. The industry favored the regulation because small halibut were often of poorer shipping quality and of lower value. In 1973, the minimum size limit was increased and expressed in terms of length: 32 inches from the tip of the lower jaw to the end of the middle of the tail. The increase was justified based on an increase in growth rate.
In 1967, IPHC Area 4E in southeastern Bering Sea was declared a nursery area and a year-round closure was instituted that still is in effect.

5.1.2 Purposes of Regulatory Measures

The limited number of groundfish regulations implemented by the State of Alaska were primarily designed for the protection of species of high commercial value such a salmon, herring, juvenile halibut, and shellfish. Examples of such regulations were the restrictions on use of pot gear, gillnets, otter trawls, and seines (Table 14).

With regard to halibut, IPHC is restricted by the present convention to manage for MSY and cannot consider other goals or economic factors. Regulations in the Bering Sea and Aleutians were designed to accomplish this goal. Specifically, season and quota restrictions controlled fishing mortality; minimum size limits, gear restrictions, and closed areas reduced the mortality on suboptimum sized halibut; the timing of the seasons and the area designations affected the distribution of fishing effort and facilitated enforcement; licensing, and statistical requirements provided scientific information on stock condition.

5.2 Foreign

5.2.1 Measures Employed to Regulate the Fishery

A number of regulatory measures affecting groundfish fisheries have been implemented through public laws and international agreements prior to enactment of the U.S. Fishery Conservation and Management Act of 1976. Initial regulatory measures originated from the International Convention for the High Seas Fisheries of the North Pacific Ocean involving Canada, Japan, and the United States, which was brought into force in 1953. The Convention provided for establishment of the International North Pacific Fisheries Commission (INPFC) to provide and coordinate scientific studies necessary to ascertain and recommend conservation measures required to ensure maximum sustained productivity of fishery resources in the Convention area (Forrester et al. 1974). One of the provisions of the Convention prohibited Japan from fishing halibut in certain areas and, starting in 1958 Japan agreed to abstain from fishing halibut providing that stocks of halibut continued to meet qualifications for abstention, e.g., that the stocks were under substantial exploitation by two or more of the contracting parties.

In 1962 member nations of INPFC agreed that halibut east of 175°W. in the Bering Sea no longer continued to qualify for abstention (Forrester et al. 1974). Following the removal of halibut from the abstention list, joint conservation measures were implemented by member nations of INPFC in 1963 which included a catch quota of 5,000 mt in a triangular area east of 170°W. Following a catch of 5,000 mt in the quota area in 1963, catches dropped abruptly and Japan withdrew her longline fleet from the quota area after 1964. Although agreement between INPFC member nations was never reached to return halibut to the abstention list, Japan has not chosen to conduct a target fishery on halibut east of 175°W. since 1964.

Table 14. Historical summary of Alaska groundfish regulations.

Year	Legal gear, definitions, and other regulations
	Earlier records not available
1940	Use of trawls prohibited except for shrimp, flounders when not capturing, injuring or destroying other food fish, and spider and King crab west of 150°W longitude exclusive of Cook Inlet.
1942	Trawls prohibited in fishing for salmon, herring, and Dungeness crab.
1948	Gear restrictions: Trawls. The size, character, and operations of otter trawls in Alaskan waters are limited as follows: (a) Otter trawls having mesh smaller than 5 inches stretched measure between knots in the bag and 6 inches stretched measure between knots in the wings are prohibited: Provided, that otter trawls now in use having mesh smaller than that specified may be used through the calendar year 1949 if registered with the Regional Director, Fish and Wildlife Service, Juneau, Alaska. (b) The use of any devices attached to the footrope or elsewhere, such as chain "ticklers", which may cause undue disturbance or destruction of the bottom, is prohibited. (c) The use of otter trawls in any area which the International Fisheries Commission has found to be populated by small immature halibut and accordingly has closed to all halibut fishing, is prohibited. (d) All operators of otter trawls shall maintain a running log on forms furnished showing date, type and size of mesh of trawl used, each locality fished, the time and duration of each tow and the estimated poundage and number of average weight of each species caught. Such logs shall be available for inspection by representatives of the Fish & Wildlife Service at any reasonable time, and the duplicate sheets shall be transmitted to the Fish and Wildlife Service at periodic intervals. On or before December 15 of each year complete statistics of operations shall be submitted to the Fish and Wildlife Service on forms provided for the purpose. (e) The use of any trawls in commercial fishing for salmon, herring, and Dungeness crabs is prohibited.

Table 14. Historical summary of Alaska groundfish regulations. (Cont'd)

Year	Legal gear, definitions, and other regulations
1949	The following species besides salmon were defined as commercial fish: Albacore (Germo alalunga) tuna Cod (Gadus macrocephalus) codfish, true cod, grey cod Eulachon (Thaleichthys pacificus) smelt, hooligan Halibut (Hippoglossus stenolepis) Herring (Clupea pallasii) Lingcod (Ophiodon elongatus) Rockfish (all species of genus Sebastodes also known as rockcod and sea bass) Sablefish (Anoplopoma fimbria) black cod Sheefish (Stenodus mackenzii) inconnu Sole and flounder (all species of family Pleuronectidae)
1958	Trawl fishermen no longer required to fill out log books.
1959	Alaska Statehood Trawls illegal for taking crab.
1960	Longlines and trawls maybe used to take groundfish. Longlines are the only legal gear with which to take sablefish within S.E. Alaska. Halibut are to be regulated according to IPHC regulations 5AAC 39.390.
1961	All defined legal gear became legal for the taking of groundfish excepting S.E. sablefish.
1967	S.E. sablefish: a 2 1/2, #20 thread or less gillnet may be aboard vessel for taking bait.
1968	S.E.: sablefish taken incidentally by longline or otter trawl maybe retained in an amount not to exceed ten percent, by weight, of each landing.
1970	Pots became legal sablefish gear within S.E.
1972	Incidental allowable catch of sablefish increased to 20%.
	1962 regulations (5AAC 39.390) referring to IPHC management of halibut repealed.

Table 14. Historical summary of Alaska groundfish regulations. (Cont'd)

Year	Legal gear, definitions, and other regulations
1976	An untreated cotton escape for sablefish pots required within S.E. Also under General Provisions, Groundfish Fishery, Gear for Groundfish. (a) Groundfish may be taken by trawls, hand troll gear, seines, longlines and pots except as legal gear may be further restricted by groundfish gear regulations of chs. 03-39 of this title and except as follows. (1) king and Tanner crab pots as defined in chs. 34 and 35 of this title may not be used to take groundfish in the areas where the regulations defined those pots: (2) groundfish taken by power gurdy troll gear being fished for salmon consistent with applicable state laws and regulations are legally taken and possessed. (3) All commercial longline or skate gear buoys or kegs shall be marked with permanent department registration number of the vessel fishing this gear.
1977	Crab pots are not defined for all areas. The most restrictive definitions are as follows: A king crab pot is a pot with rigid tunnel eye openings and which individually are a minimum of five inches in one dimension, and tunnel eye opening perimeters which individually are larger than 30 inches. A Tanner crab pot is a pot with rigid tunnel eye openings which individually are a maximum of five inches in one dimension, and tunnel eye opening perimeters which individually are larger than 30 inches; or a pot which tapers form its base to a top consisting of one horizontal opening of undescribed size. Same as 1976 except that sunken or diving gillnets maybe used for groundfish upon issuance of a permit by the commissioner (ADF&G).

U.S. Public Law 88-308, enacted in May 1964, made it unlawful for foreign vessels to fish within the 3-mile territorial waters of the United States or to fish for designated fishery resources of the adjacent U.S. Continental Shelf. In October 1966, U.S. Public Law 89-658 established a 9-mile contiguous fishery zone adjacent to the U.S. 3-mile territorial sea. The law provided that the United State would have the same jurisdiction over fisheries within this newly created zone as it had within its 3-mile territorial waters subject to the continuation of traditional fisheries by foreign nations.

In 1964, the U.S. initiated bilateral agreements with Japan and the USSR to allow continuation of their traditional fisheries within the contiguous zone in certain areas of Alaska (Office of Enforcement and Surveillance 1968). One provision of the 1964 agreements was the establishment of a king crab pot sanctuary adjacent to the north side of Unimak Island and the western Alaska Peninsula that prohibited trawling year-round. The purpose of the sanctuary was to prevent gear conflicts between mobile foreign gear and domestic fixed gear. An adjacent area, closed to trawling during winter, in order to reduce incidental catches of juvenile halibut, was added in later bilateral agreements.

The agreements with Japan and the USSR were renegotiated at two-year intervals. Subsequent agreements created some changes in areas of fishing within the U.S. contiguous zone, and provided areas within the zone for transshipment of cargo between foreign fishing and support vessels. This series of agreements was expanded to include Canada in 1970, allowing for reciprocal fishing privileges within the contiguous fishing zone. Agreements were also signed with the ROK in November 1972, and with Poland in May 1975. No fishery agreements have been signed with Taiwan.

Starting in 1973, the bilateral agreements between the United States and Japan and the USSR begin to include catch quotas for these nations in the eastern Bering Sea and Aleutian Island regions. Annual quotas for the years 1973-76 are given in Table 15.

In addition to the crab pot sanctuary, the bilateral agreements have provided other area-time closures to Japanese and Soviet trawl fisheries for the protection of halibut. These closures are designed to reduce the incidental catch of halibut by trawl fisheries in areas and time periods that halibut form concentrations. Area-time closures currently in effect for these fisheries are shown in Figures 18a and 18b.

Restrictions on Polish and ROK fishing vessels in the eastern Bering Sea and Aleutian Islands region are shown in Figures 19 and 20.

Current regulations pertaining to foreign groundfish fisheries are found in Section V-A of the Preliminary Fishery Management Plan for the Trawl Fishery of the Bering Sea and Aleutian Islands, and include catch limitations, prohibition on the retention of certain species of importance to the United States, and time-area closures to prevent gear conflicts and provide protection to halibut. Catch limitations imposed on foreign fisheries in 1977 are listed in Table 16.

5.2.2 Purposes of Regulatory Measures

Most of the regulatory measures pertaining to foreign groundfish fisheries in the eastern Bering Sea and Aleutian Islands were implemented for conservation of halibut stocks and to prevent gear conflicts between foreign trawlers and domestic fixed gear (crab pots and halibut setlines). In negotiating these restrictions on foreign fisheries in international waters, certain concessions were provided the fisheries involved in terms of fishing and loading privileges within the U.S. contiguous fishing zone.

Table 15. Catch quotas applicable to Japanese and Soviet fisheries in the eastern Bering Sea and Aleutian Island region in 1973-76.(MT)

Area/fishery	Species	1973	1974	1975-76
		Japan		
Eastern Bering Sea Mothership-North Pacific Trawl Groundfish	Pollock	1,500,000	1,300,000	1,100,000
	other than pollock	--	--	160,000
	Herring	1/ (33,000)	1/ (33,000)	15,000
North Pacific Longline-Gillnet	Herring	2/ (4,600)	2/ (4,600)	3,000
Landbased Dragnet	Groundfish (All species)	--	--	35,000
Aleutian Region Mothership-North Pacific Trawl and Longline-Gillnet	Pacific ocean perch	--	--	9,600
	Sablefish	--	--	1,200
Landbased Dragnet	Groundfish (All species)	--	--	8,500
		U.S.S.R.		
Eastern Bering Sea	Flatfish	100,000		3/
	Pollock	--		210,000
	Herring	--		30,000
	Other Species	--		120,000
Aleutian Region	Rockfish	--		12,000
	Other species	--		16,000

1/ 1969 level
2/ 1971 level
3/ Included in other species

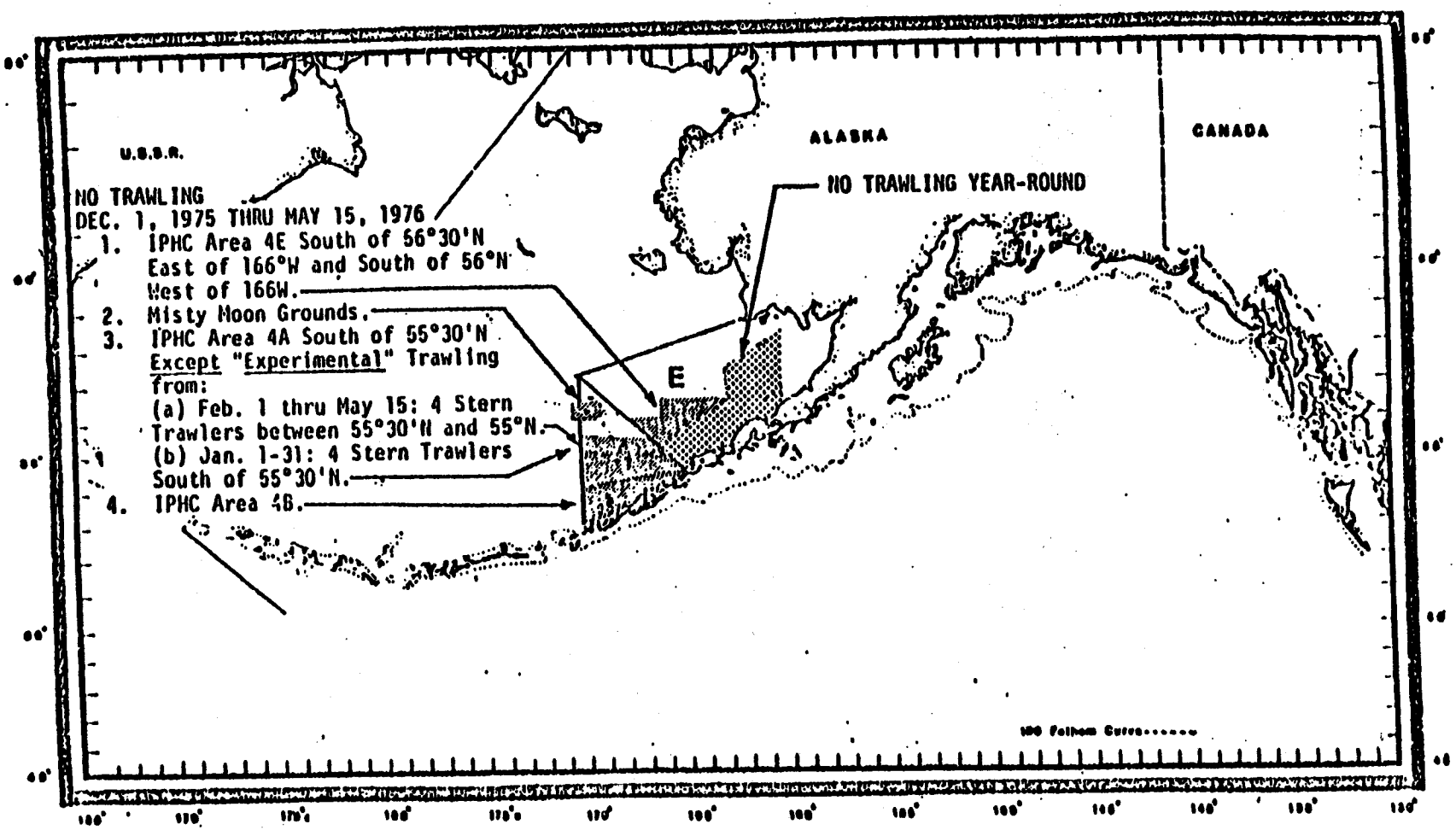

Figure18a--Area-time closures and restrictions for Japanese trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

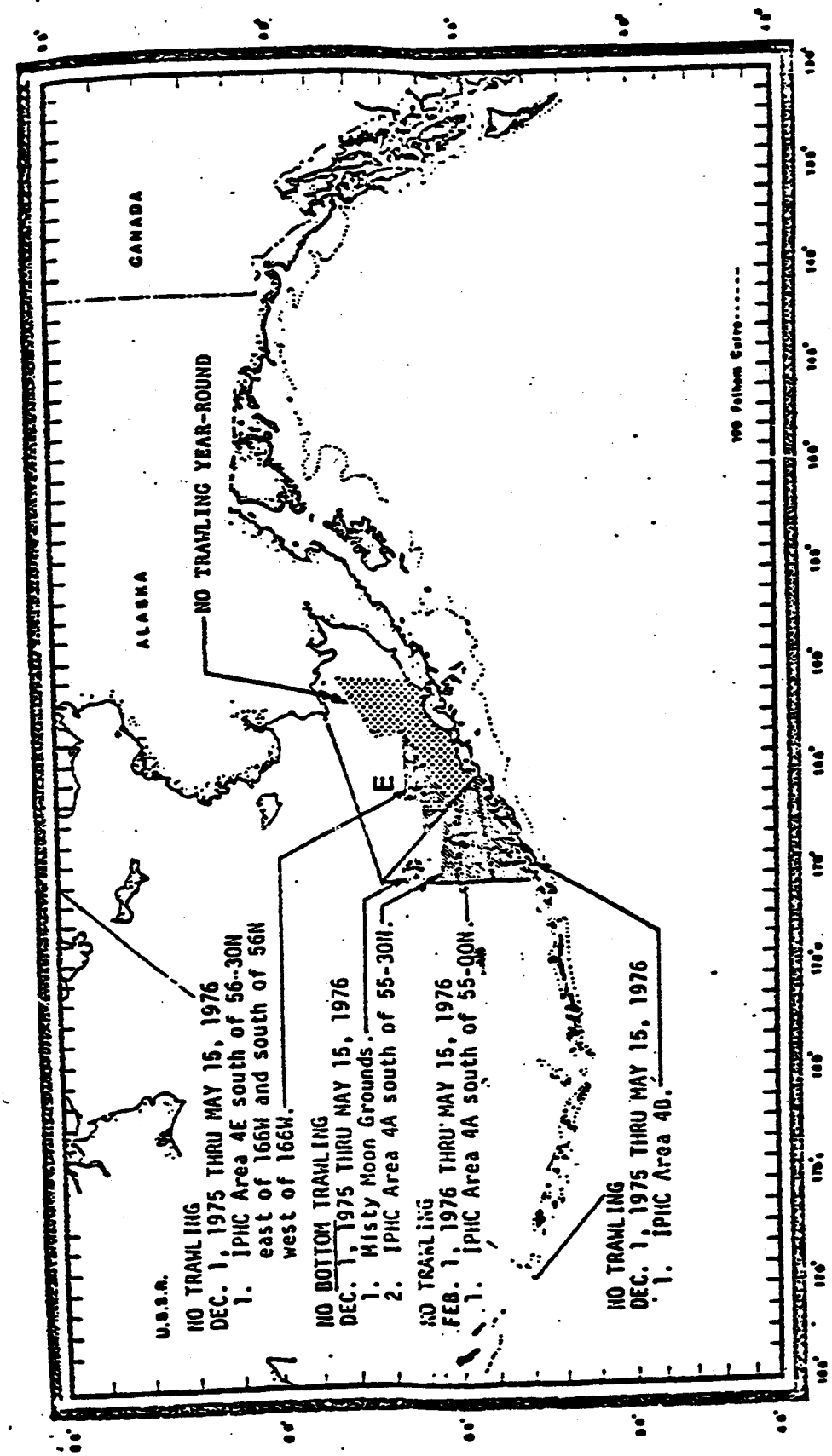

Figure 18b--Area-time closures and restrictions for Soviet trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

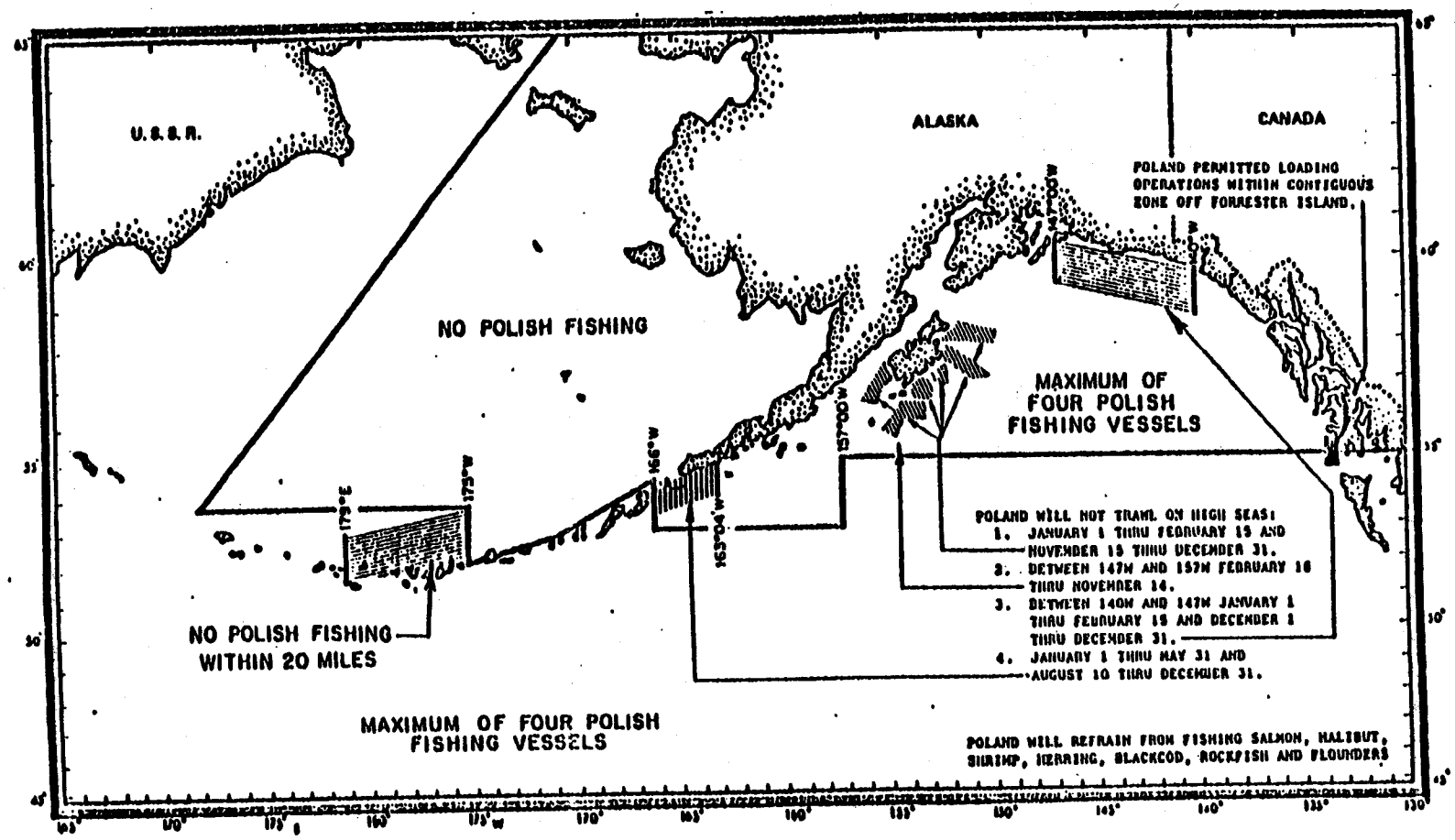

Figure 19.--Area-time closures and restrictions for fisheries of the Polish People's Republic in the Gulf of Alaska and Bering Sea, effective through December 31, 1976.

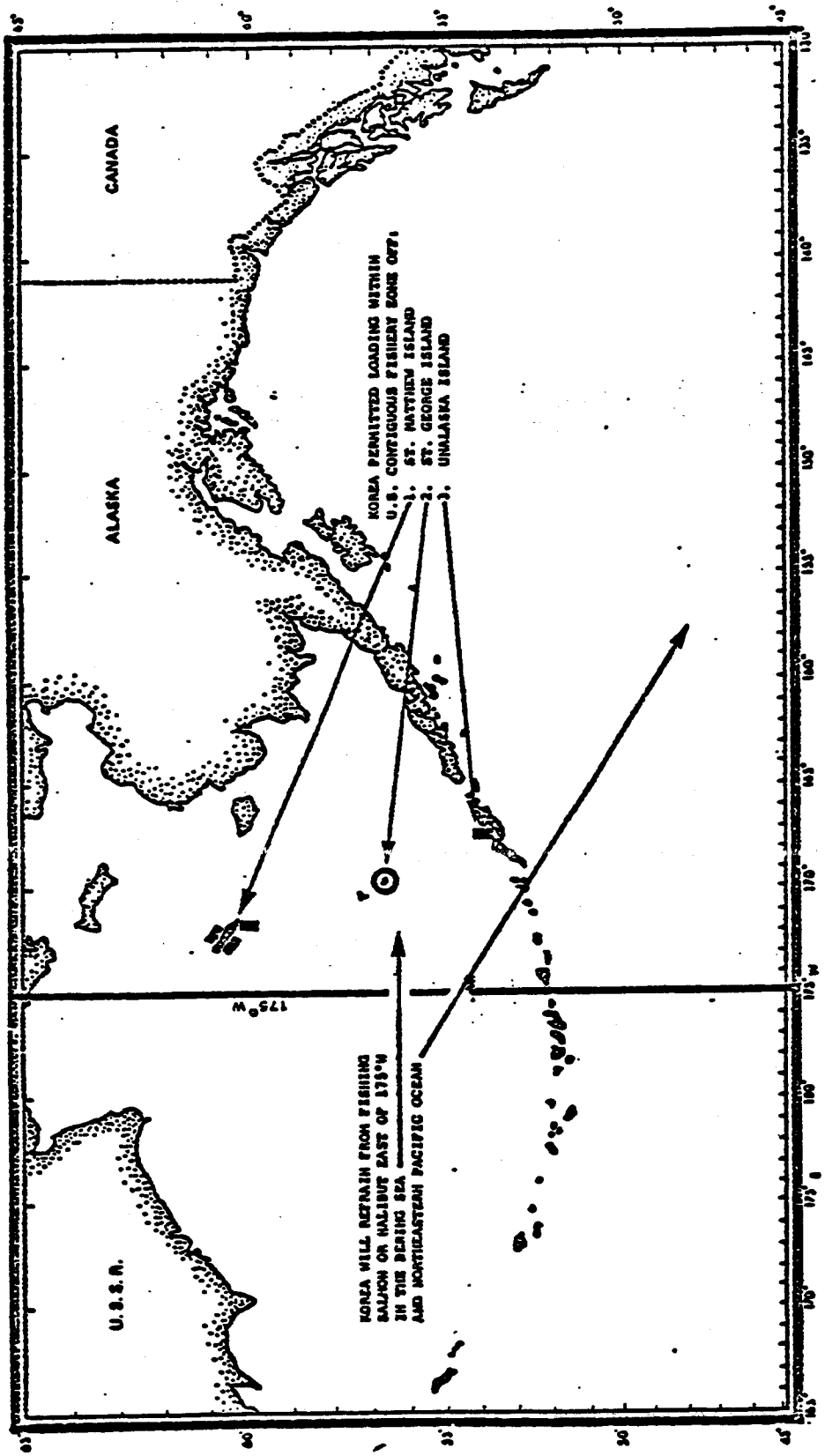

Figure 20.--Provisions of the United States-Republic of Korea Fisheries Agreement effective through December 12, 1977.

Table 16. 1977 Groundfish and squid catch limitations (1000 mt) for foreign fisheries in the eastern Bering Sea and Aleutian Islands region.

Species	Area	Nation Japan	USSR	ROK	Total Taiwan	Unas-assigned	Foreign signed[1/]	Total allocation
Pollock	Bering Sea/ Aleutians	792.3	112.7	40.0	5.0	950.0	0	950.0
Sablefish	Bering Sea	3.6[2/]	0.6[3/]	0.4[2/]	0.2[3/]	4.8	0.2	5.0
	Aleutians	2.0[2/]	0.2[3/]	0.2[2/]	0	2.4	0	2.4
Pacific cod	Bering Sea/ Aleutians	38.1	17.2	0	0	55.3	2.7	58.0
Yellowfin sole	Bering Sea/ Aleutians	62.1	40.8	0	0	102.9	3.1	106.0
Other flounders	Bering Sea/ Aleutians	61.5	40.4	0	0	101.9	3.1	105.0
Pacific ocean perch	Bering Sea	2.8	3.5	0	0	6.3	0.2	6.5
	Aleutians	6.5	8.1	0	0	14.6	0.4	15.0
Other groundfish	Bering Sea	40.4	17.4	1.6	0.2	59.6	0	59.6
	Aleutians	23.1	9.9	0.89	0.11	34.0	0	34.0
Squid	Bering Sea/ Aleutians	10.0	0	0	0	10.0	0	10.0

1/ Portion of total foreign allocation unassigned for possible use by a domestic fishery.

2/ Includes incidental trawl catch.

3/ Incidental catch only.

With the decline in abundance of halibut in the eastern Bering Sea in the mid-1960's, negotiations were directed toward reducing or preventing foreign fisheries from targeting on halibut. When it became apparent that these measures were not creating the desired improvement in the condition of the halibut stock, other measures involving time-area closures were negotiated to reduce the incidental catch of halibut by foreign trawl fleets. The retention of trawl-caught halibut was also prohibited.

As evidence became available of deterioration in the condition of other bottomfish stocks in the eastern Bering Sea and Aleutian Islands, negotiations were initiated to limit or reduce foreign catches of these species in an attempt to arrest these declines and restore the resources to higher productivity. Catch quotas for Japanese and Soviet fisheries were first implemented in 1973 and were carried forward, with some modifications, until 1977 when foreign fisheries came under jurisdiction of the U.S. Fishery Conservation and Management Act.

5.3 Effectiveness of Management Measures (foreign and domestic)

Closures to foreign trawling of crab and halibut fishing areas have undoubtedly reduced conflicts between the foreign trawlers and U.S. fixed gear. Gear losses have continued, but recent losses have occurred outside areas closed to foreign trawling.

Restrictions on the North American setline fishery have reduced fishing mortality on stocks of adult halibut, but the primary problem appears to be a reduction in the number of young halibut entering the fishery. Recent time-area closures have reduced the incidental catch by foreign trawlers and the abundance of young has increased since 1972 (Table 17). Although the increase is encouraging, it will not improve conditions in the setline fishery for several years, and abundance is still well below that in the 1960s. The present poor condition of the resource probably is a result of several factors: excessive setline removals in the early 1960s, high incidental catches of juvenile halibut by foreign trawlers in the 1960s and early 1970s, and reduced productivity from adverse environmental conditions (Hoag, 1976). Because halibut are a long-lived species, rehabilitation of the resource will be a lengthy process regardless of present management measures.

Regulations in the form of catch quotas implemented in 1973 and later years to mitigate the deterioration in condition of other groundfish species in the eastern Bering Sea and Aleutians have perhaps begun to show some benefit for certain species while not for others. Other factors such as year-class strength, time-area closures designed to protect halibut but also beneficial to other species, and the reduction of effort on some species, may have also influenced the current status of some stocks.

Catch limitations have reduced the catch of pollock from over 1.8 million mt in 1972 to 950,000 mt in 1977. Based on analysis of catch and effort data from the commercial fishery the abundance of pollock declined through 1975 (Low et al. 1977). Preliminary evidence that abundance in 1976 was similar to that in 1975 (INPFC 1977) offers some indication of an arrest in the decline of pollock abundance in the eastern Bering Sea. Lower fishing mortality, stemming from the catch limitations, have probably helped to lessen the decline in the pollock stock and may be contributing to a halt in this decline.

For species such as Pacific ocean perch and sablefish there has been, as yet, no evidence that catch restrictions have improved the poor condition of these stocks. In the case of long-lived and slow growing species like Pacific ocean perch and sablefish several years will be required before evidence is available to judge the effectiveness of current management policies.

Table 17. Relative abundance of juvenile halibut by age group from the Bering Sea Index Stations, 1966-1977 (from IPHC 1977b).

Year	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Total
			Numbers per hour trawled				
1966	0.2	17.2	4.9	7.6	0.9	0.2	31.0
1967	0.6	4.3	4.6	6.0	0.5	0.6	16.6
1968	0.3	6.4	1.8	3.1	0.5	0.4	12.5
1969	2.7	4.1	4.7	0.4	0.7	0.2	12.8
1970	0.4	8.8	2.0	0.7	0.2	-	12.1
1971	3.7	2.6	7.6	0.3	-	-	14.2
1972	0.1	2.0	0.5	0.4	0.1	-	3.1
1973	0.1	3.7	1.9	0.7	0.2	-	6.6
1974	0.1	1.2	3.7	0.8	0.3	-	6.1
1975	0.5	3.2	5.3	2.0	0.7	0.1	11.8
1976	0.3	6.5	4.5	1.2	0.3	0.1	12.9
1977	0.4	5.4	9.5	2.1	1.4	0.1	18.9

There is evidence that the condition of stocks of yellowfin sole, rock sole, flathead sole and Alaska plaice have improved or remained relatively stable in recent years (Wakabayashi and Bakkala 1977; Bakkala and Wakabayashi 1977). Their condition has benefitted from a series of relatively strong year-classes originating in the late 1660s. Winter time-area closures in the southeastern Bering Sea, designed for the protection of halibut, also benefit these species because they form winter concentrations in this area as well. The absence of a directed Soviet fishery on these species of flounders since 1972 may have additionally benefitted the stocks. Thus, factors other than management measures directly applicable to the four small flounder species may be responsible for their current status. Catch limitations, however, are designed to maintain and improve their productivity.

For other principal species considered in the plan (Pacific cod, Atka mackerel, arrowtooth flounder, Greenland turbot, and squid) information is lacking to adequately assess the current condition of the stocks relative to the recent past. There is no evidence to suggest that the stocks are depressed and catch limitations are designed to maintain the population at current levels.

6.0 HISTORY OF RESEARCH

Investigations of groundfish resources of the eastern Bering Sea have been conducted by the United States, Canada, Japan, and USSR. U.S. research efforts have been of the longest duration (1880 to present) and were initiated to assist the development of U.S. cod and halibut fisheries. As these and other fishery resources of the eastern Bering Sea became increasingly utilized, and in some cases overfished in the decades of the 1960s and 1970s, investigations became more directed towards providing guidelines for resource management and conservation.

6.1 United States[1]

The first major study of the demersal fishery resources of any consequence occurred in 1890 when the U.S. Fish Commission's steamer Albatross was directed into the southeastern Bering Sea to determine the locations and characteristics of important cod-fishing grounds (Rathbun 1894). Later, in 1911, the Albatross also investigated halibut banks just north of Unimak Island (Alexander 1913). In 1930 the International Pacific Halibut Commission (IPHC) conducted exploratory setline fishing along the Aleutian Islands and tagging of halibut in Makushin Bay on the north side of Unalaska Island (Dunlop et al. 1964).

The first extensive and systematic survey of demersal fishery resources of the eastern Bering Sea was conducted in 1941 by the U.S. Fish and Wildlife Service (Fishery Market News 1942). Bottom trawling was conducted in the southeastern Bering Sea north to St. Lawrence Island, and in Norton Sound. Although the primary purpose of the survey was to locate areas of king crab abundance, information was also collected on the quantities and types of demersal fish encountered.

Continued interest in the commercial potential of crab and groundfish of the eastern Bering Sea resulted in further investigations after World War II. There were cooperative U.S. government-industry ventures in the northeastern Bering Sea in 1947 (King 1949) and in 1948 (Wigutoff and Carlson 1950). The IPHC resumed exploratory setline fishing and tagging of halibut in the eastern Bering Sea in the 1950s (Dunlop et al. 1964).

With the development and intensification of fisheries in the eastern Bering Sea in the 1950s and 1960s, U.S. and IPHC research surveys began to be conducted in a more systematic and standardized manner. These investigations initially sought improved information on changes in abundance and recruitment of king crab and halibut, but other species were also later included. The U.S. Bureau of Commercial Fisheries (now the National Marine Fisheries Service) began systematic annual bottom trawl surveys in the southeastern Bering Sea in 1955 to obtain information on the distribution, abundance, biology, and recruitment of king crab. These surveys were interrupted for the period 1962-1965, but were continued in 1966. In 1968, Tanner crab was included in these surveys and received special study, and in 1971 biological studies of important groundfish species were also added. These annual crab-groundfish surveys are a continuing activity by the NMFS. In the late summer of 1975 and spring of 1976, NMFS conducted multivessel groundfish and shellfish surveys in the eastern Bering Sea to provide baseline environmental information to the Bureau of Land Management's Outer Continental Shelf Environmental Assessment Program.

Beginning in 1963 and annually since 1965, the IPHC has been systematically monitoring by means of bottom trawl surveys the distribution and abundance of young halibut in the eastern Bering Sea (Best 1969a and b; 1970; 1974).

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[1] Includes Canadian research done in cooperation with the U.S., within the framework of the International Pacific Halibut Commission.

In recent years, U.S. observers have been placed aboard foreign fishing and processing vessels to examine catches of target species (primarily pollock), and incidentally-caught halibut.

6.2 Foreign

Japanese research investigations in the eastern Bering Sea began in the mid-1950s, although there had been some experimental trawl fishing on bottomfish by Japanese commercial interests in this region in the early 1930s (Kibesake 1965). In 1956 the Oshoro Maru engaged in limited exploratory trawl fishing in the eastern Bering Sea. The Oshoro Maru has continued investigations from the 1950s to present time (Hokkaido University 1957, 1960, 1964-66). Other limited trawling investigations were conducted in 1961 through 1964 (Shimonoseki University of Fisheries 1966; Tsuruta et al. 1962).

Extensive and systematic surveys of eastern Bering Sea groundfish by the Japanese were begun in 1963 by the Japan Fishery Agency (JFA), and have continued annually with the exception of 1972 (Japan Fishery Agency 1975 b). These surveys have covered broad areas of the continental shelf, and in some years the shelf edge and upper continental slope. Included in the Japanese investigations have been tagging studies on halibut, sablefish, pollock, and yellowfin sole.

The Japanese have been collecting catch and effort statistics and biological information from their groundfish fisheries since 1964, and providing these data to the U.S. through the International North Pacific Fisheries Commission.

Although the Soviet Union conducted limited exploratory surveys in the eastern Bering Sea in the early 1930s and early 1950s (Moiseev 1963), their first extensive investigations of demersal fish and shellfish resources in the eastern Bering Sea were during 1957-63. The main purpose of these surveys was the determination of the extent and potential uses of resources prior to commercial exploitation by the Soviet fleet. Information was also gathered on the biology of important species populations and environmental features associated with their distributions (Moiseev 1963-64; 1970).

Since 1963, the Soviet Union has continued its research on eastern Bering Sea fishery resources, which have included pollock and other demersal fishes.

7.0 SOCIOECONOMIC CHARACTERISTICS OF THE DOMESTIC FISHERY

7.1 Commercial Fishery

7.1.1 Commercial Fishing Fleet

In 1977 less than 100,000 pounds of groundfish was landed and sold for human consumption. The number of vessels operating in the fishery has been so small that specific information cannot be disclosed without violating the confidentiality of individual reports. There is a slightly larger groundfish fishery for bait for use by crab boats operating in the area, although fish tickets are not made out systematically when the groundfish are caught or sold. Alaska Department of Fish and Game biologists, extrapolating from a similar bait fishery operating in the Gulf of Alaska, and considering the size of the crab fishery and number of boats known to be catching groundfish for bait in the Bering Sea area, have estimated the harvest for this purpose at about 450 mt in 1977, and as high as 1,300 mt in 1978.

In all, the total domestic commercial groundfish catch in the Bering Sea/ Aleutians region (excluding halibut) is believed to have been no more than 1,500 mt in any recent year.

7.1.2 Domestic Commercial Processing Industry

Although substantial freezing and transshipping facilities are located at Dutch Harbor, with the exception of very small amounts of groundfish frozen for crab bait no groundfish processing (except halibut) has occurred in this region in recent years.

7.1.3 Products and Markets

The viability of a domestic Bering Sea groundfish fishery will ultimately depend on the ability of U.S. industry to market products at prices which cover their production costs. An understanding of these market conditions will be important for the accurate determination of DAH. Although the U.S. and world groundfish markets are not fully understood, it appears that there are not at present significant opportunities to market Bering Sea groundfish at prices which will cover U.S. costs of production. For at least the near term, the domestic groundfish fishery in the Bering Sea will be limited to local markets for bait and to demonstration projects. The market for fishery products is in a state of change, however, and it is entirely possible that new markets could open up in the near future. One possible change might come from management actions taken to deliberately influence market conditions.

It is at least theoretically possible that the determination of OY could influence markets and prices. For any commodity a reduction in supply from one source, such as foreign groundfish landings, may improve market opportunities for other suppliers, such as U.S. fishermen. At present there is no information on whether this relationship is significant for Bering Sea stocks, or whether it might be sufficient to overcome costs of U.S. operations.

Table 18 illustrates the importance of the Northeast Pacific (FAO area 67, including the Pacific Coast above California) in production of pollock, flounders, and cod. In 1975 the Northeast Pacific produced 20% of the world's pollock, 16% of the world's flounders, and 3% of the world's cod. For these groundfish species the likelihood of influencing world price through manipulation of OY is low due to the relatively small share of world production coming from the northeastern Pacific. For example, if the pollock OY for the eastern Bering Sea was to be set 30% below ABC in an attempt o increase the world price for that species, world pollock supply would be reduced by something less than 6% (30% x 20% = 6%). However, for particular markets (e.g., the Japanese market for "surimi", it might be possible for reductions in foreign allocations to have an influence on either price offered for U.S. products or the willingness of customers to consider buying such specific products from U.S. processors.

If it were found that such a relationship did exist, its exploitation would present an additional set of tradeoffs between the management objectives of domestic industry development, consumer interest and price, full utilization of the resource and U.S. foreign policy interests. No such relationship has yet been identified; therefore, no adjustments to OY for this purpose have been made.

Published information on U.S. groundfish utilization and prices is reported in Table 18a. Apparent consumption for any period is a derived figure: the sum of beginning stocks, domestic productions and imports, less ending stocks and exports.

In 1977 U.S. apparent groundfish consumption was 803.4 million pounds, 364 million pounds of fresh and frozen fillets and 438.9 million pounds of sticks and portions. Eighty percent of fillets and essentially all the frozen blocks used in sticks and portions were imported.

1977 retail prices for groundfish fillets ranged from $3.32 per pound for fresh flat fillets to $1.68 per pound for frozen ocean perch fillets. An average price for all sticks and portions was $1.77 per pound. Historically, groundfish prices have risen at a greater rate than general inflation, while prices of substitutes such as beef, pork and poultry have not kept pace.

The distribution of groundfish consumption by region and market type is not available from published sources. However, approximations were obtained by consultation with industry. Over half the stick and portion production is sold to institutions, the remainder is sold to households. Within the institutional category, most fish sticks are sold to such public institutions as schools, hospitals, and military installations, whereas restaurants are the major institutional buyers of fish portions.

Institutions buy an even greater proportion of frozen fish fillets. Within the institutional category, most fillets are sold to restaurants.

On a geographic basis, frozen groundfish consumption is higher in the midwest and south where alternate fish products are not as readily available.

Table 18. 1975 World and Northeast Pacific production of selected groundifsh (metric tons).

	Total	Northeast Pacific (FAO Area 67)	Percentage Produced in Northeast Pacific
Pollock and Saithe	5709117	1117858	20
Flounders	1146276	179145	16
Atlantic and Pacific Cod	2589086	70815	3

Table 18a. U.S. Groundfish Utilization and Prices.

Product and Species	Beginning Stocks	Domestic Production	Imports	Total	Ending Stocks	Apparent Consumption
	Supplies and Utilization (millions pounds product weight)					
Fresh and frozen fillets	53.2	70.7	303.9	427.8	63.3	264.5
Cod	16.2	25.4	122.2	163.8	27.2	136.6
Flatfish (flounder and turbot)	17.6	24.2	95.6	137.4	18.9	118.5
Haddock	5.1	10.5	40.9	56.5	7.7	48.8
Ocean Perch	14.3	10.6	45.2	70.1	9.5	438.9
Sticks and Portions	31.1	(437.8)*	.6	469.4	30.5	438.9
Sticks, Cooked						
Cod						
Haddock						
Pollock						
Whiting						
Portions, raw breaded						
Cod						
Haddock						
Pollock						
Whiting						
Blocks	61.1	4.6	385.1	450.8	73.2	(377.6)*
Cod						
Cod minced						
Flounder						
Haddock						
Pollock						
Pollock, Alaska						
Whiting						
Wolffish						
Total	145.4	75.3	689.6		167.0	803.4**

Table X 1977 U.S. Groundfish Supplies, Utilization and Prices
Source: National Marine Fisheries Service NOAA, Foodfish Market Review and Outlook, December 1977
*Excludes production of sticks and portions from imported blocks.
**Excludes blocks but includes sticks and portions.

Table 18a. continued

	Prices (cents per pound 1977 dollar)				
		Whole Sale		Retail	
Fresh and frozen fillets	Ex-vessel	Fresh	Frozens	Fresh	Frozen
Cod	25.5	162.3	91.1	253.1	169.7
Flatfish (flounder and turbot)	47.6		116.7	331.5	235.5
Haddock	33.6	161.6	104.9	253.7	185.3
Ocean Perch	15.3		93.1		168.0
Sticks and Portions					177.0
Sticks, Cooked					
Cod			109.1		
Haddock			111.3		
Pollock			74.9		
Whiting			72.3		
Portions, raw breaded					
Cod			109.7		
Haddock			111.7		
Pollock			73.7		
Whiting			70.3		
Blocks					
Cod			97.8		
Cod minced			36.1		
Flounder			95.6		
Haddock			101.4		
Pollock			60.4		
Pollock, Alaska			60.7		
Whiting			54.4		
Wolffish			87.9		

7.2 Recreational Fishery

Historically, there was no recreational fishing in the Bering Sea/Aleutians area; presently, the effort is small, if indeed it exists, and is conducted in inshore waters.

7.3 Subsistence Fishery

Subsistence fishing activities of Native Alaskans in the Bering Sea/Aleutians area pre-date history. To what extent the subsistence effort was conducted in offshore waters can be based only on scant historical reference and oral tradition. The vast majority of these efforts were concentrated on salmon, anadromous char and river herring, taken for the most part by various methods in inshore waters.

Additional efforts were conducted offshore on halibut and cod. One example of the cod fishery is that of the village of Mekoryuk, on Nunivak Island, where fishing activity offshore was conducted until the late 1940s, when, for reasons unknown, the cod failed to appear in their accustomed waters. As a consequence, that fishery does not exist at the present time. The bulk of the subsistence effort offshore was directed against otter, seal, sea lion, walrus, polar bear and birds and eggs inhabiting islands and rocks.

7.4 Indian Treaty Fishery

No Indian (Native Aleut-Indian-Eskimo) treaty fishing rights are reserved in the Fishery Conservation Zone.

7.5 Area Community Characteristics

Profiles for over 100 Alaskan coastal communities, several of which are located in or near the Bering Sea/Aleutians region, are available at the North Pacific Fishery Management Council office.

A sample community profile is shown in Appendix I.

7.6 Interaction Between User Groups

7.6.1 Trawl vs. Halibut

The halibut fishery in the Bering Sea and Aleutians is affected by domestic fisheries for crab and shrimp and by foreign fisheries for groundfish. The kind of impacts include destruction of gear, preemption of fishing grounds, and a reduction in abundance that results from the incidental capture of halibut. The North American setline catch peaked in 1963 at 4,900 mt but has been below 500 mt since 1972.

The effects of current domestic operations on both the halibut fishery and resource are less than those of foreign fisheries. Gear conflicts are minimal, and the annual incidental catch of halibut by domestic trawlers is probably less than 100 mt (however, domestic king crab and shrimp fisheries may take incidentally up to 1,000 mt of halibut). A greater impact on the halibut fishery could occur if domestic effort toward groundfish increases.

Regarding foreign fisheries, halibut fishermen occasionally report instances of gear destruction or preemption of grounds. The most important effect of foreign fishing is that of incidental catches. Foreign vessels target on species other than halibut but halibut are taken incidentally in substantial numbers; although regulations require that halibut be released, most die from injuries received during capture.

Hoag and French (1976) used data collected by observers on Japanese trawlers to examine the incidental catch of halibut. The average incidence and size during 1969-1974 is shown by area and month in Table 19. The incidence was highest in the southeastern Bering Sea in the winter and spring. The majority of the halibut were 3 to 7 years old and less than 5 kg. More recent data from observers (Hoag and French, ms.) show a similar seasonal picture, although the rate of incidence is lower because critical areas have been closed to trawling. In February and March 1978, observers were, for the first time, aboard two Japanese longline vessels fishing the southeastern Bering Sea. Their data show that when the longliners fished in shallow water (220-320 m) for Pacific cod the incidence of halibut became extremely high (30 halibut per mt of catch; about 14% by weight). The incidence was much lower (1.5 halibut per mt) when the vessels fished in deeper water (500-620 meters) and the target species were Greenland turbot and sablefish. The average weight of halibut was about 5 kg and the observers reported that most of the halibut were released alive.

Hoag and French (1976) estimated the annual incidental catch of halibut by the Japanese and Soviet trawl fisheries from 1954 to 1974. Their estimates show that the total incidental catch in the Bering Sea peaked in 1971 at 11,500 mt but then dropped to about 5,800 mt in 1974. However, about one-third to one-half of this catch occurs in the western Bering Sea and may have only limited effect on the North American fishery. Since 1974, foreign trawling has been prohibited in specific areas of the southeastern Bering Sea during the winter and spring to reduce the incidental catch of halibut. These closures along with a reduction in fishing effort have sharply reduced the incidental catch. Preliminary projections indicate that the incidental trawl catch in the eastern Bering Sea has declined from about 7,000 mt in 1971 to less than 2,000 mt in 1976.

The incidental catch of halibut in the Aleutians is much less than in the Bering Sea, probably around 500 mt.

Hoag (1976) used estimates of the incidental halibut catch and assessed the effect of trawling on the North American setline fishery. The results showed that trawling reduced the survival of juvenile halibut and, therefore, recruitment to the setline fishery. Because the incidental catch consists of juvenile halibut, the yield loss to the setline fishery occurs for many years after a given incidental catch, i.e. over the projected lifetime of the fish in the setline fishery. Also, the magnitude of the eventual loss is about 20 percent greater than the magnitude of the incidental trawl catch itself because growth exceeds natural mortality at young age. In the eastern Bering Sea, the estimated annual yield loss in recent years has been about 5,000 mt and represents over 95% of the total potential catch (i.e. of the total potential production, setlines take less than 5 percent). The recent reductions in the incidental catch will not significantly benefit the setline fishery for several years.

In 1977, the average incidence rate for halibut in all foreign trawl fisheries is estimated to have been 0.267 individuals per metric ton of total groundfish catch; average weight of incidentally caught halibut was 8.99 kg.

7.6.2 Trawl vs. Crabs

U.S. observers aboard foreign trawlers sample the catch prior to sorting by species and count the number of crabs in each sample per unit weight of the entire sample. This provides an incidence rate, expressed as number of crabs per metric ton of total catch. Average incidence rates for particular statistical areas and quarters are then multiplied by the corresponding total catch of each country, and summed over quarters to arrive at an estimate of total incidental crab catch, by nation, for the year.

Table 19. The average incidence and weight of halibut in Japanese trawls in the Bering Sea, by month and area, 1969-1971.

Month	A	B	C	De	Dw	E
			Incidence (number per metric ton)			
January	--	--	0.054	--	0.070	25.437
February	0.163	--	2.787	--	0.196	2.629
March	5.779	4.930	0.476	--	0.720	8.073
April	2.935	1.341	1.465	--	0.012	2.516
May	7.145	6.976	1.022	--	0.131	3.062
June	--	0.000	1.155	--	1.114	1.987
July	--	--	0.040	0.013	0.066	0.000
August	0.021	--	0.157	0.013	0.103	--
September	0.008	0.000	0.187	--	0.007	--
October	0.018	0.000	0.023	--	-.037	0.022
November	0.064	--	--	--	0.049	1.266
December	0.014	--	0.249	--	0.074	27.643
			Average size (kg)			
January	--	--	3.20	--	2.28	0.39
February	0.69	--	1.14	--	5.90	1.07
March	0.93	0.81	1.46	--	2.66	0.48
April	0.93	0.80	1.00	--	0.68	1.33
May	0.64	0.41	1.22	--	1.59	1.13
June	--	--	2.76	--	6.11	1.94
July	--	--	3.01	3.50	7.45	--
August	17.73	--	7.42	3.50	2.03	--
September	7.30	--	3.68	--	4.44	--
October	3.55	--	8.70	--	4.70	2.38
November	1.33	--	--	--	5.15	2.17
December	0.66	--	5.37	--	2.57	0.85

Before 1977, U.S. observers were only aboard Japanese independent stern trawlers (large trawlers) and groundfish motherships. No valid technique was available for extrapolating incidence rates observed in those two fleets over the Japanese landbased dragnet (small trawlers), Soviet, or Korean trawl fleets. In 1977, however, all fleets were observed and estimated incidental catches of crabs are as follows (number of crabs):

Country	King Crab	Tanner Crab
Japan	583,400	17,446,000
USSR	1,200	3,500
ROK	11,200	54,000
Total	595,800	17,503,500

Between 65 and 70 percent of the incidental Tanner crab catch was C. opilio. Incidence rates for both king and Tanner crabs were highest in the Japanese landbased dragnet fleet.

To provide some insight into recent trends, estimates of incidental crab catches by the Japanese mothership and independent stern trawl fleets during 1973-77 are (number of crabs):

Year	King Crab	Tanner Crab
1973	465,600	112,000,000
1974	489,900	155,000,000
1975	155,900	60,000,000
1976	?	26,000,000
1977	297,300	9,600,000

In 1977, the average incidence rate for king crabs in all foreign trawl fisheries is estimated to have been 0.481 individuals per metric ton of total groundfish catch; average weight of incidentally caught king crabs was 1.15 kg. Comparable values for Tanner crabs are estimated to have been 12.970 individuals/mt and 0.33 kg average weight.

7.6.3 Trawl vs. Salmon

Using the same sampling methods as for halibut and crabs, data collected by U.S. observers produced the following estimates of incidental salmon catches in 1977:

Country	Total Number of Salmon
Japan	23,890
ROK	23,798
USSR	42
Total	47,730

Of this total, 91% were chinook salmon (O. tshawytscha) and 9% chum salmon (O. keta).

In 1977, the average incidence rate for salmon in all foreign trawl fisheries is estimated to have been 0.030 individuals per metric ton of total groundfish catch; average weight of incidentally caught salmon was 4.0 kg.

7.6.4 Trawl vs. Sablefish Longlines and Pots

Japanese longline fishermen report that the trawl fishery has expanded geographically and bathymetrically to the point where traditional sablefish longline grounds have been pre-empted. If the condition of sablefish stocks in this region improve to the point where they could support a viable domestic fishery (see Section 9.6), the stated interest of U.S. fishermen for developing a longline and pot fishery for that species could be thwarted by the risk of gear conflicts with trawlers unless gear separation measures are affected.

7.6.5 Foreign vs. Domestic Trawling

With the exception of a very small crab bait fishery, no domestic trawling has taken place in the region. Many U.S. fishing interests perceive the presence of fleets of large foreign trawlers as a de facto impediment to the development of a domestic groundfish trawl fishery in the Bering Sea because of the possibility of: (l) preemption of favored grounds by concentrations of foreign vessels that are 2-3 times the size of the largest U.S. trawlers, and (2) competition for fish by foreign vessels that can apparently operate successfully at levels of abundance and average fish sizes that are less than that required for economic operation of domestic trawlers. (See also Section 10.4).

7.7 Revenues Derived from Fishery

Federal revenues are based on charges placed on foreign fisheries, while state (Alaska) revenues are based on fees and taxes placed on the domestic fishery.

7.7.1 Federal Revenues

A summary of U.S. revenues expected in 1978 from charges placed on foreign nations fishing for groundfish within the FCMA zone in the Bering Sea/Aleutians area is presented below:

Expected Revenue from Foreign Nations, Bering Sea/Aleutians, Groundfish, 1978

Type of Revenue	Total Dollars	Source of Dollars			
		Japan	U.S.S.R.	R.O.K.	Taiwan
Income - vessel fee	566,700	226,000	269.500	65,800	4,800
Income - poundage fee	7,230,600	4,995,400	2,012,900	202,400	19,900
Reimburseable income (U.S. observer cost)	294,100	224,900	54,500	14,700	--
Fines and penalties	--	--	--	--	--
TOTAL	8,090,800	5,446,300	2,336,900	282,900	24,700

Revenues from vessel and poundage fees total $7,796,700 for 1978. Reimbursable income (to cover the cost of placing U.S. observers aboard foreign fishing vessels in the Bering Sea/Aleutians area) is tentatively estimated at $294,100. Fines and penalties are tied to violations and are, therefore, variable income items. The expected total federal revenue for 1978 is around $8,090,800.

7.7.2 State Revenues

Aside from the halibut fishery, virtually no domestic groundfish fishery has existed in the Bering Sea/Aleutians area in recent times. The approximate state revenues derived from the fishery in 1977 are presented below:

Type of Revenue	State-wide Total, 1977[1/]	Bering Sea/Aleutians Groundfish Fishery Halibut	Other
	(DOLLARS)		
Raw fish tax	3,830,280	5,000	*
Cold storage tax (including freezer ship)	2,372,785	5,000	*
Vessel and gear license	654,220	200	*
Commercial fish licenses	430,836	50	*
TOTAL	7,288,121	10,250	*

* negligible to none

1/ Source: Alaska State Department of Revenue

8.0 BIOLOGICAL AND ENVIRONMENTAL CHARACTERISTICS OF THE FISHERY

8.1 Habitat Requirements by Life History Stage

This section summarizes habitat requirements and life histories of the groundfish species managed by this FMP. The adjacent table lists the abbreviations used in the habitat tables for each species.

Abbreviations used in the EFH report tables to specify location, depth, 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, give depth if appropriate (e.g., fjords)
IP = island passes (areas of high current), give 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)

Bottom Type
M = mud S = sand R = rock
SM = sandy mud CB = cobble C = coral
MS = muddy sand G = gravel K = kelp
SAV = subaquatic vegetation (e.g., eelgrass, not kelp)

Oceanographic Features
UP = upwelling G = gyres F = fronts
CL = thermo- or pycnocline E = edges

General
U = Unknown NA = not applicable

8.1.1 Walleye pollock

Management Plan and Area Eastern Bering Sea-Aleutian Islands (BSAI) and Gulf of Alaska (GOA)

The Gulf of Alaska are managed under the Gulf of Alaska Groundfish Fisheries Management Plan and the Eastern Bering Sea and Aleutian Islands pollock stocks are managed under the Eastern Bering Sea and Aleutian Islands 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.

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 may be pelagic and not available to bottom trawls, and secondly 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 pelagically 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 pelagically 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.

Age	Mean length (cm)			Mean weight (kg)	Maturity
	Southeast Shelf	Northwest Shelf	eastern Bering Sea	eastern Bering Sea	
2	29.8	25.9	28.2	0.170	1%
3	36.1	31.9	34.5	0.303	29%
4	41.1	36.7	39.5	0.447	64%
5	45.1	40.6	43.4	0.589	84%
6	48.2	43.7	46.6	0.722	90%
7	50.7	46.2	49.1	0.840	95%
8	52.6	48.3	51.1	0.942	96%
9	54.2	49.9	52.7	1.029	97%
10	55.4	51.2	54.0	1.102	97%
11	56.4	52.3	55.0	1.163	100%
12	57.1	53.1	55.8	1.212	100%
13	57.7	53.8	56.5	1.253	100%
14	58.2	54.4	57.0	1.286	100%
15	58.6	54.8	57.4	1.312	100%

Age	Gulf of Alaska		
	Mean length	Mean Weight	Maturity
2	27.7	0.186	3%
3	35.6	0.380	12%
4	41.2	0.579	33%
5	45.3	0.760	64%
6	48.3	0.911	87%
7	50.4	1.033	96%
8	52.0	1.129	99%
9	53.1	1.204	100%
10	54.0	1.261	100%
11	54.6	1.305	100%
12	55.1	1.338	100%
13	55.4	1.253	100%
14	55.7	1.286	100%
15	55.9	1.312	100%

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 1990, the Gulf of Alaska pollock Total Allowable Catch (TAC) has been divided into four regions; the Shumagin International North Pacific Fishery Commission (INPFC) area, the Chirikof INPFC area, the Kodiak

INPFC area and the eastern Gulf of Alaska (east of 147° W). From 1990 to 1995 the TAC was divided into four quarterly fishing seasons with openers in January, June, July and October. In 1996, the TAC was divided into three fishing seasons with openers in January, June and September. One hundred percent of the catch is allocated to shoreside processing plants with the majority of the catch being processed on Kodiak Island.

Nearly the entire harvest of pollock is taken with pelagic trawl gear. In 1996 pelagic trawls took 91% of the pollock harvest. The pollock fishery has a very low bycatch rate with discards 10% or less since 1992. 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, but in the bottom trawl pollock fishery the bycatch of other species is higher. Between 1991 and 1994 the bycatch of other species was 18% in the bottom trawl pollock fishery, and 3% in the pelagic trawl pollock fishery. Most of the bycatch was Pacific cod and flatfish species.

The eastern Bering Sea pollock fishery primarily harvests mature pollock. The 50% selectivity corresponds to the age of 50% maturity, age 4. Fishery selectivity increases to a maximum around age 7-8 and then declines. 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.

Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selectivity	5%	27%	50%	70%	90%	100%	88%	89%	77%	79%	79%	77%	87%	87%

The Gulf of Alaska pollock fishery also targets mature pollock. Fishery selectivity increases to a maximum around age 5-7 and then declines. The selectivity pattern varies between years due to shifts in fishing strategy.

Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selectivity	6%	19%	45%	77%	100	97%	67%	38%	21%	21%	21%	21%	21%	21%

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.

Upper size limit of juvenile fish

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.

Sources for additional distribution data

Eggs and Larvae:

Art Kendall, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 206-526-4108.

Richard Brodeur, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 206-526-4318.

Shallow water concentrations:

Bill Bechtol, Alaska Department of Fish and Game, 3298 Douglas Place, Homer, Alaska 99603-8027.

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.

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SPECIES: Bering Sea/Aleutian Islands Walleye Pollock

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	17-20 d. at 4C	None	Feb-Apr	OCS, UCS	P	N/A	G?	
Larvae	60 days	copepod naupli and small euphausiids	Mar-Jul	OCS	P	N/A	G? F	pollock larvae with jellyfish
Juveniles	Age 0.4 to Age 4	Pelagic crustaceans, copepods and euphausiids	Aug. +	OCS, MCS, ICS	P, SD	N/A	CL, F	
Adults	Age 4 - 16	Pelagic crustaceans and fish, primarily juvenile pollock	Spawning Feb-Apr	OCS, BSN	P, SD	UNK	F UP	Increasingly demersal with age. Appears to prefer 2-3°C water for spawning.

8.1.2 Pacific cod

Management Plan and Area(s) Groundfish, BSAI and GOA

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 metaphorphosis 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.

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 3 years for trawl gear and 4 years for other longline and pot gear. In the GOA, the age at 50% recruitment is 4 years for trawl gear and 5 years for longline and pot gear. More than 100 vessels participated 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 essentially year-round. Bycatch of crab and halibut often 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 Shumagins.

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 polychaetes, 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.

What is the approximate upper size limit of juvenile fish (in cm)? The estimated size at 50% maturity is 67 cm.

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)

Larvae/juveniles: NMFS, Alaska Fisheries Science Center, FOCI Program, Ann Matarese 206-526-4111

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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 13-23 ppt
Larvae	U	copepods (?)	winter-spring	U	P (?)	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) non-spawning (Jun-Dec)	ICS, MCS, OCS ICS, MCS, OCS	D	M, SM, MS, S	U	

8.1.3 Yellowfin sole

Management Plan and Area Groundfish, Bering Sea/Aleutian Islands (BSAI)

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. 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.

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.

Relevant Trophic Information

Groundfish predators include Pacific cod, skates and Pacific halibut, mostly on fish ranging from 7 to 25 cm standard length.

Approximate upper size limit of juvenile fish? 27 cm

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, polychaetes, amphipods and echiurids.. Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures, feeding diminishes.

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SPECIES: 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	polychaetes bivalves amphipods echiurids	all year	BAY ICS OCS	D	S[1]		
Late Juveniles	5.5 to 10 yrs	polychaetes bivalves amphipods echiurids	all year	BAY ICS OCS	D	S[1]		
Adults	10+ years	polychaetes bivalves amphipods echiurids	spawning/ feeding May-August non-spawning Nov.-April	BAY BEACH ICS ICS MCS OCS	D	S[1]	ice edge	

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8.1.4 Greenland turbot

Management Plan and Area Groundfish, Bering Sea/Aleutian Islands (BSAI)

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. 1996).

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.

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).

Approximate upper size limit of juvenile fish? 59 cm

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, polychaetes 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.

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SPECIES: 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 polychaets small pollock	all year	ICS MCS OCS USL	D, SD	M/S+M[1]		
Adults	5+ years	pollock small fish	spawning Nov-February non-spawning March- October	OCS USL LSL OCS USL LSL	D, SD	M/S+M[1]		

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8.1.5 Arrowtooth flounder

Management Plan and Area Groundfish, BSAI and GOA

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 inner 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 is 0.2 (Turnock et. al 1996, Wilderbuer and Sample 1996).

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.

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.

Approximate upper size limit of juvenile fish? Males 27 cm and females 37 cm.

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.

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SPECIES: 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 OCS	P			
Larvae	2-3 months?	U phyto/zoo plankton?	Spring summer?	BAY ICS OCS	P			
Early Juveniles	to 2 yrs	euphausiids crustaceans amphipods pollock	all year	ICS OCS USP	D	GMS[1]		
Late Juveniles	males 2-4 yrs females 2-5 yrs	euphausiids crustaceans amphipods pollock	all year	ICS 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.	OCS USP ICS OCS USP BAY	D	GMS[1]	ice edge (BS)	

[1]Pers. Comm., Dr. Robert McConnaughey (206) 526-4150

8.1.6 Rock sole

Management Plan and Area Groundfish, BSAI

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). 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). 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). The age or size at metamorphosis is unknown. 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 females and natural mortality rate is believed to range from 0.18 - 0.20.

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 and other flatfish fisheries and are caught with these species and Pacific halibut in rock sole directed fisheries.

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.

Approximate upper size limit of juvenile fish? 34 cm

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, polychaetes, amphipods and miscellaneous crustaceans. Wintertime migration to deeper waters of the shelf margin for spawning and to avoid extreme cold water temperatures, feeding diminishes.

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SPECIES: 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	polychaetes bivalves amphipods misc. crust.	all year	BAY ICS OCS	D	S[1]		
Late Juveniles	to 9 years	polychaetes bivalves amphipods misc. crust.	all year	BAY ICS OCS	D	S[1]		
Adults	9+ years	polychaetes bivalves amphipods misc. crust.	feeding May-September spawning Dec.-April	MCS ICS MCS OCS	D	S[1]	ice edge	

[1]Pers. Comm. Dr. Robert McConnaughey (206) 526-4150

8.1.7 Other flatfish

Management Plan and Area Groundfish, BSAI

Life History and General Distribution

The "other flatfish" species complex is made up of the following flatfishes:

Alaska plaice (*Pleuronectes quadrituberculatus*)
rex sole (*Errex zachirus*)
Dover sole (*Microstomus pacificus*)
starry flounder (*Platichthys stellatus*)
longhead dab (*Pleuronectes proboscidea*)
butter sole (*Pleuronectes isolepis*).

Alaska plaice is the most abundant and commercially important species of the complex and the description of its habitat and life history are given.

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 Greate 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, in press).

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. They are caught as bycatch in Pacific cod, bottom pollock and other flatfish fisheries and are caught with these species and Pacific halibut the directed fishery.

Relevant Trophic Information

Groundfish predators include Pacific halibut (Novikov, 1964) yellowfin sole, beluga whales and fur seals Salveson 1976).

Approximate upper size limit of juvenile fish? 27 cm

Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, usually inhabiting shallow areas.

Adults: 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 polychaetes, amphipods and echiurids. Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures. Feeding diminishes until spring after spawning.

Literature

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SPECIES: 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 OCS	P			
Larvae	2-4 months?	U phyto/zoo plankton?	spring and summer	ICS MCS	P			
Juveniles	up to 7 years	polychaetes amphipods echiurids	all year	ICS MCS	D	S+M[1]		
Adults	7+ years	polychaetes amphipods echiurids	spawning March-May non-spawning and feeding June.-February	ICS MCS ICS MCS	D	S+M[1]	ice edge	

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9.1.8 Flathead sole

Management Plan and Area Groundfish, BSAI and GOA

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 and have been found in ichthyoplankton sampling on the southern portion of the Bering Sea shelf in April and May (Waldron 1981). Larve 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.

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.

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.

Approximate upper size limit of juvenile fish? Unknown age at 50% maturity.

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 polychaetes.

Literature

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SPECIES: 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	polychaetes bivalves ophiuroids pollock and Tanner crab	all year	MCS ICS OCS	D	S+M[1]		
Late Juveniles	3 yrs	polychaetes bivalves ophiuroids pollock and Tanner crab	all year	MCS ICS OCS	D	S+M[1]		
Adults	U	polychaetes bivalves ophiuroids pollock and Tanner crab	spawning Jan-April non-spawning May-December	MCS OCS ICS ICS MCS OCS	D	S+M[1]	ice edge	

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8.1.9 Sablefish

Management Plan and Area(s) Groundfish, GOA and BSAI

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 20-30 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.

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 primarily in the spring and summer (the regulatory season is between March 15 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.

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.

What is the approximate upper size limit of juvenile fish (in cm)?

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)

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

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Habitat and Biological Associations (if known) Narrative

Egg/Spawning
Larvae
Juveniles
Adults - other than depth, none is noted.

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SPECIES: Bering Sea/Aleutian Islands 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, 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 ? or NA	
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, generally soft bottoms,	U on slope, ? in fjords	
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, generally soft bottoms,	U on slope, ? in fjords	

8.1.10 Pacific ocean perch

Management Plan and Area(s) Groundfish, BSAI and GOA

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.

Fishery

Pacific ocean perch are caught almost exclusively with bottom trawls. Age at 50% recruitment has been estimated to be between 9 and 10 years in the Gulf of Alaska, and 7.25 years in the Bering Sea/Aleutian Islands. The fishery in the Gulf in recent years has been concentrated in the summer months, especially July, due mostly to management regulations. In the Bering Sea and Aleutian Islands, most of the fish have been caught during the spring in March and April. Reflecting the summer distribution of this species, the fishery in the Gulf is concentrated in a relatively narrow depth band at 190-250 m along the continental slope. Major fishing grounds are at the entrance of large gullies, where the continental slope is more gradual and a greater area of habitat is found at the preferred depth range. The major grounds include Ommaney Trough, Yakutat Canyon, Amatuli Trough, off Portlock and Albatross Banks, Shelikof Trough, off Shumagin Bank, and south of Unimak and Unalaska Is. In the Bering Sea and Aleutian Islands, the major fishing grounds are north of Unimak Pass, in Seguam and Amukta Pass, north of Atka Is., on Petrel Bank, south of Amchitka Island, and along the upper continental slope northwest of the Pribilof Islands.

For NPFMC-managed species, the major bycatch species in the Gulf of Alaska Pacific ocean perch trawl fishery in 1995 included (in descending order by percent): other species of rockfish, arrowtooth flounder, and sablefish. Among the "other species of rockfish," shortraker/rougheye were most common. There is no information available on the bycatch of non-NPFMC-managed species in the Gulf of Alaska fishery, nor any bycatch information at all for the Aleutian Islands and Bering Sea fisheries.

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.

What is the approximate upper size limit of juvenile fish (in cm)?

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.

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)

Eggs and Larvae: NMFS, Alaska Fisheries Science Center, Auke Bay Laboratory, Bruce Wing, (907) 789-6043; NMFS, Alaska Fisheries Science Center, FOCI program, Art Kendall (206) 526-4108; Canada Dept. of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C., Bruce Leaman, (604) 756-7176.

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Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: Pacific ocean perch

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	Internal incub-tion; ~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, SD	CB, G,?M, ?SM,?MS	U	U

8.1.11 Shortraker Rockfish, Rougheye Rockfish, and Northern Rockfish

Management Plan and Area(s) Groundfish, BSAI and GOA

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 semi-demersal and can be found at depths ranging from 25 to 875 m; however, commercial concentrations usually occur at depths from 100 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. Shortraker and 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.

Fishery

Trawl and longline gear are the primary methods of harvest. Even though both species are found to as far south as Point Conception, California, commercial quantities are primarily harvested from northern Washington throughout Alaskan waters. Depths of commercial harvests usually occur from about 100 to 500 m. Both species are associated with a variety of habitats from soft to rocky habitats along the continental slope, although boulders and sloping terrain appear to be a desirable habitat feature for both species. Trawling in such habitats often requires specialized fishing skills to avoid gear damage and to keep the trawl in the proper fishing configuration. Age at recruitment is uncertain, but is probably on the order of 20+ years for both species. Shortraker and rougheye rockfish are often caught as bycatch in trawl and longline fisheries for sablefish and halibut.

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.

What is the approximate upper size limit of juvenile fish (in cm)

For shortraker rockfish, length at 50% sexual maturity is about 45 cm and about 44 cm for rougheye rockfish

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)

Larvae: NMFS, Alaska Fisheries Science Center, FOCI program, Art Kendall, 206-526-4108.

Habitat and Biological Associations (if known) Narrative

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 semi-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.

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SPECIES: 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	SD	M, S, R, SM, CB, MS, G	U	

8.1.13 Thornyheads and Dusky Rockfish

Management Plan and Area(s) Groundfish, BSAI and GOA

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. Juvenile shortspine thornyheads have a pelagic period of about 14-15 months and settle out at about 22 to 27 mm. Fifty percent of female shortspine thornyheads are sexually mature at about 21 cm and 12-13 years of age.

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.

Relevant Trophic Information

Shortspine thornyheads prey mainly on epibenthic shrimp and fish. Yang (1993, 1996) 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).

What is the approximate upper size limit of juvenile fish (in cm)

Female shortspine thornyheads appear to be mature at about 21-22 cm.

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)

Larvae: NMFS, Alaska Fisheries Science Center, FOCI program, Art Kendall, 206-526-4108.

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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	

8.1.14 Atka mackerel

Management Plan and Area(s) Groundfish, BSAI and GOA

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).

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.

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.

What is the approximate upper size limit of juvenile fish (in cm)? 35 cm

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)

Larvae: NMFS, Alaska Fishery Science Center, FOCI program, Rick Brodeur 206-526-4318
Juveniles: NMFS, Alaska Fishery Science Center, NMML, Richard Merrick 206-526-6173

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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

8.1.15 Squid

Management Plan and Area(s): BSAI & GOA groundfish

Species Representatives:

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*)

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.

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.

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).

What is the approximate upper size limit of juvenile fish (in cm)?

For *B. magister*, approx. 20 cm ML for males, 25 cm ML for females; both at approximately 1 year of age.

Additional source of information

Beth Sinclair, NMFS, Seattle, WA 206-526-6466

Habitat Narrative 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.

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SPECIES: *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

8.1.16 Capelin

Management Plan and Area(s): BSAI & GOA groundfish

Species Representative:
Capelin (*Mallotus villosus*)

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 (60-70%) 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.

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.

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 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.).

What is the approximate upper size limit of juvenile fish (in cm)? 13 cm

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)

Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961
Jim Blackburn, ADFG, Kodiak AK 907-486-1861

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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)	BCH (to 10 m)	D, SD	S, CB		
			non-spawning (Sep-Apr)	ICS, MCS, OCS	P	NA?	F Ice edge in winter	-2 - 3°C Peak distributions in BS?

8.1.17 Eulachon

Management Plan and Area(s): BSAI & GOA groundfish

Species Representative:
Eulachon, candlefish *(Thaleichthys pacificus)*

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.

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.

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.).

What is the approximate upper size limit of juvenile fish (in cm)? 14 cm

Source of Additional Data

Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961
Jim Blackburn, ADFG, Kodiak AK 907-486-1861

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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+		spawning (May-June)	Rivers-FW	D	S (CB?)		
		Copepods Euphausiids	non-spawning (July-Apr)	MCS, OCS, USP	P	NA?	F?	

8.1.18 Sculpins

Management Plan and Area(s): BSAI & GOA groundfish

Species Representatives:

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*)

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.

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.

Relevant Trophic Information

Feed on bottom invertebrates (e.g., crabs, barnacles, mussels and other molluscs); larger species eat fish.

What is the approximate upper size limit of juvenile fish (in cm)? Unknown

Sources for Additional Data:

Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961
Jim Blackburn, ADFG, Kodiak AK 907-486-1861

Habitat and Biological Associations (if known) Narrative

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.

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SPECIES: 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	

8.1.19 Sharks

Management Plan and Area(s): BSAI & GOA groundfish

Species Representatives:

Lamnidae:	Salmon shark (*Lamna ditropis*)
Squalidae:	Sleeper shark (*Somniosus pacificus*)
	Spiny dogfish (*Squalus acanthias*)

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.

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.

What is the approximate upper size limit of juvenile fish (in cm)?

Unknown for salmon sharks and sleeper sharks; for spiny dogfish: 94 cm for females, 72 cm for males.

Source of Additional Data

William Raschi, Bucknell University,

Habitat and Biological Associations (if known) Narrative

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 BS; 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 BS and AI; epipelagic, primarily over shelf/slope waters in GOA, and outer shelf in BS.

Sleeper sharks are widely dispersed on shelf/upper slope in the GOA, and along outer shelf/upper slope only in the BS; generally demersal, and may be less commonly found in the Aleutian Islands.

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SPECIES: 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

8.1.21 Skates

Management Plan and Area(s): BSAI & GOA groundfish

Species Representatives:

Alaska skate (*Bathyraja parmifera*)
Aleutian skate (*Bathyraja aleutica*)
Bering skate (*Bathyraja interrupta*)

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.

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.

Relevant Trophic Information

Feed on bottom invertebrates (crustaceans, molluscs, and polychaetes) and fish.

What is the approximate upper size limit of juvenile fish (in cm)? Unknown

Source of Additional Data

William Raschi, Bucknell University

Habitat and Biological Associations (if known) Narrative

Egg/Spawning: Deposit eggs in horny cases on shelf and slope.

Juveniles and Adults: 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.

Literature

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SPECIES: SKATES

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic 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	

8.1.22 Octopus

Management Plan and Area(s): BSAI & GOA groundfish

Species Representatives:

Octopoda: Octopus *(Octopus gilbertianus; O. dofleini)*
Vampyromorpha: Pelagic octopus (*Vampyroteuthis infernalis*)

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.

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.

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).

What is the approximate upper size limit of juvenile fish (in cm)? Unknown

Additional source of information Unknown

Habitat Narrative for *Octopus* spp.:

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.

Literature

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SPECIES: *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 (IS, MS?)	D	R, G?	U	Euhaline waters
Young juveniles	U	zooplankton	summer-fall?	U (IS, MS, OS, USL?)	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	IS, MS, OS, USL	D	R, G, S, MS?	U	Euhaline waters

8.2 Stock Units

The groundfish and squid resources considered in this Plan consist of species that are wide ranging in their general distribution, occurring in the eastern Bering Sea, Aleutians waters, and in the Gulf of Alaska. Within each of these major geographical regions separate stocks or populations of these species may exist, but our state of knowledge is such that we cannot be certain of this possibility for most species. Research results and fisheries information indicate that for most species resident stocks exist in each major region (E. Bering Sea, Aleutians, and Gulf of Alaska). For other species, such as Pacific halibut and those of squid, this may not be the case.

Those species that are generally considered to have separate stocks residing in the Aleutians as well as the eastern Bering Sea are pollock, yellowfin sole, sablefish, Atka mackerel, Pacific ocean perch, Pacific cod, Greenland turbot, arrowtooth flounder and various species of sole.

For pollock the eastern Bering Sea stock is larger than that of the Aleutians. There has also been some speculation that in the eastern Bering Sea proper, this species may be further subdivided into a northern and a southern stock, primarily because spawning concentrations have been found north as well as south of the Pribilof Islands. (Japan Fishery Agency 1974 b). However, it is difficult to confirm such a separation since there apparently is a considerable amount of mixing of fish through seasonal north-south movements as evidenced from tagging studies.

Tagging studies indicate the existence of separate spawning stocks for eastern Bering Sea yellowfin sole, one of which resides in waters north of a line between the Pribilof Islands and Cape Avinof and another south of this line, with only a limited exchange between them (Wakabayashi 1974). Studies of differences in growth rate, meristic features, and genetic characters, however, have not been conclusive (Wakabayashi et al. 1977). Furthermore, U.S. researchers estimate that about 90% of the total yellowfin sole biomass of the eastern Bering Sea lies in the southern stock area, making the question of less practical importance. Therefore, until more definitive results are obtained, all yellowfin sole of the eastern Bering Sea will be considered as belonging to one stock.

Adult sablefish live mainly in offshore waters at bottom depths of 200 meters and greater throughout their geographical range. Their movements appear to be localized from tagging studies which show that most recovered fish have been taken in the same general area where they had been tagged and released (Low 1977). A few tagged fish, however, have been recovered a considerable distance from their area of release, and some of these movements have been between major geographical areas, such as the Gulf of Alaska and Bering Sea. These extensive movements, although few, demonstrate that some exchange of fish between major areas does occur, and that separate stocks, if they do exist, may be biologically closely related. At this stage of our knowledge it may be best to consider sablefish as being comprised of separate stocks throughout its geographical range, but that minor intermixing of the stocks does occur. For managing fisheries on these stocks, it may be convenient to treat these stocks as four major and distinct groups; an eastern Bering Sea group, an Aleutians group, a Gulf of Alaska group, and a U.S. west coast group.

There is some circumstantial evidence that Atka mackerel may be comprised of localized stocks throughout its geographical range which includes waters off Kamchatka and the Aleutians, and the eastern Bering Sea and western Gulf of Alaska. The species seeks certain bottom areas for spawning and will return to these areas year after year to reproduce (Rass 1970). Only a few of these areas have been determined, but it is likely that more exist and the spawning concentrations associated with each probably should be considered to be discrete stocks. Until more precise evidence of the location of specific spawning areas becomes available, concentrations in the Aleutians area, the eastern Bering Sea area, and the western Gulf of Alaska will be assumed to comprise separate stocks.

For Pacific ocean perch, differences in biological features (e.g., growth rate) between eastern Bering Sea and Aleutian fish suggest that each of these areas has its own unique stock (Chikuni 1974).

Evidence for the separation of other principal groundfish species (cod, turbot, flathead sole, rock sole, and plaice) is not available, but as a conservative measure, each of these species will be considered to be comprised of separate stocks in the Aleutians and eastern Bering Sea.

Available evidence suggests significant movement of halibut between the eastern and western Bering Sea and between the eastern Bering Sea and the northeastern Pacific Ocean (Best 1977, Dunlop et al. 1964). Circulation patterns indicate that eggs and larvae spawned in the eastern Bering Sea should remain within the Bering Sea. However, the cyclonic circulation in the area will transport eggs and larvae in a northwesterly direction and the current is sufficient to transport larvae to the Asian Coast. It is also likely that larvae originating in the Gulf of Alaska are transported into the Bering Sea.

Large numbers of juvenile halibut inhabit the eastern Bering Sea, and this region may serve as a nursery ground for other regions. Recoveries of tagged juveniles are meager but indicate a movement into the Gulf of Alaska. One juvenile tagged west of the Pribilof Islands was recovered in southeastern Alaska five years later. Tagging data are more extensive for adult halibut and show movements as far south as northern California; Dunlop et al (1964) estimated an emigration rate of 24% over a 7-year period. Tagging also indicates movements from the Gulf into the Bering Sea and between eastern and western Bering Sea, but these movements appear to be relatively infrequent.

In the Aleutians, tagging and other studies indicate that the halibut in the region are an intermingling component of stocks in the Gulf of Alaska and British Columbia (Bell 1967). The total amount of bottom area suitable for halibut in the Aleutians is small and the overall productivity of the region is much less than in the Bering Sea and other regions of the northeast Pacific. Nevertheless, halibut are sufficiently concentrated in local areas to provide good catches for a few vessels.

Squid resources of the eastern Bering Sea and Aleutians waters are believed to be mainly comprised of five species that are wide ranging in their distribution in northern waters. Four of these species (Gonatus fabricii, Gonatus magister, Gonatotopsis borealis, and Morotenthis robustus) inhabit the near surface and mid-waters of the other continental shelf and beyond the shelf. The other species (Rossia pacifica) prefers inshore waters where it forages throughout the water column. All these squid species are, therefore, much more mobile than most of the groundfishes and apparently roam quite freely throughout their range. Because of this capability, it is assumed that there is considerable intermingling of individuals from different regions; hence, each squid species may be considered as having one interbreeding population common to the Bering Sea, Aleutians, and the western Gulf of Alaska.

8.3 Data Sources

8.3.1 Catch and Effort Data

Catch and effort statistics are collected on a continuing basis from two main sources: from the commercial fishery and from research surveys. Commercial fishery data are used mainly to compute CPUE trends to monitor the relative abundance of stocks under exploitation. In addition to CPUE computation, trawl survey information can also be used to estimate standing stocks. Commercial fishery data of sufficient detail and precision for Bering Sea/ Aleutians stock assessment studies are:

(1) Catch and effort statistics of the Japanese mothership, longline- gillnet, and North Pacific trawl and land-based trawl fisheries, as provided through INPFC;

(2) Catch and effort statistics collected by U.S. observers stationed aboard foreign vessels.

Under the FCMA, similar types of rather precise catch and effort statistics will soon become available from all nations participating in this region's groundfish fishery.

Catch and effort statistics are also obtained from research trawl surveys conducted by the United States' National Marine Fisheries Service, Fishery Agency of Japan, and the International Pacific Halibut Commission. Data from the Fishery Agency of Japan are made available to the U.S. in publications, the INPFC and during bilateral scientific meetings. The International Pacific Halibut Commission conducts an annual assessment of juvenile halibut abundance in the Bering Sea which provides catch and effort information concerning not only halibut but many other groundfish species as well.

Statistics from Japanese fishing operations have been among the most detailed and complete of any nation in the world. In general, they are by species, ½° Latitude by 1° Longitude statistical areas, month, gear type, and vessel class. An exception however, has been Japan's land-based trawl fishery from which the available statistics have been less timely and in less detail. This appears to reflect the fact that they have been collected at the provincial level in Japan rather than by the Fishery Agency of Japan, as has been the case for the other fisheries.

Although improving since the early 1970's, statistics provided by the U.S.S.R. have generally reflected only gross catches of imprecise species groupings for very large statistical areas. Until very recently, effort information has either been lacking entirely or in a form that had little utility for assessing relative abundance (e.g., catch per tow without reference to tow duration).

As regards other nations fishing for bottomfish in the Bering Sea/Aleutians Region, Poland has provided statistics in detail comparable to those of Japan for its very limited fishery. Since 1968, South Korea has conducted a growing groundfish fishery in the Region but no statistics concerning it are available for the period prior to 1976 and those acquired since have been incomplete. Operations by Taiwanese vessels have been few and no statistics have yet been reported.

For status of stock evaluations, the catch and effort data bases generally relied upon are those of the Japanese fisheries, and research surveys conducted by Japan, the United States, and IPHC.

8.3.2 Biological Data

Biological data concerning Bering Sea/Aleutians groundfish resources are collected on a continuing basis from the commercial fishery and from research surveys. Those from the commercial fisheries have generally been limited to length-frequency samples from the Japanese fisheries until U.S. observers were placed aboard foreign vessels to sample the catch. The observer program covers a significant portion of the several foreign fishing fleets and has been constructing an extensive data base on length, weight, age and sex of the principal species taken by foreign fisheries.

The most comprehensive source of biological information is that collected during trawl surveys conducted by the United States' National Marine Fisheries Service. In these surveys, length, weight, age, and sex information and at times, sexual maturity and stomach content data, are collected for all species encountered during the surveys. Annual research surveys conducted by the Fishery Agency of Japan and the Soviet Pacific Scientific Research Institute of Fisheries and Oceanography have also provided excellent sources of information on life history, abundance, and distribution of principal species.

8.4 Quality of Data

To be most useful in the evaluation of stock condition and sustainable yield, data from the commercial fisheries should include the catch by species and the quality and quantity of effective effort expended to take this catch; they should be provided for relatively small geographical areas and time periods. In this way trends in catch and standardized catches-per-unit-of-effort (CPUE) can be monitored by precise time-area units so reliable inferences may be drawn concerning stock abundance. In addition, biological sampling should be adequate to estimate size and age composition of the catch, by time and area. These basic fisheries data (catch, effective effort, age and size composition) provide much of the input for determining mortality rates, relative year class strength, changes in stock density, recruitment, and other population characteristics upon which the condition of stocks can be measured.

Japan provides very detailed statistics on her fisheries (see Section 8.3), but even these are deficient in terms of fishing effort, age and size data, and completeness in reporting catches by species. The fishing power of the Japanese fleet has increased because of increases in vessel horsepower, improvements in fish detecting and harvesting gears, and experience acquired by the fishermen of the grounds, making difficult (perhaps impossible) adjustments to the reported nominal effort to reflect true fishing power. There is also the problem of determining what proportion of the total fishing effort was expended on each major species.

Until recent years data on size composition of the principal species harvested by Japan were insufficient because of incomplete areal and seasonal coverages, and the lack of associated age data to accompany the size information.

The U.S.S.R. has had a very poor history of reporting on her fisheries. There was virtually no breakdown of the catch by statistical areas that is useful in stock assessment nor were there data on the age and size composition of the catch. Likewise, data provided by other nations have virtually no utility for stock assessment purposes.

The problem of inadequate detail of commercial fishery information has been partially solved as the U.S. observer program has expanded in scope to sample the foreign commercial catch. This program is also addressing the question of the accuracy and precision of reported catch data.

In addition to the observer program which provides a reliable source of catch, effort, and biological data, research vessel surveys provide an independent and, at times, less biased means of estimating the condition of groundfish stocks. The surveys are conducted in such a manner that estimates of age and size composition and other population characteristics can be obtained for the resource complex as a whole within the survey area, whereas commercial fisheries often concentrate on certain species, sizes of fish, and specific areas. Since research surveys can be done in a standardized manner, CPUE from the surveys serves as a very meaningful indicator of changes in fish density by time and area. Furthermore, surveys of juvenile or pre-recruit fish can best be done by means of research surveys; such surveys provide one of the few means by which predictions of incoming year class strengths can be obtained. There is also the relatively new approach of assessing stock size by acoustical sounding.

The main deficiency in existing survey data is the lack of areal coverage. Because of limitations in budget and physical aspects of the gear and vessels, the deeper waters (greater than 200 m) are generally not surveyed. Therefore, portions of the stocks of deep water flounders (arrowtooth flounder and Greenland turbot), sablefish, Pacific ocean perch and even pollock are not fully sampled. What the research surveys lack in coverage, however, is made up in detail which augments the broader but less precise data base obtained from the commercial fisheries.

8.5 Ecological Relationships

8.5.1 Environmental Characteristics

The Bering Sea shelf, with an area of some 1 million km2, is about twice the size of that of the Barents Sea or the North Sea. On the average, it is slightly deeper than the North Sea but shallower than the Barents Sea. The bottom is trawlable over most of the shelf. The Aleutian Island shelves are relatively narrow and rocky, similar to that of the Gulf of Alaska.

Relatively weak tidal currents dominate the Bering Sea shelf. The permanent flow is sluggish and, therefore, the exchange of water masses between shallow and deep areas is very slow. On the other hand, the tidal currents around the Aleutian Islands are relatively strong and strong semi-permanent currents flow through the passes between the islands, effecting the water exchange between the deeper part of the Bering Sea and the central North Pacific.

Central and northern parts of the Bering Sea shelf are ice covered part of the year. Due to the absence of temperature and salinity stratification in the waters over the shelf during autumn and winter, cold water (0°C) is formed there under the ice from surface to bottom. This cold water on the bottom can persist until mid-summer and affects the distribution and migrations of demersal fish.
The annual range of temperature change over the Bering Sea continental shelf (from surface to about 150 m depth) can exceed 10°C. Over deep water near the Aleutian chain this annual change is less than 5°C. There is a subsurface temperature maximum of about 3.5°C, with associated high salinity, at a depth of about 150 m in the whole region under consideration. The areas along the continental slope, where this warmer subsurface layer intercepts the slope, are important overwintering areas for many demersal and even some pelagic fish (e.g. herring).

Of the oceanographic processes and their year-to-year variations, the following are the most significant in respect to the biota: (1) year-to-year variation of ice cover in the central and south-central part of the Bering Sea shelf; (2) the autumnal turnover of water masses on the shelf (returning nutrients from deeper layers and near the bottom to surface layers); (3) considerable monthly surface layer temperature anomalies (up to 3°C) in the central and southern Bering Sea; (4) formation of subzero bottom temperatures on the Bering Sea shelf; and (5) rapid flushing of the Aleutian Island shelves.

8.5.2 Biological Characteristics

The Bering Sea is a typical high latitude area, with relatively few species, among which some dominate quantitatively to a high degree over the others. In scarcely any other ocean region is one fish species quantitatively so dominant as pollock in the Bering Sea. Rather pronounced cannibalism occurs in dominant species in general and cannibalistic interactions cause long-term quantitative changes in the ecosystem complex.

The most pronounced biological characteristic of the Bering Sea and Aleutian Islands are is the presence of large numbers of marine mammals (e.g. 1.4 million fur seals alone) and birds (ca. 10 million shearwaters arriving each summer), which consume together at least as many fish as the commercial catch of all nations from this region.

Another basic biological characteristic of the Bering Sea is the presence of benthos on the extensive continental shelf, providing a food source (and support) for flatfish communities and for commercially exploitable crabs. The abundant benthos in the northern half of the Bering Sea contains, however, little "fish food"; most of it is made up of large, hard shelled clams. This northern benthos is similar to other high-latitudes benthos, where a phenomenon called "successive accumulation of generations" occurs.

A fourth general biological characteristic of the Bering Sea/Aleutians region is the relatively high basic organic productivity. This high productivity is largely caused by deep autumn/winter turnover which returns regenerated nutrients to the surface layers. This high organic production (combined with relatively slow decomposition rate of organic detritus in colder waters) causes the presence of a high standing crop of larger zooplankters (euphausids) and boreal squids (gonatid squids), which in turn serve as an important food source for fish (and partly for mammals and birds). Thus, several semi-demersal fish species (e.g. pollock, rockfishes, etc.) are less dependent upon benthic food and can live a pelagic life over deep water in the Bering Sea/Aleutians region.

8.5.3 Ecosystem Characteristics

In the marine ecosystem there are intensive interactions between different species, their prey items, and environmental factors. Changes in abundance and distribution of one species (e.g. caused by fishery) affect the abundance and distribution of other species as well. Therefore, wise fisheries management requires the quantitative knowledge of all of these interactions; single species population dynamics' approaches are no longer fully adequate for modern fisheries management.

The quantitative processes in the marine ecosystem are beginning to be simulated and studied with numerical, dynamic, deterministic marine ecosystem reproduction models. A few results, pertinent to management of the Bering Sea groundfish fishery are presented briefly in this section. These results originate from the Dynamical Numerical Marine Ecosystem Model (DYNUMES III), currently in use at the Northwest and Alaska Fisheries Center, Seattle.

The DYNUMES III model permits the determination of equilibrium biomasses of individual species and groups of species (Table 20). Individual biomasses have also been calculated for both the juvenile and exploitable portions of populations (Figure 21). It is of interest to note that the total biomass of, for instance, all finfish varies but little from one year to another in a given region, but individual species can have considerable long-period fluctuations (periods usually larger than 10 years) in abundance, whereby some species incline and others decline in abundance.

The DYNUMES model permits the computation of the main component of "natural mortality"--i.e. grazing and the determination of the portions grazed, for instance, by mammals and by other fish (Figure 22). Grazing (consumption) is computed in trophodynamic computations. The results also allow the computation of annual turnover rates of the biomasses (Table 20).

In ecosystem sense, there is no "surplus" production in the sea for man to take. The question is mainly one of balance between ecosystem components, i.e. changes in target species biomasses and the resultant changes in the biomasses of pray, predator, and competitor species. The determination of such fishery-induced changes is one of the major objectives of the DYNUMES model.

The results of conservative computations of the consumption of fish and other ecological groups by marine mammals and birds in the eastern Bering Sea are given in Table 21 (the computations are conservative in the sense that the lowest estimates of the number of mammals and their food requirements were used). The results show that mammals consume more than twice as much finfish as is taken in the total commercial catch. This strongly implies that finfish yield is at least as much a function of marine mammal abundance as it is a function of the finfish fishery itself.

The DYNUMES model shows that an intensive fishery can be, in some cases, beneficial to the production of biomass. Adult pollock are cannibalistic on juvenile pollock. The growth rate of juvenile fish, which feed mainly on euphausids, is considerably higher than the growth rate of older fish. When an intensive fishery

removes older, cannibalistic pollock, the grazing pressure on juveniles is relieved and productivity of the pollock biomass, at large, is enhanced. The model also indicates that in an underexploited population, cannibalistic interaction would result in a self-generating cycle of pollock abundance with a period of about 12 years.

Intraspecific cannibalism, as well as interspecific predator-prey relations cause a partial spatial separation of juveniles and adults (see Figures 23-24).

Table 20. Biomass, annual consumption, annual turnover rate, and relative monthly consumption of different species and/or ecological groups in the eastern Bering Sea, as computed with DYNUMES II.

Species/ecological group	Mean biomass (B) 10^3 tons	Annual (C) consumption 10^3 tons	Annual turnover rate C	% of Biomass consumed per month
Pollock	8,235	5,820	0.7	5.8
Herring 3,260	2,970	0.9	7.7	
Other pelagic fish	6,870	6,595	1.0	8.7
Yellowfin sole	1,475	866	0.6	4.9
Other Flatfish	2,030	1,630	0.8	6.7
Other gadids	2,840	2,680	0.9	8.1
Other demersal fish	2,550	2,790	1.1	9.0
Total finfish	27,260	23,350	0.86	
Squids	4,050	3,020	0.75	6.4
Benthos 25,600	19,730	0.77	6.3	
Zooplankton		83,970		
Phytoplankton		(52,500)		

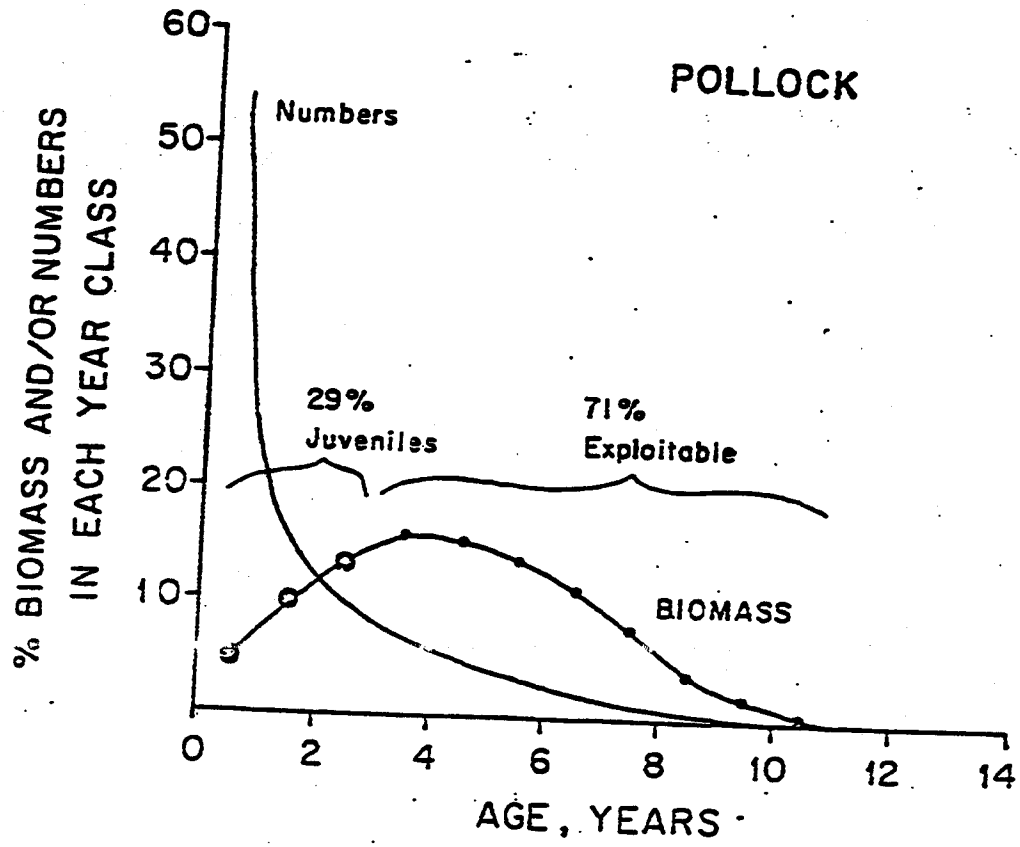


Figure 21—Distribution of biomass and numbers of walleye pollock within different year classes (% of total).

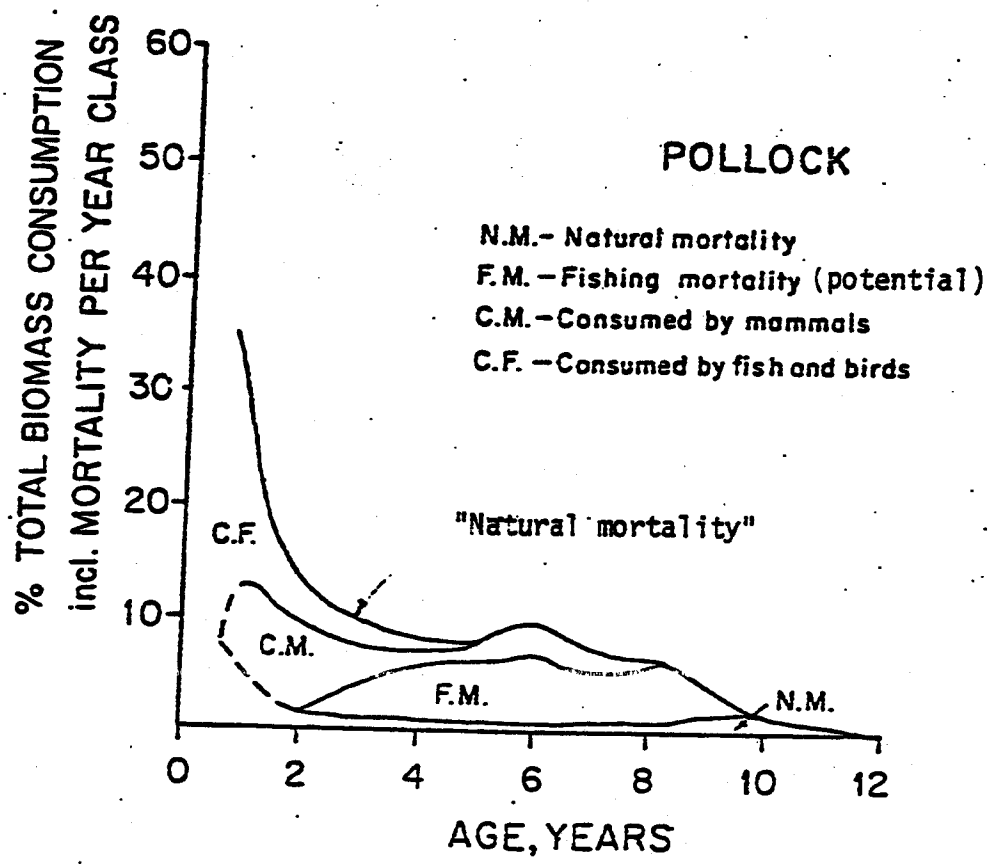


Figure 22.—Distribution of "consumption" with age of walleye pollock, as percent of total biomass.

Table 21--Annual consumption by marine birds and mammals in the eastern Bering Sea (in 10^3 tons), as computed with DYNUMES II ("conservative" inputs).

Species/group of species	Species/group of species consumed										
	Herring	Other pelagic	Salmon	Pollock	Other gadids	Flatfish	Total finfish	Zooplankton	Squids	Benthos	"Others" (Unspecified)
Marine birds	11.7	40.3	1.5	26.3	+	1.9	81.7	105.2	13.2	2.8	14.3
Fur seal	26.5	8.8	8.8	322.3	22.1	-	388.5	-	44.2	-	8.8
Sea lion	16.8	11.2	22.4	182.2	19.6	-	252.2	-	+	-	+
Bearded seal	25.0	25.0	8.3	83.5	41.7	41.7	225.2	-	66.8	509.2	33.4
Harbor seal	66.9	31.2	6.7	89.2	13.4	8.9	216.3	-	89.2	104.8	13.4
Ringed/ribbon seal	24.2	47.5	3.0	84.7	30.3	-	189.7	-	30.3	+	9.1
Walrus	+	+	1.6	6.6	+	4.9	13.1	-	+	311.4	3.3
Total pinnipeds	159.4	123.7	50.8	768.5	127.1	55.5	1,285.0	-	230.5	925.4	68.0
Baleen whales	20.7	27.7	-	13.8	6.9	-	69.1	1,189.3	124.5	-	+
Toothed whales	231.5	408.5	0.5	340.4	68.1	68.1	1,117.1	-	-	-	245.1
Total, whales, porpoises, dolphins	252.2	436.2	0.5	354.2	74.0	68.1	1,186.2	1,189.3	124.5	-	245.1
Total by birds and mammals	423.3	600.2	52.8	1,149.0	201.1	125.5	2,552.9	1,294.5	479.5	928.2	327.4

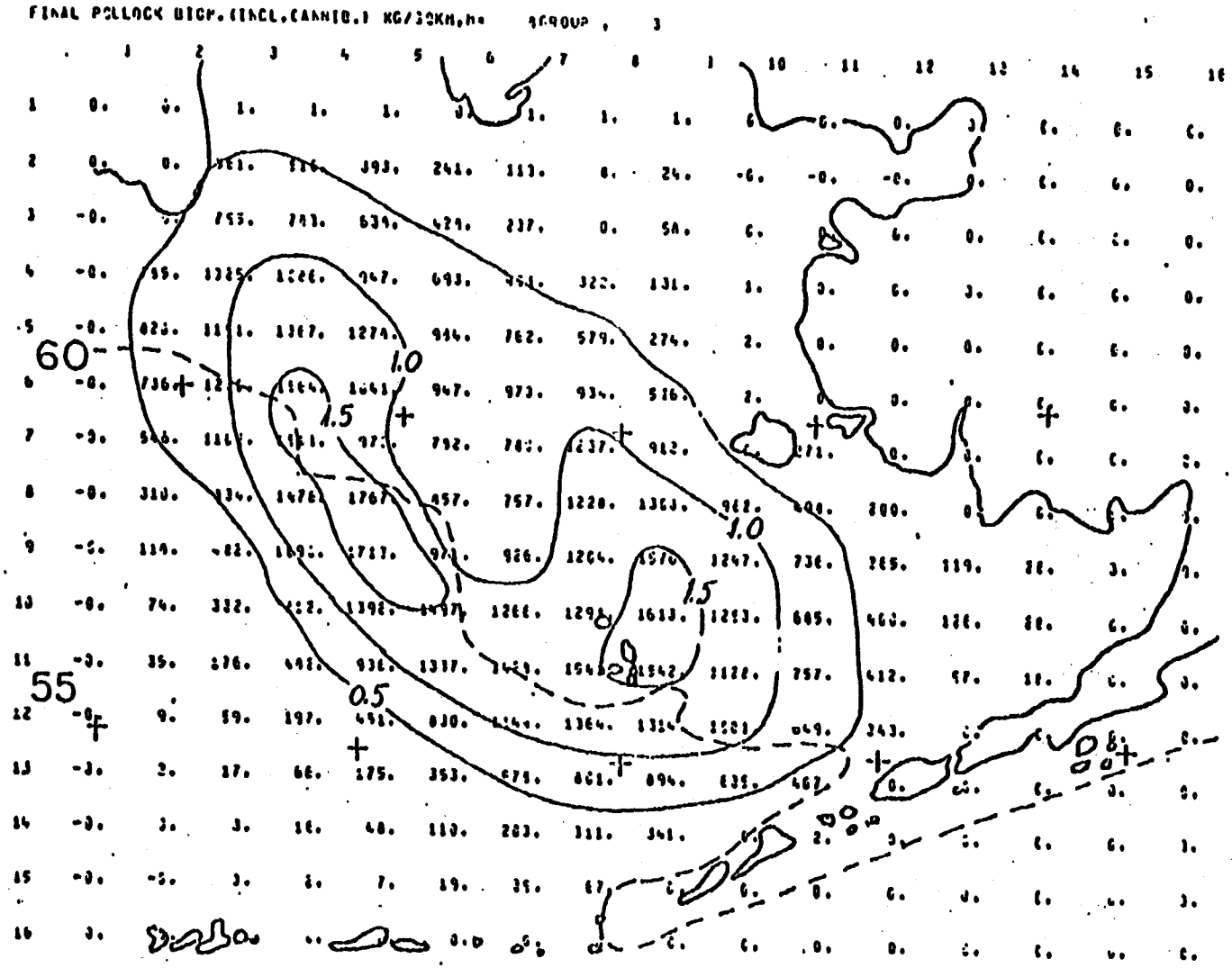


Figure 23 --Distribution of group 3 pollock (35 cm long) in August, computed with DYNUMES II (isopleths in mt/km^2).

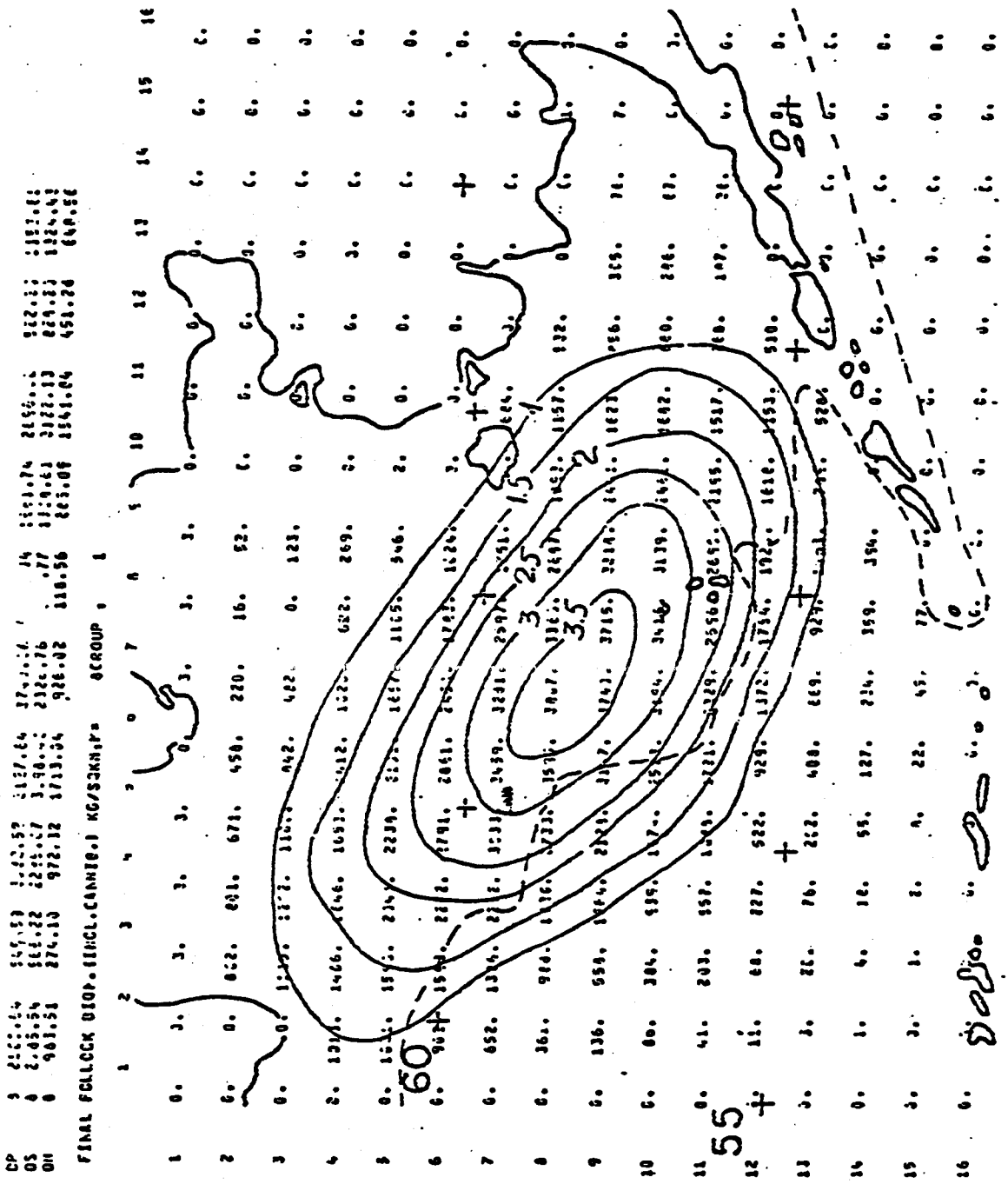


Figure 24--Distribution of group 1 pollock (juvenile) in August, computed with DYNUMES II (isopleths in mt/km^2).

8.6 Current Status of Stocks

Stock assessment studies leading to determination of OY have been conducted on the following Bering Sea/Aleutians groundfish species categories:

Alaska pollock
Pacific halibut
Yellowfin sole
Turbots (arrowtooth flounder, Greenland turbot)
Other flatfishes
Pacific cod
Rockfishes (primarily Pacific ocean perch)
Sablefish
Atka mackerel
Squid
Others

Results of those studies, including the determination of maximum sustainable yield, current equilibrium yield, and acceptable biological catch are contained in the Stock Assessment and Fishery Evaluation (SAFE), as described in Section 11.3.

The approach used in Bering Sea groundfish assessment is to determine statistical trends that relate to stock condition and/or (2) apply applicable population dynamics theories and models to determine stock characteristics and their dynamics, and finally (3) assess the overall condition of the stock, often-times empirically, by taking into account statistical trends and population dynamics theories and models. The techniques used to analyze the data vary considerably from species to species depending on the quality and completeness of the available data bases. For each of the above species or species groups, the biological production potential, in terms of maximum sustainable yield (MSY), current equilibrium yield (EY), and acceptable biological catch (ABC), has been determined. The units for which these biological potentials have been derived are species or species groupings rather than the broader multiple species or ecosystem.

Maximum sustainable yield (MSY) is the largest average catch which can be taken from a stock over a period of years (in this case, generally since the development of significant fisheries in the 1960s) under the environmental conditions which persisted during that same period. This assumes an equilibrium in the population associated with a degree of stability in the environment during the time period considered. Even for such a relatively short time period neither the environment nor the dynamics of many fish populations can be expected to have been constant. The concept of MSY, therefore, is more applicable to longer-lived species in which variations in biomass are buffered by the presence of many year classes. Any long term stability in survival and recruitment, even in these populations is probably exceptional. As a general rule, therefore, MSY cannot be directly applied as a goal for fisheries management without proper evaluation of statistical trends in stock condition, such as can be inferred from current CPUE and age composition. In some instances, recent changes in environmental conditions may constrain current population growth to level far below historic levels of MSY. Under such circumstances the population would be at a lower level of equilibrium which may permit only a correspondingly low level of harvest, and even the most drastic of management measures may not restore a stock to some former level of productivity.

The present state of the science is inadequate to predict the capacity of environment for the production of fishery resources, ascertain with any certainty whether the depletion was a consequence of natural factors of overfishing, or to predict with confidence the consequences of remedial management action. The complicated interaction processes associated with the productivity marine fish populations in an ecosystem are not very well

understood and even such fundamental assumptions as the association between stock size and recruitment strength, which are implicit in manipulation of harvest to achieve MSY, have not been verified or quantified. In fact, it is generally recognized by fisheries scientists that the existing theories and models pertaining to fishery resources management suffer some fundamental inadequacies, and concepts and theories must be developed to answer present and future management demands. Until such new concepts supercede the old, the latter can still serve as a useful basis for deriving management decisions, providing their limitations and underlying assumptions are recognized and evaluated with the best available information. This is the philosophy and approach used throughout this plan.

In contrast to MSY, equilibrium yield (EY) is based on the best estimates of the current condition of stocks. It is the annual or seasonal harvest which, theoretically, will maintain a stock at approximately the same level of abundance (apart from the effects of environmental variation) in succeeding seasons or years. In both under- and overexploited stocks, EY is less than MSY. When, on the basis of statistical trends, survey data, or other information, there is reason to believe that the abundance of stock is below that required to produce MSY, EY is then the maximum production that can be sustained under current population conditions. To rebuild such stocks to more productive levels, the annual or seasonal catch would have to be set below EY.

By definition, ABC is a seasonally determined catch that may differ from MSY for biological reasons. It may be lower or higher than MSY in some years for species with fluctuating recruitment. Operationally, ABC is the final, biologically-based estimate in the process leading to the determination of optimum yield (OY).

An important factor in determining ABC is an appraisal of the biological data base to evaluate its quality and completeness. If it is found lacking, a conservative approach to exploitation may be called for until evidence is produced to support a contention that higher yields can be sustained. In the absence of such evidence only catch levels which are equal to or less than the low end of the MSY-EY ranges can be considered relatively free from the risk of overexploitation. This concept acknowledges the possibility of overexploitation but, in the biological sense, overexploitation can lead to reduced abundance or undesirable ecosystem imbalance that might prevail for years while underexploitation leaves the resource base in a healthy condition, need only have a temporary effect on user groups, and, to some extent, the temporary loss to the users may be made up the following year.

In instances where a reasonably firm data base indicates that a stock is "healthy" in the context of current environmental and ecosystem conditions--i.e., is capable of producing the maximum equilibrium yield that then prevailing environmental conditions will allow--ABC may appropriately be set well into (rather than at the low end of) the current EY range, even though EY is believed to be lower than MSY. Similarly, next year's ABC may be set higher than this year's EY if higher than average recruitment is predicted (for instance, from prerecruit surveys).

8.7 Estimate of Future Stock Conditions

With the exception of Pacific ocean perch, Pacific halibut, and sablefish all other groundfish species in the Bering Sea/Aleutians region are believed to be at levels of abundance equal to or greater than those that would produce MSY. The management regime described in Section 14.0 is designed to keep those healthy stocks at or somewhat above the level of abundance required for MSY, while providing sufficient relief to halibut, ocean perch, and sablefish so that their stocks can rebuild.

With particular regard to halibut, winter trawl closures of the past several years (which are continued in this Plan) appear to have been responsible for reversing the downward trend in juvenile halibut abundance.

In addition, there is no evidence of natural phenomena that could be expected to cause either serious biological or socioeconomic consequences, although the possibility of undetected year class failures, declines in growth rate, or other adverse symptoms cannot be completely discounted. On the other hand, unforeseen enhancements of stocks condition are equally likely.

With the implementation of this plan, the short-term outlook for stock conditions is good.

In the context of long-term expectations, we are just now beginning to understand and quantify the complex relations among species and between the biota and the environment of this ecosystem (see Section 8.5). Until this understanding is much further developed, we are unable to predict the long-term effect on the ecosystem of the current, single species management strategies or of subtle environmental changes.

8.8 Description of Habitat Types

The Bering Sea covers a flat, relatively featureless shelf whose southern boundary extends from near Unimak Pass to Cape Navarin, and from a deepwater basin bounded by the shelf and the Aleutian Island Arc. The Bering Sea has certain characteristic features which make it different from other corresponding regions in higher latitudes (see Table 22 from Favorite and Laevastu, 1981). The Aleutian Island Arc contains a narrow shelf that drops off rapidly to the Bering Sea on the north and the North Pacific Ocean to the south. Seasonal changes are more moderate than over the Bering Sea shelf. Ocean currents flow through the passes between the Islands, and south of the chain the narrow shelf is washed by a westward current which is stronger in the eastern part; on the Bering Sea side this current is missing.

The waters of the Bering Sea can be partitioned (Kinder and Schumacher, 1981 a,b) during the summer by transition zones which separate four hydrographic domains (Figure 25). The hydrographic domains are distinguished by bottom depth and seasonal changes in their vertical density structure. During the winter the structure is absent or much less apparent under the ice. Beginning in the nearshore area, the coastal domain includes waters less than 50 m in depth that due to tidal mixing do not stratify seasonally. A zone of transition separates the coastal domain from the middle shelf domain. In the middle shelf domain, over bottom depths of 50 to 100 m, seasonal stratification sets up during the ice-free season, and warmer, less saline waters overlie colder and more saline bottom waters. This stratification persists until broken down by winter cooling and storms. A broad transition zone separates the middle shelf zone from the outer shelf domain. This latter domain, in water depths from 100 to 170 m, is characterized by well-mixed upper and lower layers separated by a complex intermediate layer containing fine density structure. In general, the outer shelf waters intrude shoreward near the bottom, while middle shelf waters spread seaward above them. Beyond the outer shelf domain, the shelf break front separates the shelf waters from the oceanic domain, with its more saline, less aerobic waters overlying the Bering Sea slope and deep basin.

Table 22 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 & out) caused by ice Limited production in winter
Cold bottom water	Outmigration of biota Higher mortalities & lower growth of benthic & demersal biota Accumulation of generations
High runoff	Low salinities (near coasts) High turbidities Presence of eurohaline fauna
Sluggish circulation	Local biological production Local pelagic spawning
Biological Features	
High production & slow turnover	High standing stocks
Fewer species (than in lower latitudes)	Few species quantitatively very dominant
High amounts of marine mammals & birds)	High predation by apex predators
Pronounced seasonal migrations	Great local space & time changes of abundance
Fisheries Resource Features	
Pollock dominate semidemersal species	Flexible feeding & breeding habits, especially environmental adaption
Yellowfin sole dominant demersal species	Abundant bethos food supply
Herring & capelin dominant pelagic species	Important forage species in the ecosystem
Abundant crab resources	Large, relatively shallow shelf Few predators on adults, especially environmental adaption
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 & birds Very limited local fisheries, no pollution

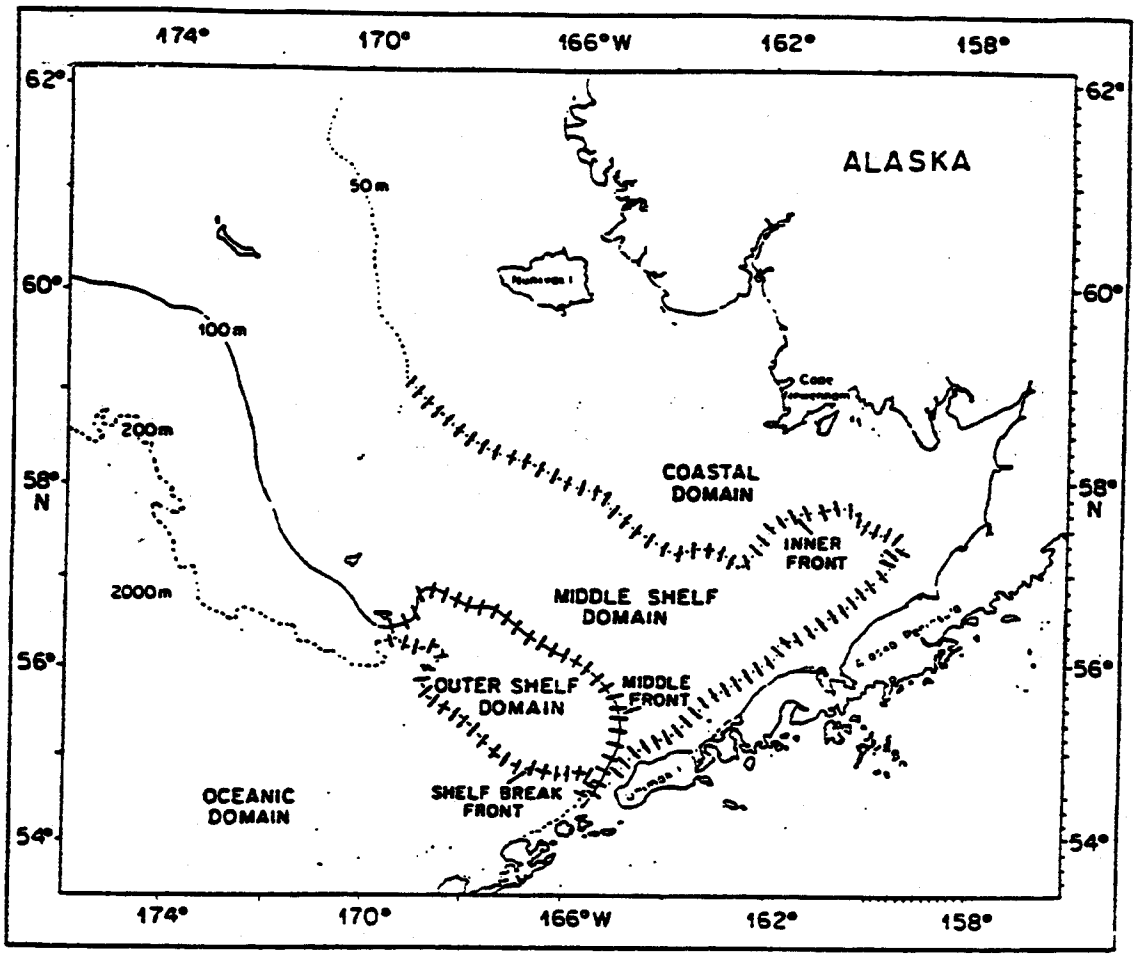


Figure 25. Hydrographic Domains And Transition Zones (Bars) During Summer In Bering Sea

Net circulation in the Bering Sea is generally sluggish. However, moderate to strong tidal and wind-driven currents can be established over the shelf. Nearshore coastal currents from the Gulf of Alaska shelf flow into the Bering Sea through Unimak Pass and then apparently continue northeastward along the Alaska Peninsula. Within Bristol Bay, the flow becomes counter-clockwise and follows the 50 m depth contour toward Nunivak Island. In the middle shelf domain (water depths from 50 - 100 m), currents are weak and variable, responding temporarily as wind-driven pulses. In the outershelf domain, a mean northwestward flow exists along the shelf edge and upper slope following depth contours.

With respect to the physiographic regimes and hydrographic domains of the Bering Sea, many species perform seasonal and spawning migrations from one domain to another. Shelf dwellers, such as yellowfin sole and Pacific halibut spawn in deep water 275-410 m (Garrison and Miller, 1982), while walleye pollock form mid-water spawning shoals. Other species also make similar off-on shelf migrations for spawning and feeding. Adult sablefish and Pacific ocean perch live principally on the continental slope at water depths greater than 200 m but are known to make large daily vertical movements within the water column for feeding.

8.9 Essential Fish Habitat for BSAI Groundfish

Summaries and assessments of habitat information for BSAI groundfish are provided in the "Essential Fish Habitat Assessment Report for the Groundfish Resources of the Bering Sea and Aleutian Islands Regions" dated April 1, 1998. Habitat descriptions and life history information was reviewed and the levels of information available for each life history stage was determined. The approach set forth in regulations at 50 CFR 600.815(a)(2) for gathering and organizing the data necessary to identify EFH was applied. In evaluating the level of knowledge available, a level 0 was defined as a subset of level 1. For life stages of BSAI groundfish, it was determined that information at levels 0, 1, and 2 was available.

Table 8.2. Levels of essential fish habitat information currently available for BSAI groundfish, by life history stage. Juveniles were subdivided into early and late juvenile stages based on survey selectivity curves.

Species	Eggs	Larvae	Early Juveniles	Late Juveniles	Adults
Pollock	1	1	1	1	2
Pacific cod	0a	0a	0a	1	2
Yellowfin sole	0a	0a	0a	1	2
Greenland turbot	0a	0a	0a	1	2
Arrowtooth flounder	0a	0a	0a	1	2
Rock sole	0a	0a	0a	1	2
Other flatfish	0a	0a	0a	1	2
Flathead sole	0a	0a	0a	1	2
Sablefish	0a	0a	0a	1	2
Pacific ocean perch	-	0a	0a	1	1
Northern rockfish	-	0b	0b	1	1
Shortraker rockfish	-	0b	0a-b	0b	1
Rougheye rockfish	-	0b	0a-b	1	1
Dusky rockfish	-	0b	0b	0a	1
Thornyhead rockfish	0a	0a	0a	0a	1
Atka mackerel	0a	0a	0b	0b	2
Squid	0a	-	0a	0a	0a
Other species					
sculpins	0a	0a	0a	0a	1
skates	0a	-	0a	0a	1
sharks	-	-	0a	0a	0a
octopus	0a	-	0a	0a	0a
squid	0a	-	0a	0a	0a
Forage fish species					
smelts	0a	0a	0a	0a	0a
other forage fish [1,2]	0	0	0	0	0

NOTE: "-" indicates a species that has internal fertilization and bears live young.
[1]Other forage fish includes all members of the lanternfish, deep sea smelt, sand lance, sandfish, gunnel, shanny, krill, bristlemouth families.
[2]For the egg and larvae stages for Myctophids, Bathylagids, Pholids, and Stichaeids, the larvae stage for Sandfish, and the egg, larvae and juvenile stages for gonostomids, information is insufficient to infer general distribution.
0a: Some information on a specie's life stage upon which to infer general distribution.
0b: No information on the life stage, but some information on a similar species or adjacent life stage from which to infer general distribution.

Table 8.9.1. Summary of habitat associations for groundfish in the BSAI and GOA.

		Dover sole					Rock sole					Arrowtooth flounder					Greenland turbot					Yellowfin sole					Pacific cod					Walleye pollock				
HABITAT ASSOCIATIONS	Life Stage/Activity	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A
Location	Beach (intertidal)																					X	X			X										
	Inner Shelf (1-50 m)	X	X	X	X			X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X		X	X	X			X		
	Middle Shelf (50-100 m)	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X		X	X	X			X		
	Outer Shelf (100-200 m)	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X			X	X	X	X	X	X	X
	Upper Slope (200-1000 m)	X	X			X								X	X	X				X	X											X				
	Lower Slope (>1000m)																				X															
	Basin (> 3000 m)																															X				X
	Bay/Estuarine								X	X			X			X						X	X	X	X	X										
	Island pass																																	X		
	Not Known																											X								
Substrate	Mud/Clay/Silt			X	X	X								X	X	X				X	X						X		X	X	X					
	Sand/Granule			X	X	X			X	X	X			X	X	X				X	X			X	X	X	X		X	X	X					
	Gravel								X	X	X			X	X	X															X					
	Pebble																																			
	Cobble																																			
	Boulder																																			
	Bedrock																																			
	Not Applicable	X	X															X	X			X	X					X				X	X	X		
Vegetation	Kelp Forest																																			
	Sea Grasses																																			
Pelagic Domain	Near Surface																											X								
	Pelagic	X	X					X				X	X					X				X	X									X	X	X	X	X
	Semi-demersal/Semi-pelagic																X			X	X													X	X	X
	Demersal			X	X	X	X		X	X	X			X	X	X	X			X	X			X	X	X	X	X		X	X	X					
	Not Known																		X																	
Oceanography	Upwelling areas																																			X
	Gyres																															X	X	X	X	X
	Thermo/pycnocline																																	X		
	Fronts																																X	X	X	X
	Edges (ice, bathymetric)										X					X										X										X
	Life Stage/Activity	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A

Table 8.9.1. continued

HABITAT ASSOCIATIONS		Alaska plaice				Rex sole				Flathead sole					Sablefish					Pacific Ocean perch			Shortraker & Rougheye rockfish			Northern rockfish			Dusky rockfish		
	Life Stage/Activity	E	L	J	A	E	L	J	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	L	J	A	L	J	A	L	J	A	L	J	A
Location	Beach (intertidal)																														
	Inner Shelf (1-50 m)			X	X	X	X	X		X	X	X	X	X				X		X	X					X				X	
	Middle Shelf (50-100 m)		X	X	X	X	X	X	X	X	X	X	X	X				X		X	X			X		X				X	
	Outer Shelf (100-200 m)	X				X	X	X	X	X	X	X	X	X				X		X	X	X	X	X	X	X	X	X		X	X
	Upper Slope (200-1000 m)								X								X	X		X	X	X	X		X			X			X
	Lower Slope (>1000m)																X	X		X	X										
	Basin (> 3000 m)																			X											
	Bay/Estuarine																X														
	Island pass																X														
	Not Known																									X			X		
Substrate	Mud/Clay/Silt			X	X			X	X			X	X	X					X						X						
	Sand/Granule			X	X			X	X			X	X	X					X						X						
	Gravel							X	X										X		X	X			X					X	X
	Pebble																				X	X			X						
	Cobble			X	X			X	X												X	X			X		X	X		X	X
	Boulder			X	X			X	X												X				X		X	X		X	X
	Bedrock																								X						X
	Not Applicable			X	X	X	X			X	X				X	X	X			X			X			X			X		
Vegetation	Kelp Forest																														
	Sea Grasses																														
Pelagic Domain	Near Surface															X															
	Pelagic	X	X			X	X			X	X				X		X			X	X					X			X		
	Semi-demersal/Semi-pelagic																X				X	X				X	X	X			X
	Demersal							X	X			X	X	X			X	X	X			X									
	Not Known			X																			X	X						X	
Oceanography	Upwelling areas														X	X	X	X	X	X	X	X									
	Gyres																														
	Thermo/pycnocline																														
	Fronts																														
	Edges (ice, bathymetric)													X																	
	Life Stage/Activity	E	L	J	A	E	L	J	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	L	J	A	L	J	A	L	J	A	L	J	A

		Octopus			Skates			Sharks			Sculpins			Eulachon			Capelin			Squid			Atka mackerel			Thornyhead rockfish			Yelloweye rockfish		
	Life Stage/Activity	E	J	A	E	J	A	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J
Location	Beach (intertidal)										X		X	X					X			X											
	Inner Shelf (1-50 m)	X	X	X					X	X	X	X	X	X		X				X	X	X	X			X							
	Middle Shelf (50-100 m)	X	X	X	X	X	X		X	X	X	X	X	X			X	X		X	X	X				X			X	X		X	X
	Outer Shelf (100-200 m)	X	X	X	X	X	X		X	X	X	X	X	X			X	X				X				X			X	X		X	X
	Upper Slope (200-1000 m)	X	X	X	X	X	X		X	X		X	X	X			X	X					X	X	X				X	X		X	X
	Lower Slope (>1000m)																						X	X	X				X				
	Basin (> 3000 m)																							X	X								
	Bay/Estuarine														X			X													X	X
	Island pass																						X			X					X	X	
	Not Known	X	X					X																X	X		X	X			X		
Substrate	Mud/Clay/Silt			X			X			X			X	X									X						X	X			
	Sand/Granule			X			X			X			X	X	X			X	X			X	X						X	X			
	Gravel	X		X			X			X	X		X	X								X	X			X			X	X	X	X	X
	Pebble	X								X	X			X									X			X			X	X		X	X
	Cobble	X									X			X	X			X	X				X			X			X	X	X	X	X
	Boulder													X															X	X		X	X
	Bedrock																												X	X	X	X	X
	Not Applicable							X	X	X		X				X	X			X	X												
Veg.	Kelp Forest																						X			X							
	Sea Grasses																																
Pelagic Domain	Near Surface											X								X				X									
	Pelagic								X	X		X				X	X	X		X	X	X					X	X					
	Semi-demersal/Semi-pelagic		X																			X				X							
	Demersal	X		X	X	X	X		X	X	X		X	X	X			X	X			X	X						X	X	X	X	X
	Not Known																								X								
Oceanography	Upwelling areas																				X	X											
	Gyres																																
	Thermo/pycnocline																																
	Fronts													X	X			X	X		X	X				X							
	Edges (ice, bathymetric																	X	X							X							
	Life Stage/Activity	E	J	A	E	J	A	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J	A	E	L	J

HABITAT ASSOCIATIONS

		HABITAT ASSOCIATIONS																														
		Location										Substrate								Vegetation		Pelagic Domain					Oceanography					
	Life Stage/Activity	Beach (intertidal)	Inner Shelf (1-50 m)	Middle Shelf (50-100 m)	Outer Shelf (100-200 m)	Upper Slope (200-1000 m)	Lower Slope (>1000m)	Basin (> 3000 m)	Bay/Estuarine	Island pass	Not Known	Mud/Clay/Silt	Sand/Granule	Gravel	Pebble	Cobble	Boulder	Bedrock	Not Applicable	Kelp Forest	Sea Grasses	Near Surface	Pelagic	Semi-demersal/Semi-pelagic	Demersal	Not Known	Upwelling areas	Gyres	Thermo/pycnocline	Fronts	Edges (ice, bathymetric)	Life Stage/Activity
Eulachon	A			X	X	X													X				X									A
	J			X	X	X													X				X									J
	L		X																X				X									L
	E											X	X	X											X							E
Capelin	A	X	X	X	X								X			X			X				X							X	X	A
	J		X	X															X				X							X	X	J
	L		X	X															X			X										L
	E	X											X			X									X							E
Sand lance	A		X	X								X	X											X								A
	J		X	X								X	X											X								J
	L		X																X			X	X									L
	E		X										X	X											X							E
Myctophids and Bathylagids	A					X	X	X											X					X								A
	J					X	X	X											X					X								J
	L										X															X						L
	E										X															X						E
Sand fish	A		X									X	X												X							A
	J		X									X	X												X							J
	L										X															X						L
	E	X														X	X								X							E
Euphausiids	A				X	X	X	X											X				X				X				X	A
	J				X	X	X	X											X				X				X				X	J
	L										X											X	X									L
	E										X											X										E
Pholids and Stichaeids	A	X										X								X	X											A
	J	X										X								X	X											J
	L										X															X						L
	E										X															X						E
Gonostomatids	A					X	X	X											X				X									A
	J										X															X						J
	L										X															X						L
	E										X															X						E

Table 8.9.2. Summary of biological associations for groundfish in the BSAI and GOA.

BIOLOGICAL ATTRIBUTES	Walleye pollock				Pacific cod					Yellowfin sole					Greenland turbot					Arrowtooth flounder					Rock sole					Dover sole				
Life Stage/Activity	A	J	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E
Feeding Type: Carnivore	X	X			X	X	X			X	X	X			X	X				X	X	X			X	X	X			X	X	X		
Herbivore																																		
Omnivore																																		
Planktivore			X					X					X					X					X					X					X	
Detritivore																																		
Not Known																	X																	
Movements: Drift With Ocean Conditions	X	X	X	X		X	X	X																									X	
Reside in Nursery Areas										X																								
Alongshore Migrations																																		
Inshore/Offshore Migrations														X					X					X										
Not Known					X						X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X					X
Social Behavior: Solitary																																		
Schooling	X	X			X																													
Shoaling																																		
Not Known			X			X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X
Longevity of Life Stage: 1 Day																																		
1 - 30 Days				X					X																									
1 - 12 Months			X				X						X					X					X					X					X	
1 - 5 Years		X				X						X	X				X					X	X	X			X					X	X	
5 - 20 Years	X				X					X					X	X									X	X				X				
20 - 50 Years																																		
> 50 Years																																		
Not Known								X						X					X					X					X					X
Life Stage/Activity	A	J	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E	A	LJ	EJ	L	E

BIOLOGICAL ATTRIBUTES	Alaska plaice				Rex sole				Flathead sole					Sablefish					Pacific Ocean perch			Shortraker/rougheye rockfish			Northern rockfish			Dusky rockfish			Yelloweye rockfish			Thornyhead rockfish			
Life Stage/Activity	E	L	J	A	E	L	J	A	E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	A	L	J	A	L	J	A	L	J	A	L	J	A	L	J	A	E
Feeding Type: Carnivore	X	X					X	X			X	X	X			X	X	X		X	X		X	X			X			X	X	X	X			X	X
Feeding Type: Herbivore																																					
Feeding Type: Omnivore																																					
Feeding Type: Planktivore		X				X				X					X					X											X						
Feeding Type: Detritivore																																					
Feeding Type: Not Known																						X			X	X		X	X					X	X		X
Movements: Drift With Ocean Conditions										X				X	X																						
Movements: Reside in Nursery Areas																																					
Movements: Alongshore Migrations																																					
Movements: Inshore/Offshore Migrations													X			X					X																
Movements: Not Known	X	X	X	X	X	X	X	X	X		X	X		X	X				X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Social Behavior: Solitary							X	X																													
Social Behavior: Schooling																					X						X										
Social Behavior: Shoaling																																					
Social Behavior: Not Known	X	X	X	X	X				X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X		X	X	X				X	X	X	X
Longevity of Life Stage: 1 Day																																					
Longevity of Life Stage: 1 - 30 Days														X																							
Longevity of Life Stage: 1 - 12 Months		X			X										X				X																		
Longevity of Life Stage: 1 - 5 Years																X	X																				
Longevity of Life Stage: 5 - 20 Years							X													X						X										X	X
Longevity of Life Stage: 20 - 50 Years																		X												X							
Longevity of Life Stage: > 50 Years								X													X			X			X						X				
Longevity of Life Stage: Not Known	X		X	X					X	X												X	X		X			X	X					X	X		
Life Stage/Activity	E	L	J	A	L	J	A		E	L	EJ	LJ	A	E	L	EJ	LJ	A	E	L	A	L	J	A	L	J	A	L	J	A	L	J	A	L	J	A	E

	Atka mackerel				Squid				Capelin				Eulachon				Sculpins				Sharks				Skates				Octopus			
	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E
BIOLOGICAL ATTRIBUTES																																
Feeding Type																																
Life Stage/Activity	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E
Carnivore	X	X			X				X	X			X	X			X	X			X	X			X	X			X			
Herbivore																																
Omnivore																																
Planktivore			X				X			X					X				X								X				X	
Detritivore																																
Not Known								X												X			X	X				X				
Movements																																
Drift With Ocean Conditions																																
Reside in Nursery Areas																																
Alongshore Migrations																																
Inshore/Offshore Migrations	X				X								X																			
Not Known	X	X	X		X	X	X		X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Social Behavior																																
Solitary																																
Schooling	X				X								X																			
Shoaling																																
Not Known	X	X	X		X	X	X		X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Longevity of Life Stage																																
1 Day																																
1 - 30 Days	X								X				X																			
1 - 12 Months			X				X			X					X																	
1 - 5 Years	X	X			X				X	X				X															X			
5 - 20 Years																																
20 - 50 Years																																
> 50 Years																					X											
Not Known								X												X		X	X	X	X	X	X	X		X	X	X
Life Stage/Activity	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E	A	C	L	E

		BIOLOGICAL ATTRIBUTES																							
		Feeding Type						Movements					Social Behavior				Longevity of Life Stage								
	Life Stage/Activity	Carnivore	Herbivore	Omnivore	Planktivore	Detritivore	Not Known	Drift With Ocean Conditions	Reside in Nursery Areas	Alongshore Migrations	Inshore/Offshore Migrations	Not Known	Solitary	Schooling	Shoaling	Not Known	1 Day	1 - 30 Days	1 - 12 Months	1 - 5 Years	5 - 20 Years	20 - 50 Years	> 50 Years	Not Known	Life Stage/Activity
Eulachon	A				X						X			X						X					A
	J				X							X		X										X	J
	L				X			X								X								X	L
	E																	X							E
Capelin	A				X						X			X						X					A
	J				X						X			X										X	J
	L				X			X																X	L
	E																	X							E
Sand lance	A			X								X				X				X					A
	J			X								X				X								X	J
	L						X					X				X								X	L
	E						X					X				X								X	E
Myctophids and Bathylagids	A				X							X				X								X	A
	J						X					X				X								X	J
	L						X					X				X								X	L
	E						X					X				X								X	E
Sand fish	A	X										X				X								X	A
	J						X					X				X								X	J
	L						X					X				X								X	L
	E						X					X				X								X	E
Euphausiids	A				X			X							X						X				A
	J				X			X							X									X	J
	L				X			X																X	L
	E																							X	E
Pholids and Stichaeids	A			X									X								X				A
	J			X												X								X	J
	L						X									X								X	L
	E						X									X								X	E
Gonostomatids	A						X					X				X								X	A
	J						X					X				X								X	J
	L						X					X				X								X	L
	E						X					X				X								X	E

Table 8.9.3. Summary of reproductive traits for groundfish in the BSAI and GOA

	Reproductive Traits																								
	Age at Maturity				Fertilization/Egg Development					Spawning Behavior						Spawning Season									
	Female		Male																						
	50%	100%	50%	100%	External	Internal	Oviparous	Ovoviviparous	Viviparous	Batch Spawner	Broadcast Spawner	Egg Case Deposition	Nest Builder	Egg/Young Guarder	Egg/Young Bearer	Early Spring	Late Spring	Early Summer	Late Summer	Early Fall	Late Fall	Early Winter	Late Winter	Not Known
Walleye pollock	4 yrs		4 yrs		X						X					X								
Pacific cod	5 yrs		5 yrs		X					X						X						X	X	
Yellowfin sole	10.5yrs.				X						X						X	X	X					
Greenland turbot	5-10yrs.				X						X									X	X	X	X	
Arrowtooth flounder	5 yrs		4 yrs		X																			X
Rock sole	9yrs.				X					X						X							X	
Dover sole	33cm				X											X	X					X	X	
Alaska plaice	6-7yrs				X											X								
Rex sole	24cm		16cm		X											X	X	X					X	
Flathead sole					X											X								
Sablefish	65cm		57cm		X						X					X	X							
Pacific ocean perch	10.5 yrs					X			X												X	X		
Shortraker/Rougheye rockfish	20 yrs		20 yrs			X			X								X	X						
Northern rockfish	12.8 yrs					X			X								X	X						
Dusky rockfish						X			X								X	X						
Yelloweye rockfish	22 yrs		22 yrs			X			X								X	X						
Thornyhead rockfish	12 yrs									X						X							X	
Atka mackerel	3 yrs		3 yrs		X								X	X				X	X					
Squid						X											X	X						
Capelin	2 yrs	4 yrs	2 yrs	4 yrs	X						X						X	X	X					
Eulachon	3 yrs	5 yrs	3 yrs	5 yrs	X					X							X							
Sculpins					X	X							X	X								X	X	
Sharks						X		X																
Skates						X	X					X												X
Octopus						X																		X

	Reproductive Traits																								
	Age at Maturity				Fertilization/Egg Development					Spawning Behavior						Spawning Season									
	Female		Male																						
	50%	100%	50%	100%	External	Internal	Oviparous	Ovoviviparous	Viviparous	Batch Spawner	Broadcast Spawner	Egg Case Deposition	Nest Builder	Egg/Young Guarder	Egg/Young Bearer	Early Spring	Late Spring	Early Summer	Late Summer	Early Fall	Late Fall	Early Winter	Late Winter	Not Known
Eulachon	3				X		X			X						X	X							
Capelin	2				X		X			X						X	X	X	X	X				
Sand Lance	2																							X
Myctophids & Bathylagids																								X
Sand fish																								X
Euphausiids	1				X						X					X	X							
Pholids and Stichaeids	2-4				X									X		X	X					X	X	
Gonostomatids																								X

8.9.1 EFH Determination

EFH Definition for BSAI Walleye Pollock

Eggs(duration 14-25 days) - Level 1
Pelagic waters of the outer continental shelf and upper slope of the eastern Bering Sea from Unimak Island northwest to Zhenchug Canyon. Also in pelagic waters (200-400 m) depth) over basin and lower slope areas in the Aleutian Islands and the Aleutian Basin. These are likely areas of upwelling or have gyres. Spawning occurs in February-April.

Larvae (duration 60 days) - Level 1
Epipelagic waters on the inner, middle, and outer continental shelf and upper slope throughout the eastern Bering Sea, eastern portions of the Aleutian Basin and throughout the Aleutians Islands. Survival is enhanced where food (copepod nauplii and small euphausiids) is concentrated, such as along semi-permanent fronts (mid-shelf front near the 100 m isobath) in the eastern Bering Sea, within ephemeral gyres, and possibly in association with jellyfish.

Juveniles (up to 4 years) - Level 1
Throughout the eastern Bering Sea and the Aleutian Islands both pelagically and on-bottom (no known substrate preferences) throughout the inner, middle, and outer shelf regions. At ages 2 and 3 years, pollock are located off-bottom within the water column, principally in the middle and outer shelf regions northwest of the Pribilof Islands. Ranges of juveniles of strong year-classes have varied from throughout the eastern Bering Sea (1978 year-class) to almost exclusively north of Zhenchug Canyon (1989 year-class). Feeding areas contain pelagic crustaceans such as copepods and euphausiids.

Adults (4+ years old) - Level 2
Meso-pelagic and semi-demersal habitats (no known substrate preferences) along the middle and outer continental shelf in the eastern Bering Sea from the U.S. Russia Convention Line to Unimak Pass and northeast along the Alaska Peninsula and throughout the Aleutian Islands. Also exists pelagically over deep Aleutian basin waters. Feeding areas are those that concentrate pelagic crustaceans (e.g., euphausiids) and juvenile fish (primarily juvenile pollock), such as in upwelling regions along the shelf break or fronts on the middle shelf. Known spawning areas in the eastern Bering Sea are: north of Unimak Island, along the mid-shelf front (100m isobath)between Unimak Island and the Pribilof Islands, south of the Pribilof Islands, and possibly at other areas to the north, particularly at heads of submarine canyons. Known spawning areas in the Aleutian Islands are : over deep waters north of Umnak and Unalaska Islands, the region north of the Islands of Four Mountains, through Amukta Pass to Seguam Island, and north of Kanaga and Tanaga Islands. Pollock may prefer waters of 2-3°C for spawning.

EFH Definition for BSAI Pacific Cod

Eggs(duration 15-20 days) - Level 0_a
Areas of mud and sand on the inner, middle, and outer continental shelf and upper slope throughout the eastern Bering Sea and Aleutian Islands in winter and spring.

Larvae (duration unknown)- Level 0_a
Epipelagic waters throughout the eastern Bering Sea and Aleutian Islands regions in winter and spring.

Early Juveniles (up to 2 years) - Level 0_a
Areas of mud and sand and the water column on the inner and middle continental shelf of the eastern Bering Sea and Aleutian Islands, particularly those with mysids, euphausiids and shrimp.

Late Juveniles (2-4 years) - Level 1
Areas of soft substrate (clay, mud, and sand) and the lower portion of the water column on the inner, middle, and outer continental shelf areas of the eastern Bering Sea and Aleutian Islands, particularly those with mysids, euphausiids, shrimp, pollock, flatfish, crab, and fishery discards.

Adults (4+ years old) - Level 2
Areas of mud and sand along the inner, middle, and outer continental shelf up to 500m along with the lower portion of the water column of the eastern Bering Sea and Aleutian Islands. Spawning occurs in January-May near the bottom across broad areas of the shelf, but predominately along the outer shelf between 100-200 m in the eastern Bering Sea, and throughout the area<200m in the Aleutian Islands. After spawning, the mature population spreads out throughout the shelf in the eastern Bering Sea and Aleutian Islands, but with concentrations along the outer shelf northwest of the Pribilof Islands and along the outer and middle shelf areas northwest of the Alaskan Peninsula and into Bristol Bay. Feeding areas are those containing pollock, flatfish, and crab.

<u>EFH Definition for BSAI Yellowfin Sole</u>

Eggs (duration unknown)- Level 0_a
Pelagic inshore waters of the southeastern Bering Sea shelf from Norton Sound to Bristol Bay in spring and summer.

Larvae (duration 2-3 months) - Level 0_a
Pelagic inshore waters of the southeastern Bering Sea shelf from Norton Sound to Bristol Bay in spring, summer and fall.

Early Juveniles (to 5.5 years old) - Level 0_a
Demersal areas (bottom and lower portion of the water column) on the inner, middle and outer portions of the continental shelf (down to 250 m) and within nearshore bays of the eastern Bering Sea.

Late Juveniles (5.5 - 9 years old) - Level 1
Areas of sandy bottom along with the lower portion of the water column within nearshore bays and on the inner, middle and outer portions of the continental shelf (down to 250 m) of the eastern Bering Sea south of St Matthew Island (approximately 61° N) and in Norton Sound. Feeding areas would be those containing polychaetes, bivalves, amphipods and echiurids.

Adults (9+ years old) - Level 2
Areas of sandy bottom along with the lower portion of the water column on the inner, middle and outer portions of the continental shelf (down to 250 m) of the eastern Bering Sea south of St. Matthew Island (approximately 61° N) and in Norton Sound. Areas of known concentrations vary seasonally. Adult spawning areas in summer (May-August) are located along the inner shelf from Cape Constantine to Cape Peirce, throughout Kuskokwim Bay, and North of Nunivak Island. Summer (June-October) feeding concentrations of adults are located along the inner and middle portions of the shelf from Kuskokwim and Bristol Bays south along the Alaskan Peninsula to Amak Island, and northwest to St. Matthew Island. Feeding areas would be those containing polychaetes, bivalves, amphipods and echiurids. In winter, yellowfin sole adults migrate to deeper waters of the shelf (100-200 m) south of 60°N to the Alaskan Peninsula.

EFH Definition for BSAI Greenland Turbot

Eggs (duration unknown)- Level 0_a
Benthypelagic waters of the outer continental shelf and slope in the eastern Bering Sea and throughout the Aleutian Islands.

Larvae (8-9 months) - Level 0_a
Pelagic waters of the outer continental shelf, slope, and adjacent basin in the eastern Bering Sea and throughout the Aleutian Islands.

Early Juveniles (to 4 years old) - Level 0_a
Substrate and lower portion of the water column of the inner, middle and outer portions of the continental shelf and the adjacent upper slope region of the eastern Bering Sea and throughout the Aleutian Islands.

Late Juveniles (4 - 5 years old) - Level 1
Substrate (particularly mud and muddy-sand) and lower portion of the water column of the middle and outer continental shelf and adjacent upper and lower slope regions of the eastern Bering Sea and throughout the Aleutian Islands. Feeding areas would be those containing euphausiids, polychaetes, and small fish.

Adults (5+ years old) - Level 2
Substrate (particularly mud and muddy-sand) and lower portion of the water column of the outer continental shelf and adjacent upper and lower slope regions of the eastern Bering Sea and throughout the Aleutian Islands. Feeding areas would be those containing pollock and small fish.

EFH Definition for BSAI Arrowtooth flounder

Eggs (duration unknown)- Level 0_a
Pelagic waters of the middle and outer continental shelf and slope in the eastern Bering Sea and throughout the Aleutian Islands in winter.

Larvae (duration 2-3 months) - Level 0_a
Pelagic waters of the inner, middle and outer continental shelf and adjacent nearshore bays in the eastern Bering Sea and throughout the Aleutian Islands.

Early Juveniles (to 2 years old) - Level 0_a
Areas of gravel, sand and mud and the associated water column of the inner continental shelf and the adjacent nearshore bays in the eastern Bering Sea and throughout the Aleutian Islands.

Late Juveniles (2 - 4 years old) - Level 1
Areas of gravel, sand and mud and the associated water column of the middle and outer continental shelf and adjacent upper slope regions of the eastern Bering Sea and throughout the Aleutian Islands. Feeding areas would be those containing euphausiids, crustaceans, and small fish.

Adults (4+ years old) - Level 2
Areas of gravel, sand and mud and the associated water column of the middle and outer continental shelf and adjacent upper slope regions of the eastern Bering Sea and throughout the Aleutian Islands. Summer feeding areas on the middle and outer shelf would be those containing gadids, euphausiids, and other fish. Spawning areas in winter are on the outer shelf and upper slope regions.

EFH Definition for BSAI Rock Sole

Eggs (duration unknown) - Level 0_a
Areas of pebbles and sand on the middle and outer continental shelf in the eastern Bering Sea in winter (December-March).

Larvae (duration 2-3 months) - Level 0_a
Pelagic waters of the eastern Bering Sea over the inner, middle and outer continental shelf, the slope, and the Aleutian Basin.

Early Juveniles (to 3.5 years old) - Level 0_a
Inner, middle and outer portions of the continental shelf along with the lower portion of the water column of the eastern Bering Sea south of 61°N and in Norton Sound. Feeding areas would be those containing polychaetes, bivalves, amphipods and crustaceans.

Late Juveniles (3.5 - 8 years old) - Level 1
Areas of pebbles and sand along with the lower portion of the water column within nearshore bays and on the inner, middle and outer portions of the continental shelf of the eastern Bering Sea south of 61° N and in Norton Sound. Feeding areas would be those containing polychaetes, bivalves, amphipods and crustaceans.

Adults (8+ years old) - Level 2
Areas of pebbles and sand along with the lower portion of the water column on the inner, middle and outer portions of the continental shelf of the eastern Bering Sea south of 61° N and in Norton Sound. Areas of known concentrations vary seasonally and include adult spawning areas in winter and feeding areas in summer (May-October), which include Bristol Bay, portions of outer Kuskokwim Bay, north of the Alaskan Peninsula to Unimak Island, and near the Pribilof Islands. Feeding areas would be those containing polychaetes, bivalves, amphipods and crustaceans.

EFH Definition for BSAI Other Flatfish - Alaska plaice

Eggs (duration unknown)-Level 0_a
Pelagic waters of the middle and outer continental shelf of the eastern Bering Sea in spring and early summer.

Larvae (duration 2-4 months)-Level 0_a
Pelagic waters of the inner, middle and outer continental shelf of the eastern Bering Sea in summer and fall.

Early Juveniles (up to 4 years)-Level 0_a
Substrate (particularly areas of sand and mud) and lower portion of the water column on the inner and middle continental shelf of the eastern Bering Sea.

Late Juveniles (4-7 years)-Level 1
Substrate (particularly areas of sand and mud) and lower portion of the water column on the inner, middle and outer continental shelf of the eastern Bering Sea. Feeding areas will be those containing polychaetes, amphipods, and echiurids. With increasing age, plaice overwinter near the edge of the shelf, and return to the middle and inner shelf for feeding in spring, summer and fall.

Adults (7+ years)- Level 2
Substrate (particularly areas of sand and mud) and lower portion of the water column on the inner, middle and outer continental shelf of the eastern Bering Sea. Feeding areas will be those containing polychaetes, amphipods, and echiurids. Overwinters near the edge of the shelf in the southeastern Bering Sea from the Pribilof islands to Unimak Island and north along the Alaskan peninsula. Occurs across broad areas of the middle and inner shelf on summer and fall.

EFH Definition for BSAI Flathead Sole

Eggs (duration unknown)- Level 0_a
Pelagic waters of the middle and outer portions of the southeastern Bering Sea shelf, adjacent slope and basin waters, and throughout the Aleutian Islands in winter and early spring.

Larvae (duration unknown)- Level 0_a
Pelagic waters of the inner, middle, and outer portions of the southeastern Bering Sea shelf, adjacent slope and basin waters, and throughout the Aleutian Islands in spring and summer.

Early Juveniles (to 2 years old) - Level 0_a
Bottom substrate and lower water column on the inner, middle and outer portions of the southeastern Bering Sea shelf and throughout the Aleutians Islands.

Late Juveniles (2 - 3 years old) - Level 1
Bottom substrate (particularly sand and mud) and lower portion of the water column on the inner, middle, and outer portions of the southeastern Bering Sea shelf south of 61°N and throughout the Aleutian Islands. Feeding areas would be those containing polychaetes, bivalves, ophiuroids, pollock, small tanner crab and other crustaceans.

Adults (3+ years old) - Level 2
Bottom substrate (particularly sand and mud) and lower portion of the water column on the inner, middle, and outer portions of the southeastern Bering Sea shelf south of 61°N and throughout the Aleutian Islands. Feeding areas, primarily on the inner, middle and outer shelf in spring, summer and fall, are those containing polychaetes, bivalves, ophiuroids, pollock, small tanner crab and other crustaceans. Spawning areas in winter and early spring are located primarily on the outer shelf.

EFH definition for BSAI Sablefish

Eggs (duration 14-20 days)- Level 0_a
Pelagic waters of the upper and lower slope, and basin areas from 200-3000 m from late winter to early spring (December-April) in the eastern Bering Sea and Aleutian Islands.

Larvae (duration up to 3 months)-Level 0_a
Epipelagic waters of the middle and outer continental shelf, the slope and basin areas in the eastern Bering Sea and Aleutian Islands during late spring-early summer months (April - July).

Early Juveniles (up to 2 years)- Level 0_a
Pelagic waters, during first summer, along the outer, middle, and inner continental shelf of the eastern Bering Sea and Aleutian Islands. Areas of soft-bottom in nearshore bays and island passes after the first summer until end of second summer.

Late Juveniles (2-5 years)- Level 1
Areas of soft bottom deeper than 200m associated with the continental slope and deep shelf gulleys and fjords (presumably within the lower portion of the water column) of the eastern Bering Sea and Aleutian Islands. Feeding areas are those containing mesopelagic and benthic fishes, benthic invertebrates and jellyfish.

Adults (5+years)- Level 2
Areas of soft bottom deeper than 200m (presumably within the lower portion of the water column) associated with the continental slope and deep shelf gulleys in the eastern Bering Sea and Aleutian Islands. Feeding areas would be those containing mesopelagic and benthic fishes, benthic invertebrates and jellyfish. A large portion of the adult diet is comprised of gadid fishes mainly pollock.

<u>EFH definition for BSAI Pacific Ocean Perch</u>

Eggs (internal incubation, ~90days) No EFH definition determined.
Internal fertilization and incubation. Incubation is assumed to occur during the winter months.

Larvae (duration 60-180 days)- Level 0_a
Pelagic waters of the inner, middle, and outer continental shelf, the upper and lower slope and the basin areas of the Bering Sea and Aleutian Islands, during the spring and summer months.

Early Juveniles (larval stage to 3 years) - Level 0_a
Initially pelagic, then demersal in very rocky areas of the inner continental shelf of the Bering Sea and Aleutian Islands. Includes the water column.

Late Juveniles (3 to 10 years) - Level 1
Areas of cobble, gravel, mud, and sand along the inner, middle, and outer continental shelf and upper slope areas, shallower than adults, and the middle and lower portions of the water column of the Bering Sea and Aleutian Islands Regions. Feeding areas are those containing euphausiids.

Adults (10+ years)- Level 1
Areas of cobble, gravel, mud, and sand along the outer continental shelf and upper slope areas and middle and lower portions oft the water column of the Bering Sea and Aleutian Islands. Feeding areas are those containing euphausiids. Areas of high concentrations tend to vary seasonally and may be related to spawning behavior. In summer, adults inhabit shallower depths (180-250m) and in the fall they migrate farther offshore (300-420m).

<u>EFH definition for BSAI POP complex, Shortraker and Rougheye rockfish</u>

Eggs - No EFH definition determined.
Internal fertilization and incubation.

Larvae (duration unknown)- Level 0_b
Epipelagic waters of the inner, middle, and outer continental shelf, the upper and lower slope and the basin areas of the Bering Sea and Aleutian Islands, during the spring and summer months.

Early Juveniles - Level 0_{a-b}
Pelagic waters and substrate on the entire continental shelf of the Bering Sea and Aleutian Islands Regions.

Late Juveniles - Level 0_b and level 1
Areas shallower than adult along the continental shelf of the Bering Sea and Aleutian Islands Regions. Juvenile shortraker rockfish have been only rarely seen.

Adults (15+ years)-Level 1
Areas of mud, sand, rock, cobble, and gravel and the lower portion of the water column on the outer continental shelf and upper slope of the Bering Sea and Aleutian Islands. Fishery concentrations at 100-500 m. Feeding areas would be those areas where shrimps, squid and myctophids occur.

<u>EFH definition for BSAI POP complex, Northern rockfish</u>

Eggs- No EFH definition determined.
Internal fertilization and incubation.

Larvae- Level 0_b
Pelagic waters of the inner, middle, and outer continental shelf, the upper and lower slope and the basin areas extending to the seaward boundary of the EEZ of the Bering Sea and Aleutian Islands, during the spring and summer months.

Early juveniles (up to 25cm)-Level 0_b
Pelagic waters and substrate of the inner, middle, and outer continental shelf of the Bering Sea and Aleutian Islands.

Late Juveniles (greater than 25 cm)-Level 1
Areas of cobble and rock along the shallower regions (relative to adults) of the outer continental shelf of the Bering Sea and Aleutian Islands.

Adults (13+years)- Level 1
Areas of cobble and rock along the outer continental slope and upper slope regions and the middle and lower portions of the water column of the Bering Sea and Aleutian Islands. Areas of relatively shallow banks of the outer continental shelf have been found to have concentrated populations.

<u>EFH definition for BSAI Other rockfish, Dusky rockfish</u>

Eggs-No EFH definition determined.
Internal fertilization and incubation.

Larvae- Level 0_b
Pelagic waters of the inner, middle, and outer continental shelf, the upper and lower slope and the basin areas extending to the seaward boundary of the EEZ of the Bering Sea and Aleutian Islands, during the spring and summer months.

Early juveniles (up to 25cm)-Level 0_b
Pelagic waters of the inner, middle, and outer continental shelf of the Bering Sea and Aleutian Islands.

Juveniles (greater than 25cm)- Level 0_a
Areas of cobble, rock and gravel and the water column along the inner, middle, and outer continental shelf of the Bering Sea and Aleutian Islands..

Adults (up to 50 years) -Level 1
Areas of cobble, rock and gravel along the outer continental shelf and upper slope region and the middle and lower portions of the water column of the Bering Sea and Aleutian Islands. Feeding areas are those containing euphausiids.

<u>EFH definition for BSAI Other rockfish, Thornyhead rockfish</u>

Eggs- Level 0_a
Pelagic waters of the Bering Sea and Aleutian Islands during the late winter and early spring.

Larvae (duration <15 months)- Level 0_a
Pelagic waters of the Bering Sea and Aleutian Islands.

Juveniles (> 15 months)- Level 0_a
Areas of mud, sand, rock, cobble, and gravel and the lower portion of the water column along the middle and outer continental shelf and upper slope of the Bering Sea and Aleutian Islands.

Adults (12+ years)- Level 1
Areas of mud, sand, rock, cobble, and gravel and the lower portion of the water column along the middle and outer continental shelf and upper and lower slope of the Bering Sea and Aleutian Islands. Feeding areas are those containing shrimp, fish (cottids), and small crabs.

<u>EFH Definition for BSAI Atka mackerel</u>

Eggs (duration 1-1.5 months)-Level 0_a
Areas of gravel, rock and kelp in shallow water in island passes, nearshore, and on the inner continental shelf in the Aleutian Islands and south eastern Bering Sea in areas of swift current in summer.

Larvae (duration 1.5-6 months) -Level 0_a
Epipelagic waters of the outer continental shelf of the southeastern Bering Sea and Aleutian Islands, the Aleutian Basin (to the edge of the EEZ), and in the adjacent North Pacific Ocean (to the edge of the EEZ) in fall and winter.

Juveniles (up to 3 years)- Level 0_b
Unknown habitat association; assumed to settle near areas inhabited by adults, but have not been observed in fishery or surveys.

Adults (3+ years)-Level 2
Areas of gravel, rock and kelp on the inner, middle and outer portions of the shelf in the Aleutian Islands and the entire water column to the surface. Areas of gravel and rock on the outer portion of the shelf in the SE Bering Sea and extending nearshore near the Pribilof Islands, including the entire water column. Feeding areas are those containing copepods, euphausiids and meso-pelagic fish (myctophids). Spawning occurs in nearshore (inner shelf and in island passes) rocky areas and in kelp in shallow waters in summer. Move to offshore deeper areas nearby in winter. Perform diurnal/tidal movements between demersal and pelagic areas.

EFH Definition for BSAI Other species- Sculpins

Eggs - Level 0_a
All substrates on the inner, middle and outer continental shelf of the eastern Bering Sea and Aleutian Islands. Some species deposit eggs in rocky shallow waters near shore.

Larvae- Level 0_a
Pelagic waters of the inner, middle and outer continental shelf and slope of the eastern Bering Sea and Aleutian Islands, predominately over the inner and middle shelf.

Juveniles - Level 0_a
Broad range of demersal habitats from intertidal pools, all shelf substrates (mud, sand, gravel, etc.) and rocky areas of the upper slope of the eastern Bering Sea and Aleutian Islands.

Adults - Level 1
Broad range of demersal habitats from intertidal pools, all shelf substrates (mud, sand, gravel, etc.) and rocky areas of the upper slope of the eastern Bering Sea and Aleutian Islands.

EFH Definition for BSAI Other Species -Skates

Eggs-Level 0_a
All bottom substrates of the slope and across the shelf throughout the eastern Bering Sea and Aleutian Islands.

Larvae- No EFH definition determined.
Not applicable (no larval stage)

Juveniles-Level 0_a
Broad range of substrate types (mud, sand, gravel, and rock) and the water column on the shelf and the upper slope of the eastern Bering Sea and Aleutian Islands.

Adults- Level 1
Broad range of substrate types (mud, sand, gravel, and rock) and the lower portion of the water column on the shelf and the upper slope of the eastern Bering Sea and Aleutian Islands.

EFH Definition for BSAI Other Species -Sharks

Eggs- No EFH definition determined.
Not applicable (most are oviparous)

Larvae- No EFH definition determined.
Not applicable (no larval stage)

Juveniles and Adults-Level 0_a
All waters and substrate types in the inner, middle and outer continental shelf and slope of the Bering Sea and Aleutian Islands.

EFH Definition for BSAI Other Species -Octopus

Eggs-Level 0_a
All bottom substrates of the shelf throughout the eastern Bering Sea and Aleutian Islands.

Larvae- No EFH definition determined.
Not applicable (no larval stage)

Juveniles and Adults-Level 0_a
Broad range of substrate types (mostly rock, gravel, and sand) and the lower portion of the water column on the shelf and the upper slope of the eastern Bering Sea and Aleutian Islands. Feeding areas are those containing crustaceans and molluscs.

EFH Definition for BSAI Squid - Red Squid

Eggs-Level 0_a
Areas of mud and sand on the upper and lower slope throughout the eastern Bering Sea and Aleutian Islands.

Larvae- No EFH definition determined.
Not applicable (no larval stage)

Juveniles and Adults-Level 0_a
Pelagic waters of the shelf, slope and basin to the seaward edge of the EEZ in the eastern Bering Sea and Aleutian Islands. Feeding areas are those containing euphausiids, shrimp, forage fish, and other cephalopods.

EFH Definition for BSAI Forage fish complex, Eulachon

Eggs (duration 30-40 days) - Level 0_a
Bottom substrates of sand, gravel and cobble in rivers during April-June.

Larvae (duration 1-2 months) - Level 0_a
Pelagic waters of the inner continental shelf throughout the eastern Bering Sea.

Juveniles (to 3 years of age) - Level 0_a
Pelagic waters of the middle and outer continental shelf and upper slope throughout the eastern Bering Sea.

Adults (3+ years)- Level 0_a
Pelagic waters of the middle to outer continental shelf and upper slope throughout the eastern Bering Sea for non-spawning fishes (July-April). Feeding areas are those containing euphausiids and copepods. Rivers during spawning (April-June).

EFH Definition for BSAI Forage fish complex, Capelin

Eggs (duration 2-3 weeks) - Level 0_a
Sand and cobble intertidal beaches down to 10 m depth along the shores of the eastern Bering Sea in Bristol Bay, Norton Sound, and along the northern shore of the Alaskan Peninsula during May-August.

Larvae (duration 4-8 months) - Level 0_a
Epipelagic waters of the inner and middle continental shelf throughout the eastern Bering Sea.

Juveniles (1-2 yrs)- Level 0_a
Pelagic waters of the inner and middle continental shelf throughout the eastern Bering Sea. May be associated with fronts and ice edges in winter.

Adults(2+ yrs)- Level 0_a
Pelagic waters of the inner, middle and outer continental shelf throughout the eastern Bering Sea during their non-spawning cycle (September-April). Populations associated with fronts and the ice edge formed in winter. Intertidal beaches of sand and cobble down to 10 m depth during spawning (May-August).

EFH Definition for BSAI Forage fish complex, Sand lance

Eggs (3-6 weeks) - Level 0_a
Bottom substrate of sand to sandy gravel along the inner continental shelf throughout the eastern Bering Sea and the Aleutians Islands.

Larvae (100-131 days) - Level 0_a
Pelagic and neustonic waters along the inner continental shelf throughout the eastern Bering Sea and the Aleutians Islands.

Juveniles - Level 0_a
Soft bottom substrates (sand, mud) and the entire water column of the inner and middle continental shelf throughout the eastern Bering Sea and the Aleutians Islands. Feeding areas contain zooplankton, calanoid copepods, mysid shrimps crustacean larvae, gammarid amphipods and chaetognaths.

Adults- Level 0_a
Soft bottom substrates (sand, mud) and the entire water column of the inner and middle continental shelf throughout the eastern Bering Sea and the Aleutians Islands. Feeding areas contain zooplankton, calanoid copepods, mysid shrimps crustacean larvae, gammarid amphipods and chaetognaths.

EFH Definition for BSAI Forage fish complex, Myctophids and Bathylagids

Eggs - Level 0_c - No EFH definition determined
No information available at this time.

Larvae - Level 0_c - No EFH definition determined
No information available at this time.

Juveniles - Level 0_a
Pelagic waters ranging from near surface to lower portion of water column of the slope and basin regions throughout the eastern Bering Sea, the Aleutians Islands, and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean.

Adults- Level 0_a
Pelagic waters ranging from near surface to lower portion of water column of the slope and basin regions throughout the eastern Bering Sea, the Aleutians Islands, and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean.

EFH Definition for BSAI Forage fish complex, Sand fish

Eggs - Level 0_a
Egg masses attached to rock in nearshore areas throughout the eastern Bering Sea and the Aleutians Islands.

Larvae - Level 0_c - No EFH definition determined
No information available at this time.

Juveniles - Level 0_a
Bottom substrates of mud and sand of the inner continental shelf throughout the eastern Bering Sea and the Aleutians Islands.

Adults- Level 0_a
Bottom substrates of mud and sand of the inner continental shelf throughout the eastern Bering Sea and the Aleutians Islands.

EFH Definition for BSAI Forage fish complex, Euphausiids

Eggs - Level 0_a
Neustonic waters throughout the eastern Bering Sea, the Aleutians Islands, and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean in spring.

Larvae - Level 0_a
Epipelagic waters throughout the eastern Bering Sea, the Aleutians Islands, and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean in spring.

Juveniles - Level 0_a
Pelagic waters throughout the eastern Bering Sea, the Aleutians Islands and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean. Dense populations are associated with upwelling or nutrient-rich areas, such as the edge of the continental shelf, heads of submarine canyons, edges of gullies on the continental shelf, in island passes along the Aleutian Islands and over submerged seamounts.

Adults- Level 0_a
Pelagic waters throughout the eastern Bering Sea, the Aleutians Islands and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean. Dense populations are associated with upwelling or nutrient-rich areas, such as the edge of the continental shelf, heads of submarine canyons, edges of gullies on the continental shelf, in island passes along the Aleutian Islands and over submerged seamounts.

EFH Definition for BSAI Forage fish complex, Pholids and Stichaeids

Eggs - Level 0_c - No EFH definition determined
No information available at this time.

Larvae - Level 0_c - No EFH definition determined
No information available at this time.

Juveniles - Level 0_a
Intertidal to demersal waters of the inner continental shelf with mud substrate throughout the eastern Bering Sea and the Aleutians Islands. Certain species are associated with vegetation such as eelgrass and kelp.

Adults- Level 0_a
Intertidal to demersal waters of the inner continental shelf with mud substrate throughout the eastern Bering Sea and the Aleutians Islands. Certain species are associated with vegetation such as eelgrass and kelp.

EFH Definition for BSAI Forage fish complex, Gonostomatids

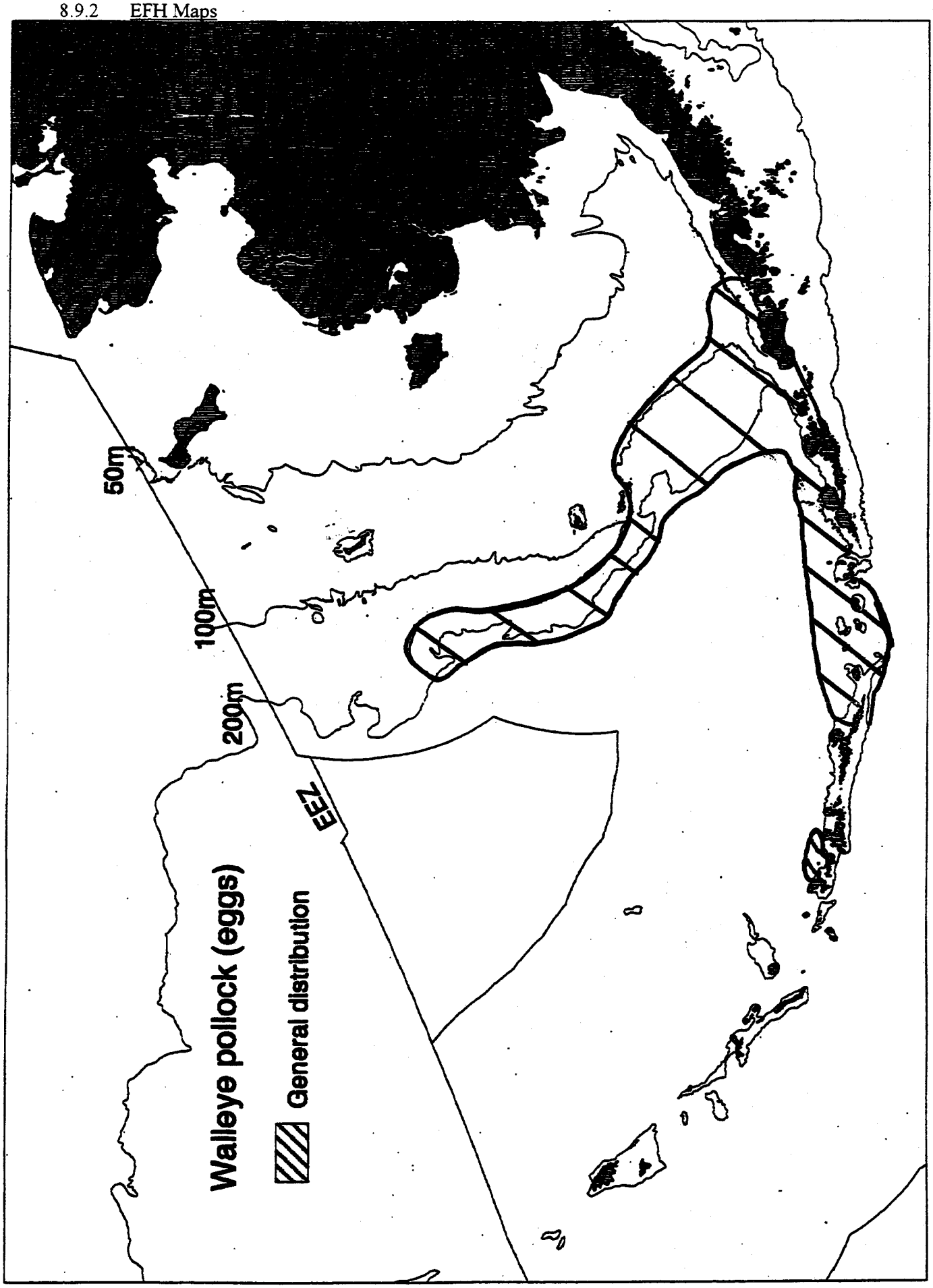
Eggs - Level 0_c - No EFH definition determined
No information is available at this time.

Larvae - Level 0_c - No EFH definition determined
No information is available at this time.

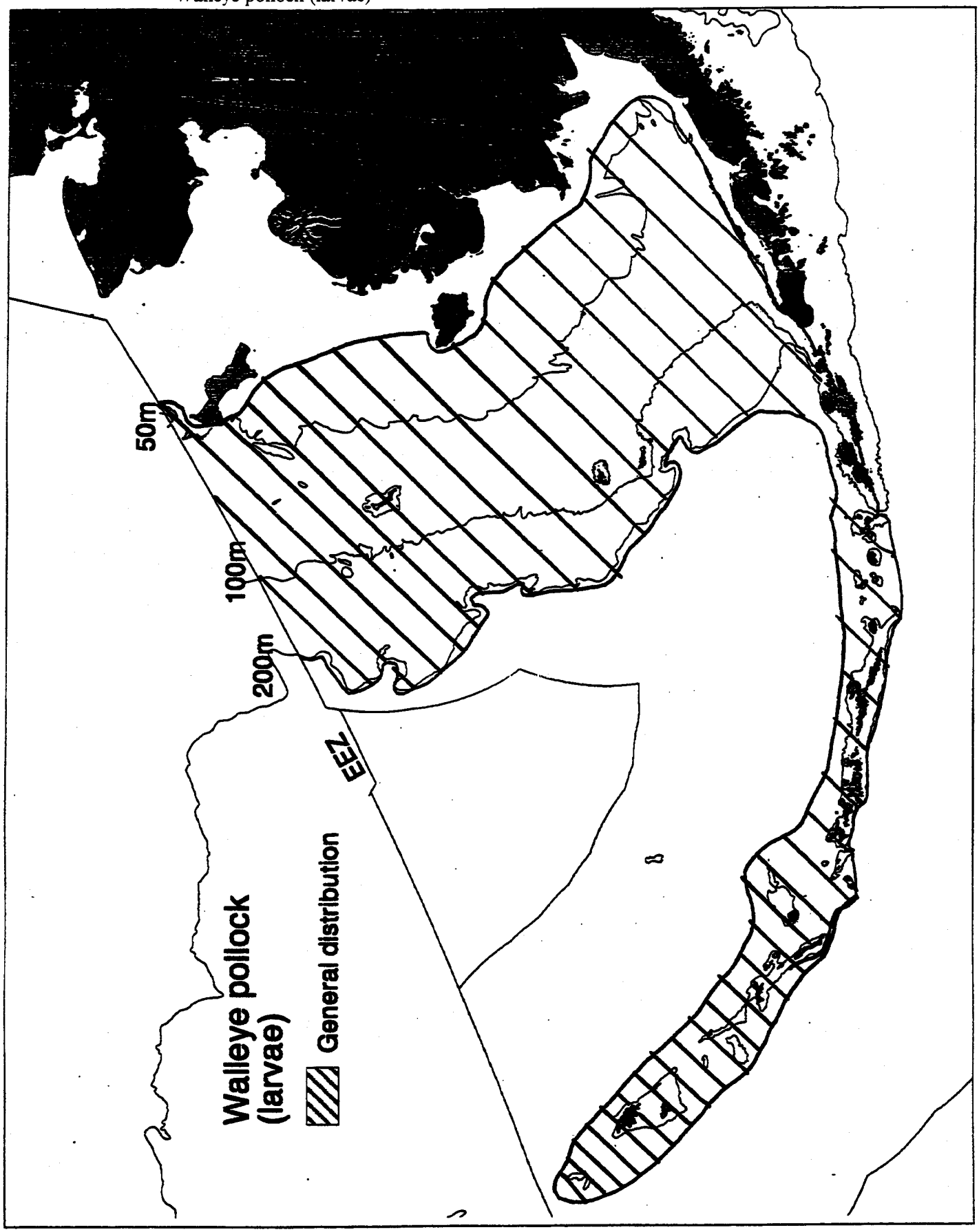
Juveniles - Level 0_c - No EFH definition determined
No information is available at this time.

Adults- Level 0_a
Bathypelagic waters throughout the eastern Bering Sea, Aleutians Islands, and to the seaward extent of the EEZ in the Bering Sea and North Pacific Ocean.

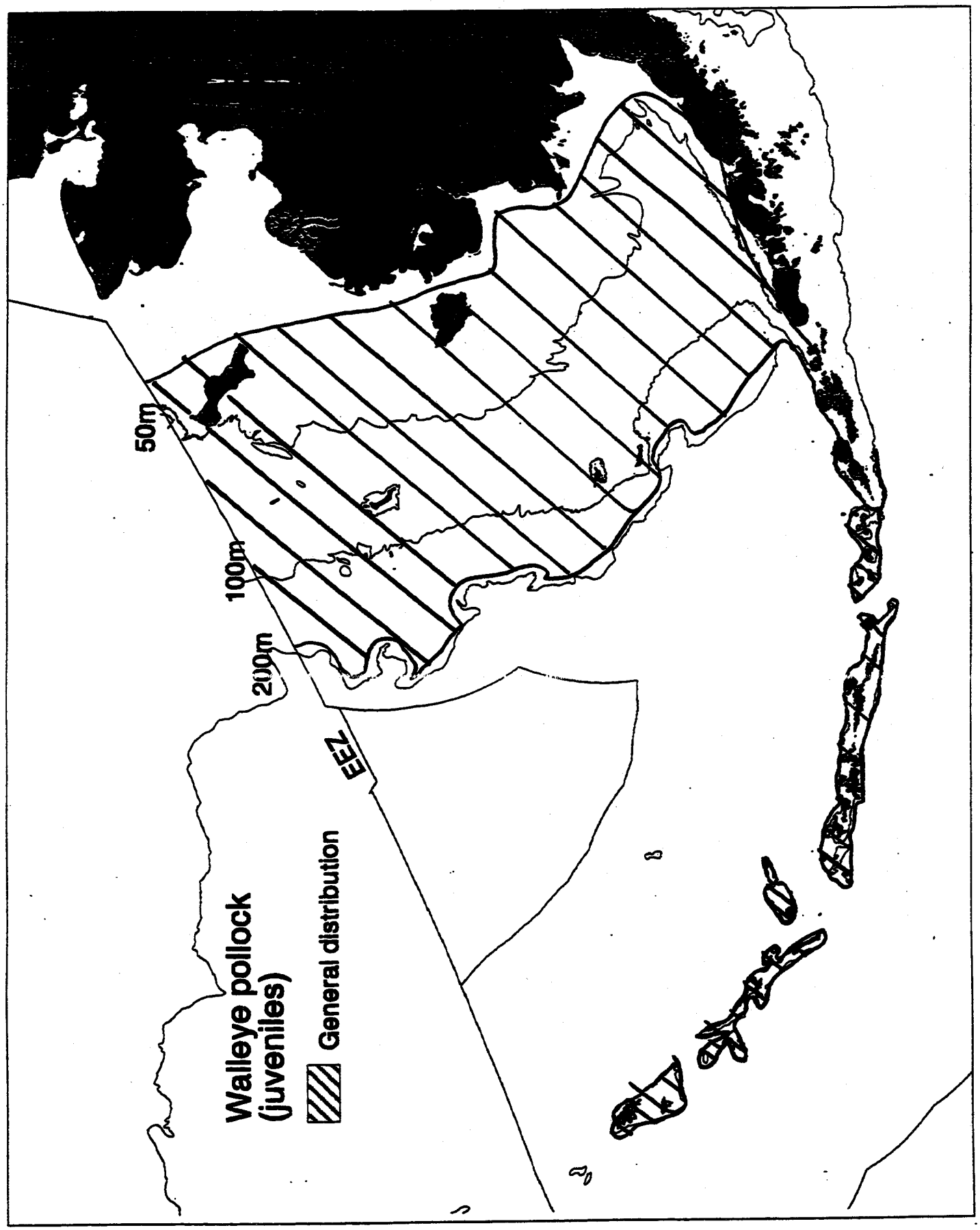
8.9.2 EFH Maps


Walleye pollock (eggs)
General distribution
50m
100m
200m
EEZ

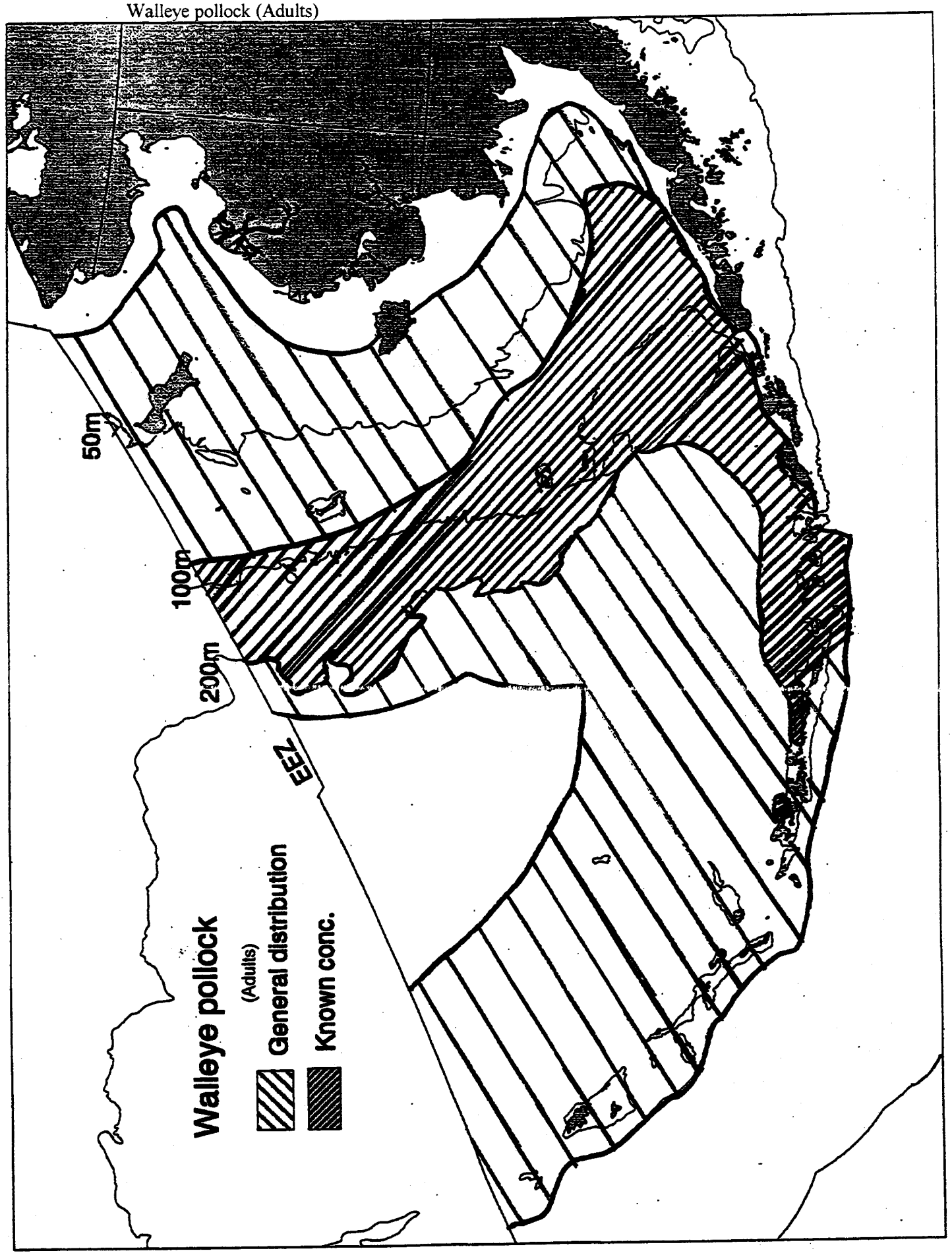
Walleye pollock (larvae)



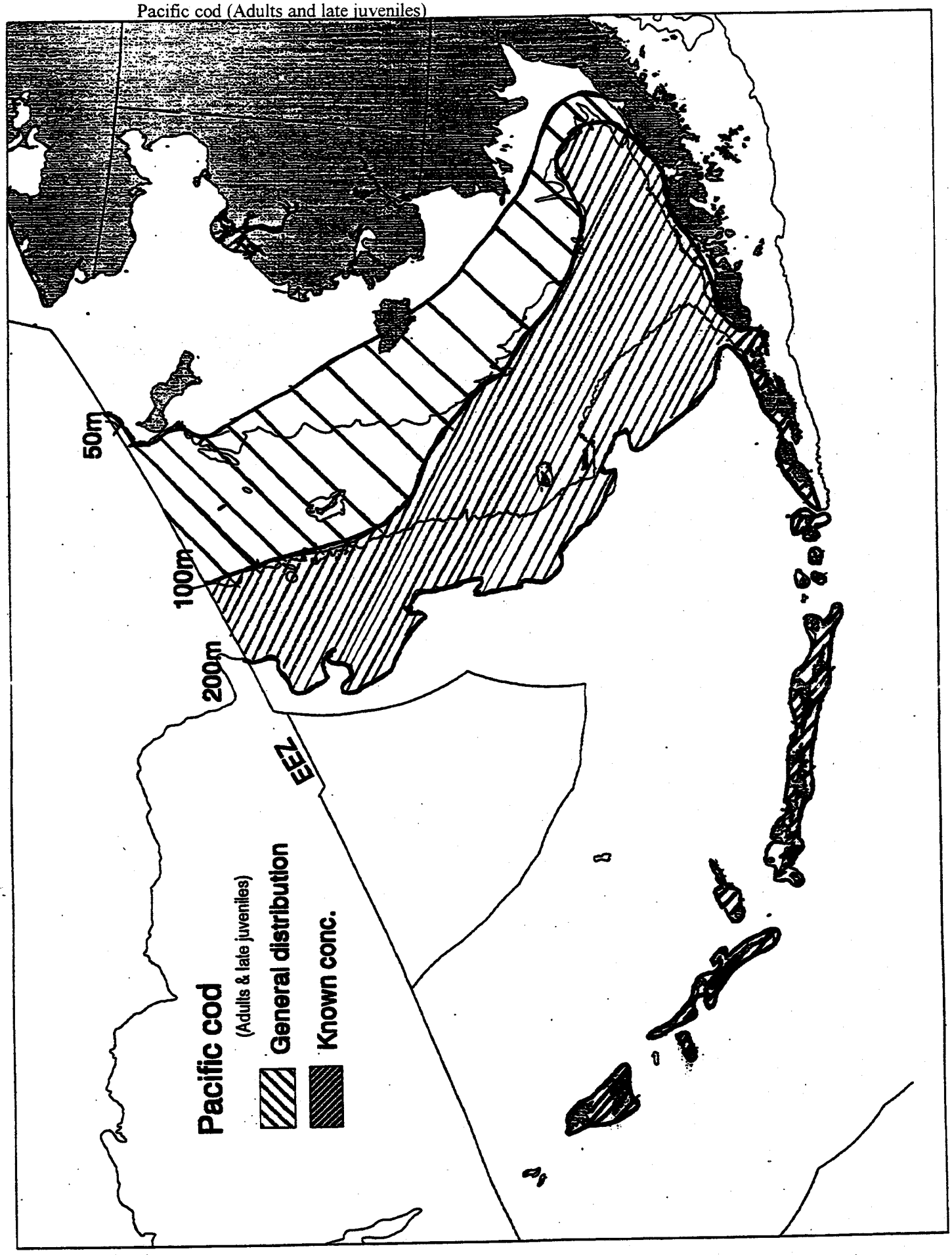
Walleye pollock (juveniles)



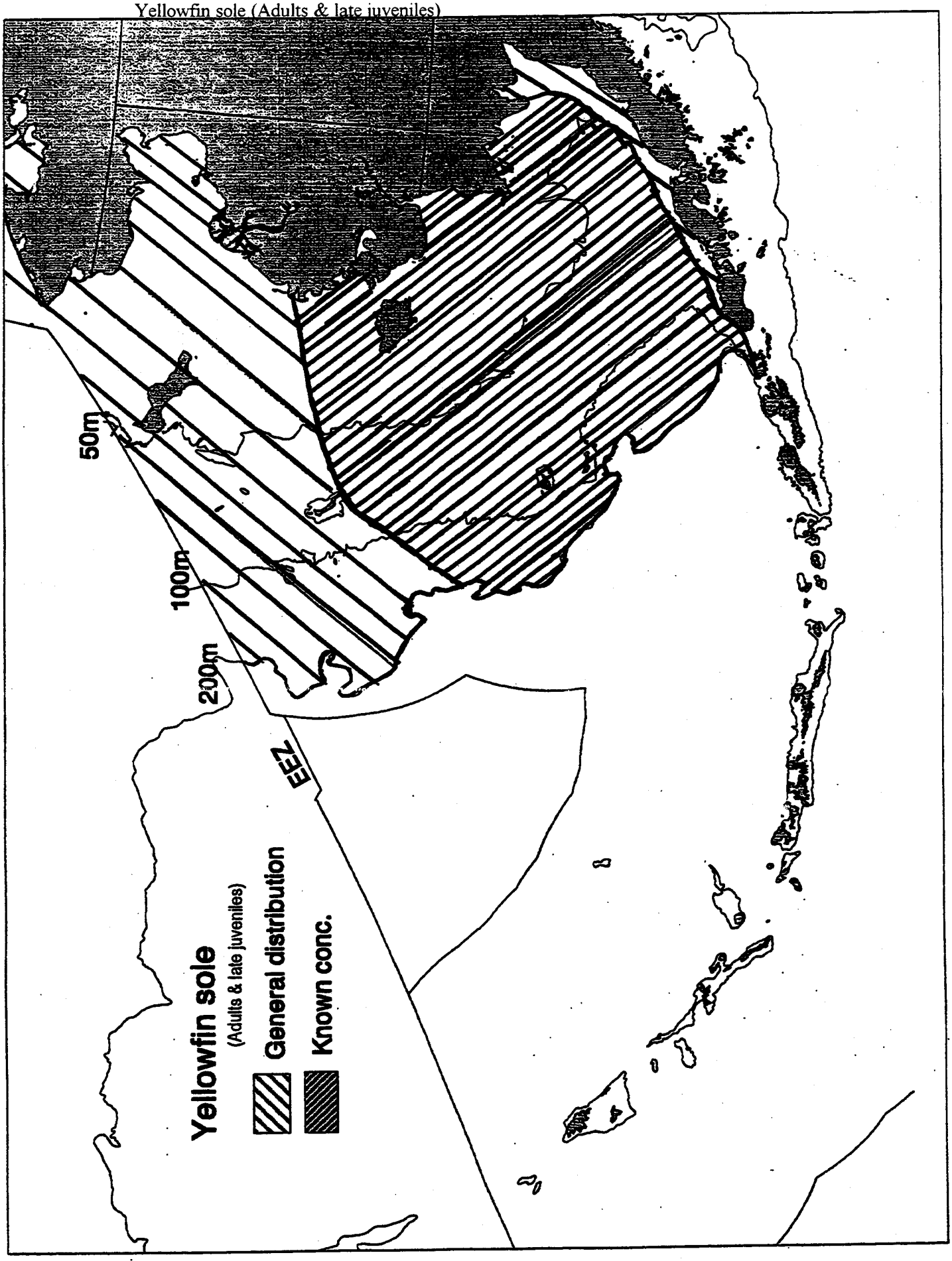
Walleye pollock (Adults)



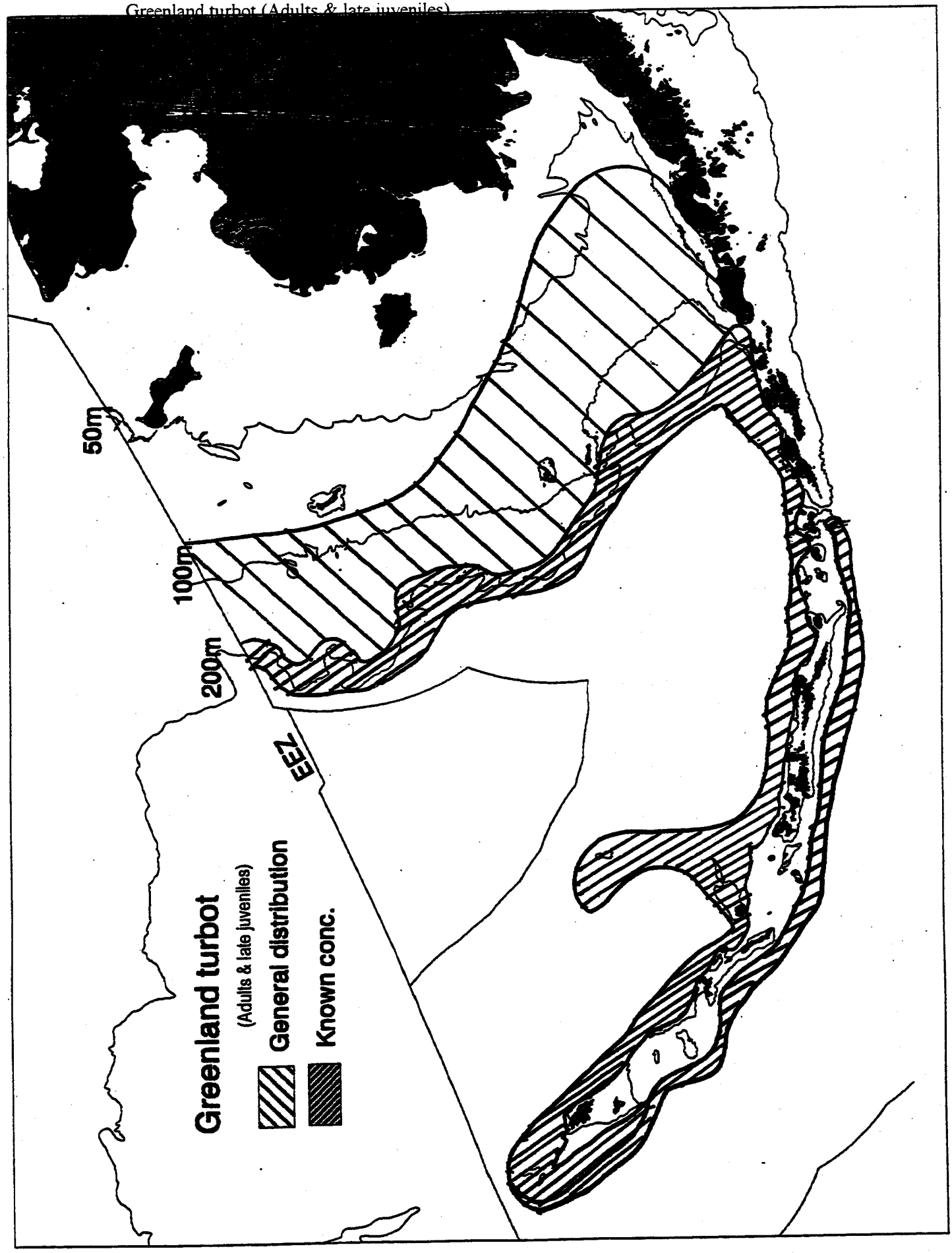
Pacific cod (Adults and late juveniles)



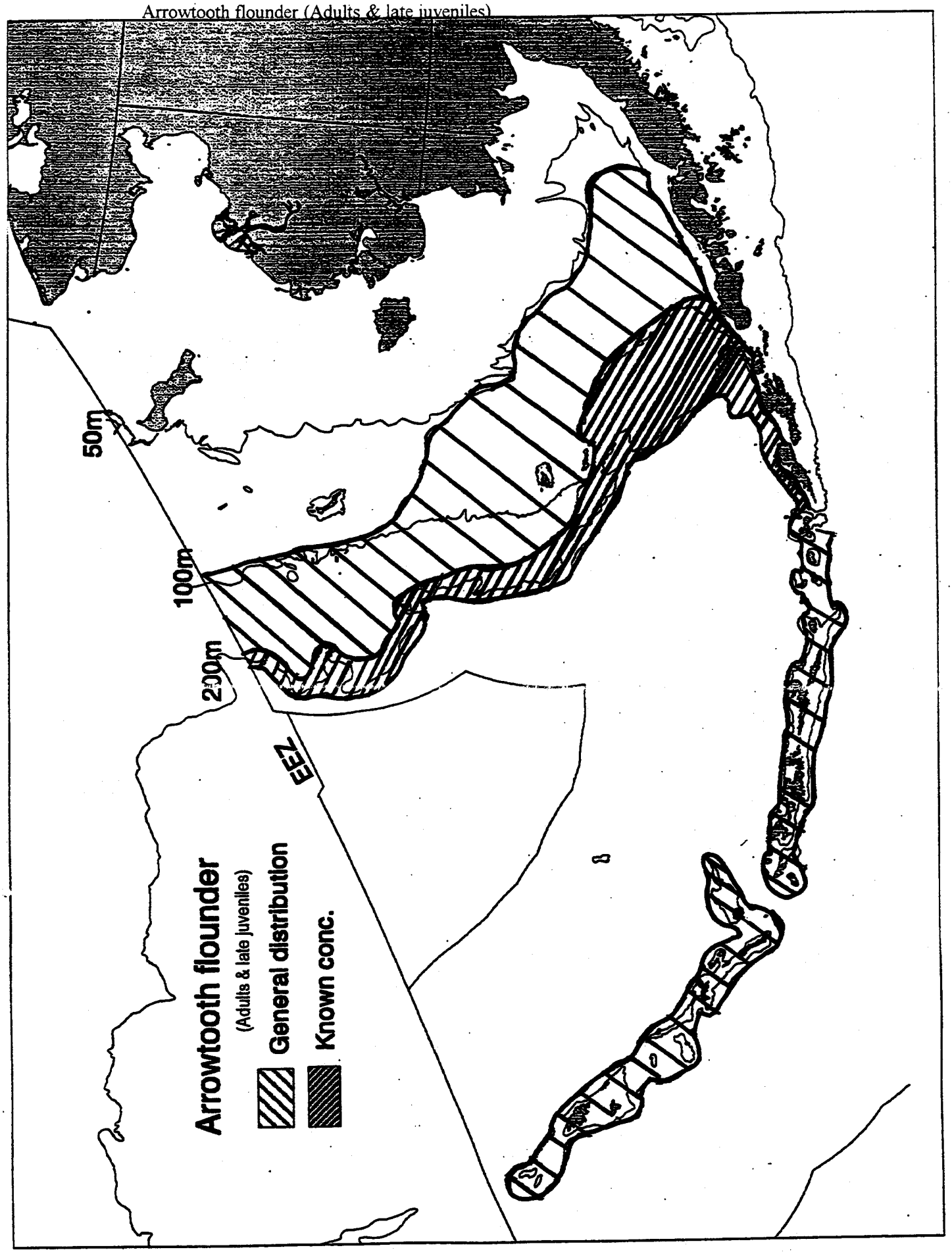
Yellowfin sole (Adults & late juveniles)



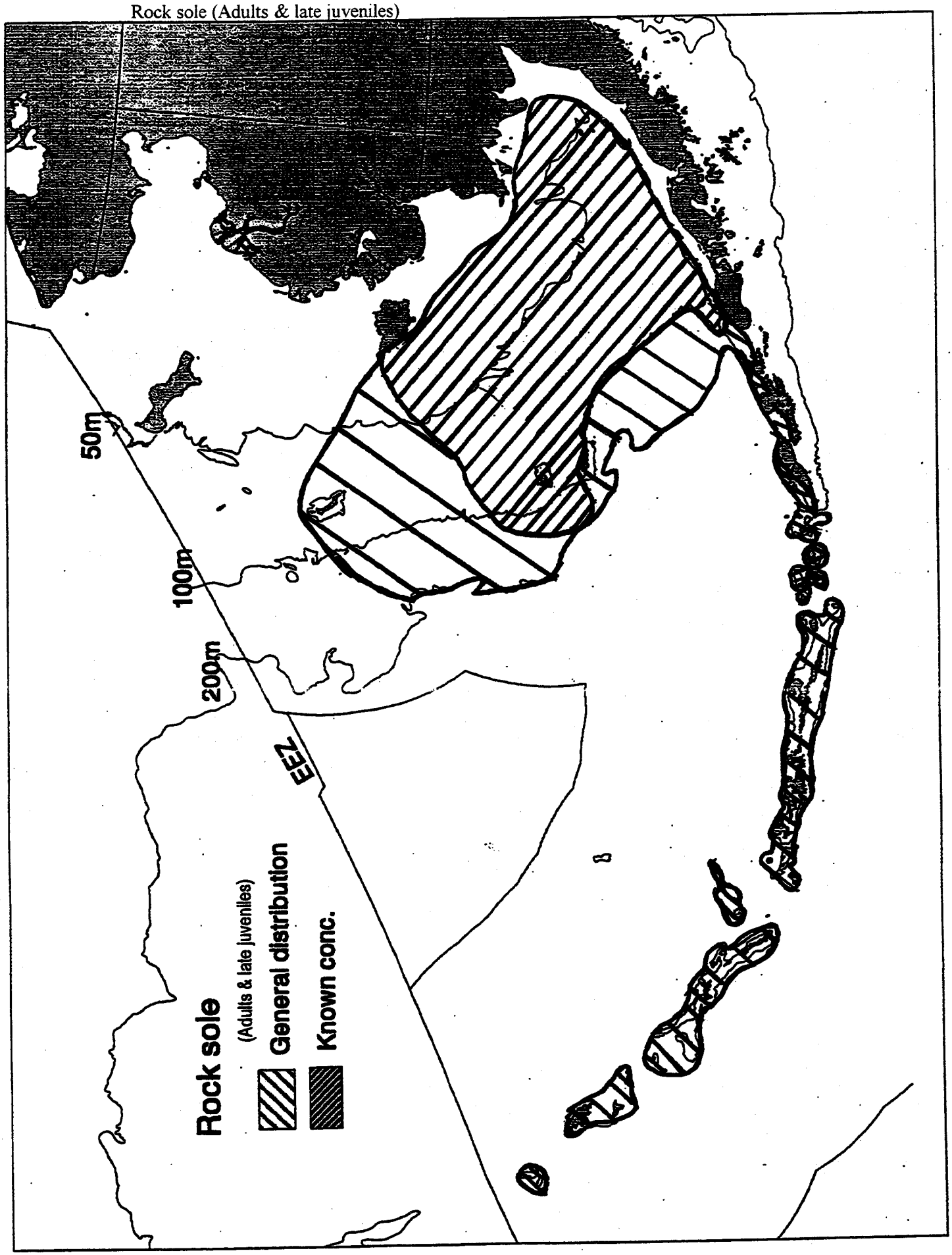
Greenland turbot (Adults & late juveniles)



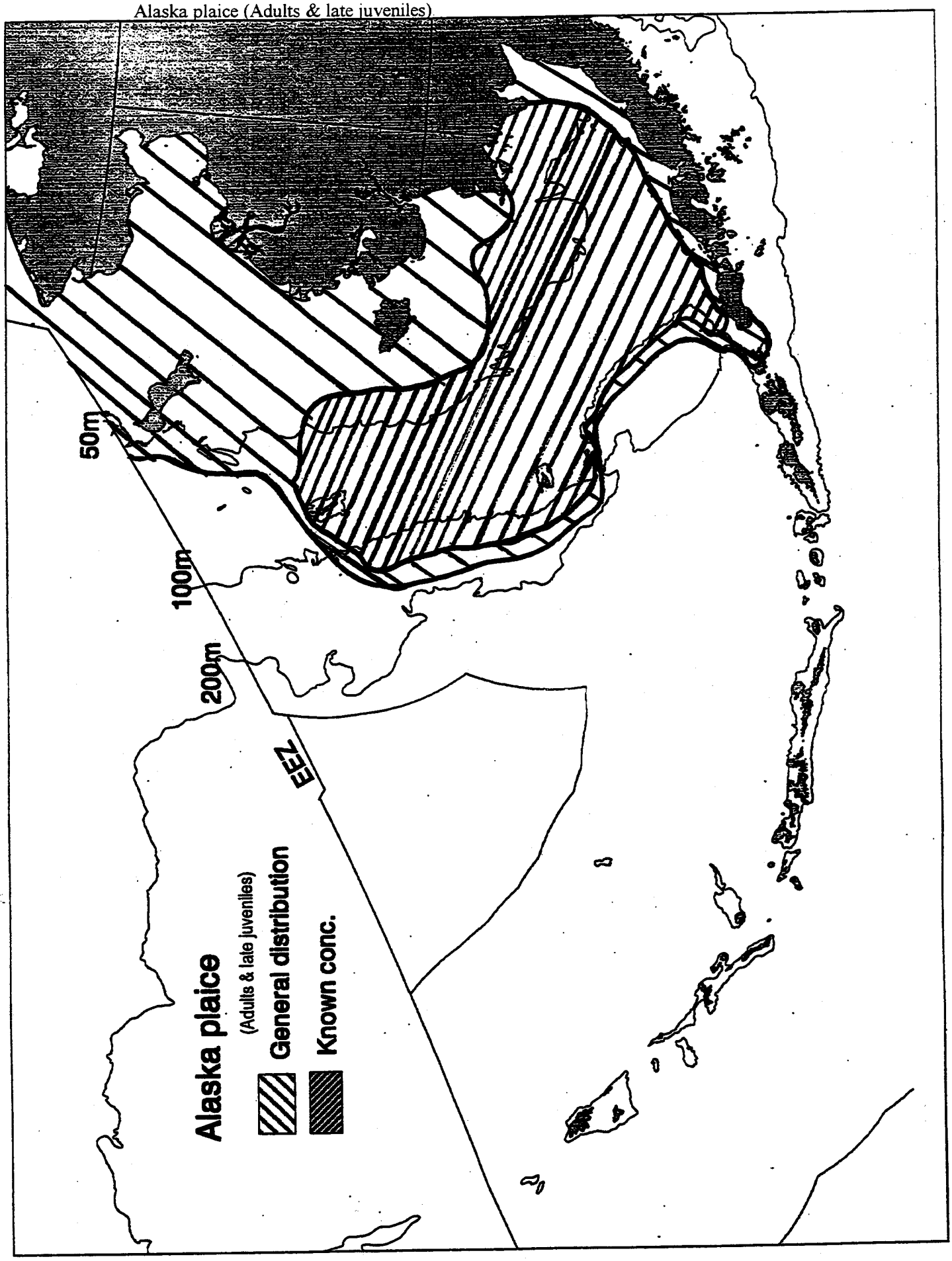
Arrowtooth flounder (Adults & late juveniles)



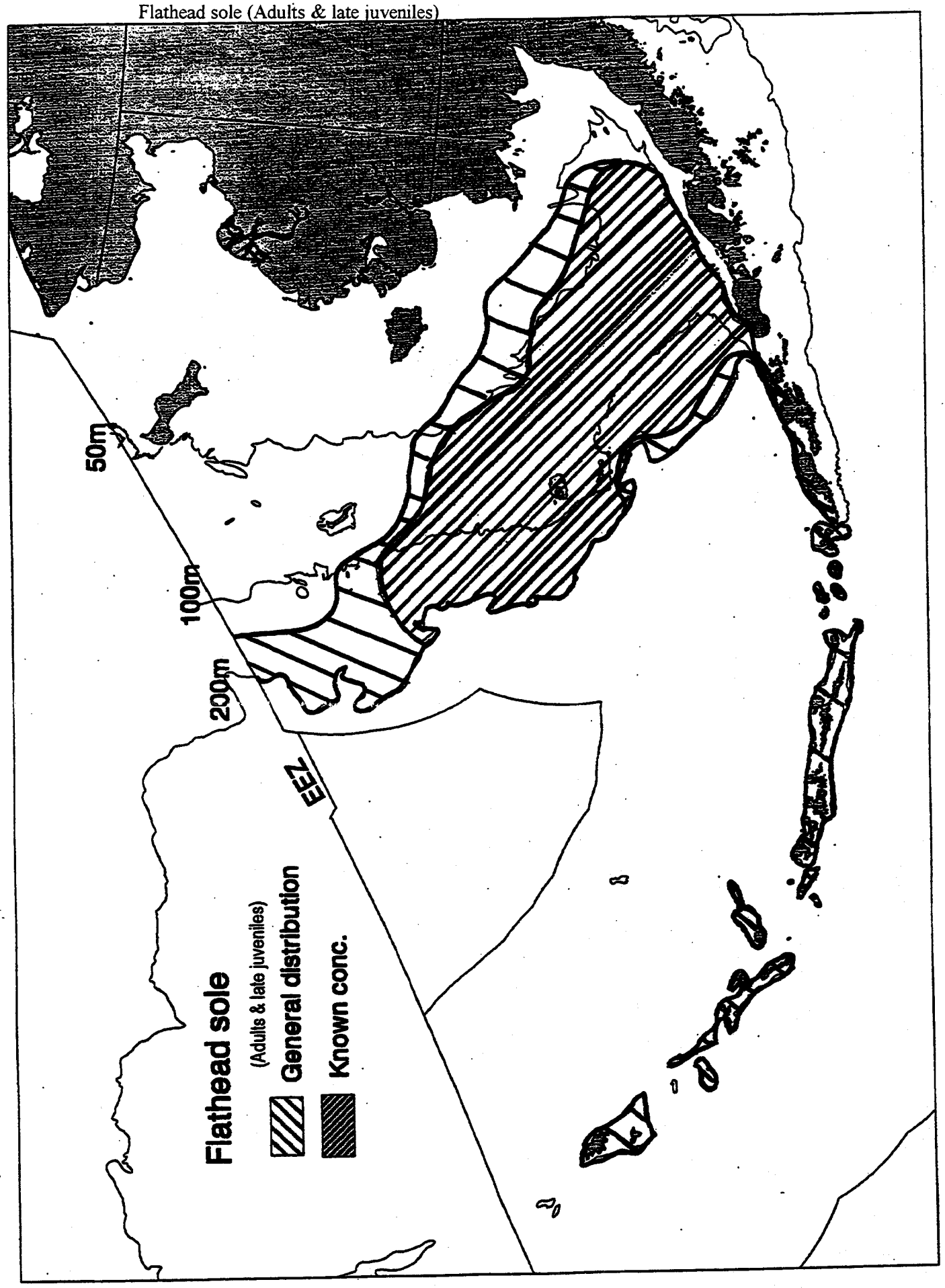
Rock sole (Adults & late juveniles)



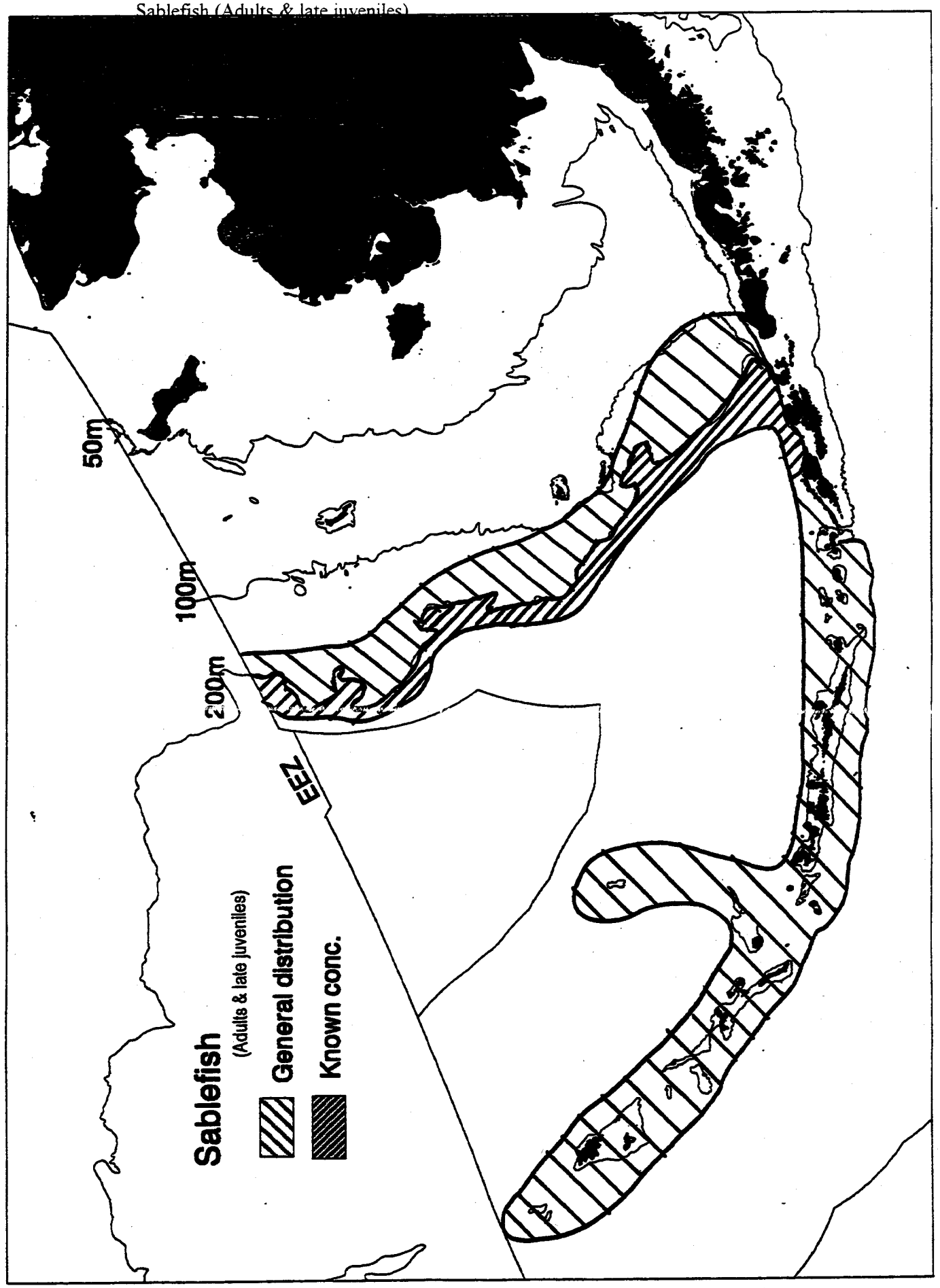
Alaska plaice (Adults & late juveniles)



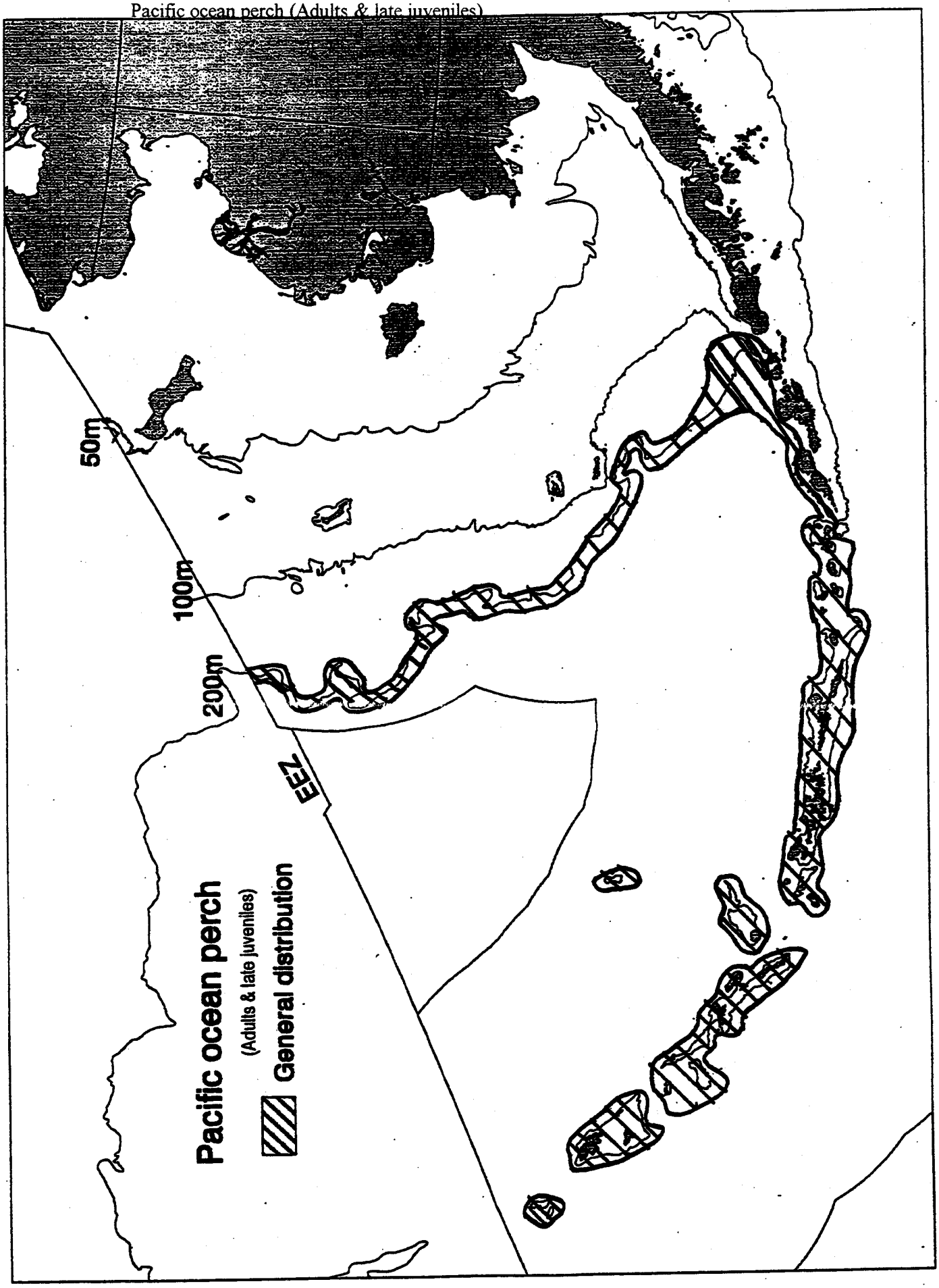
Flathead sole (Adults & late juveniles)



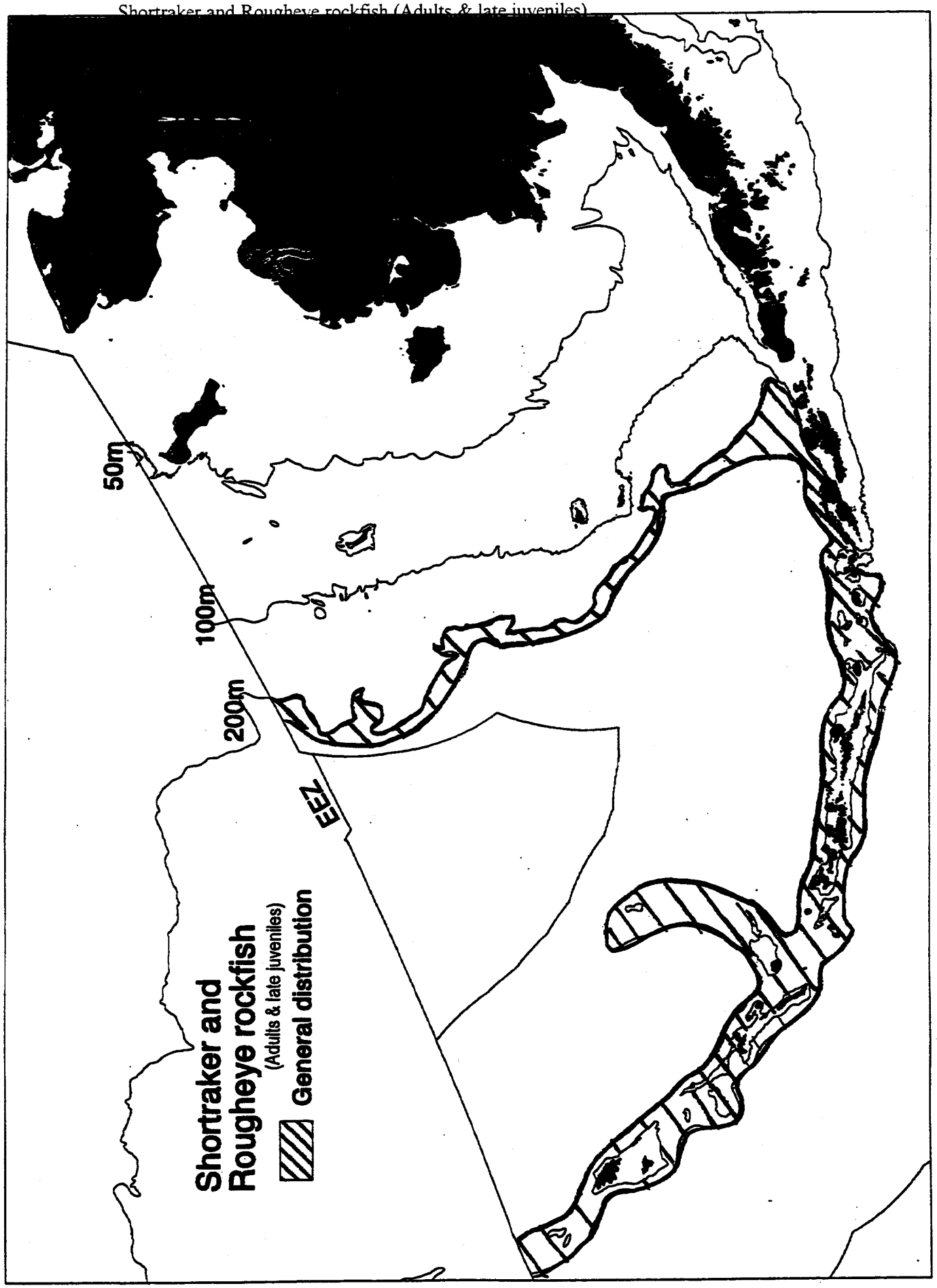
Sablefish (Adults & late juveniles)



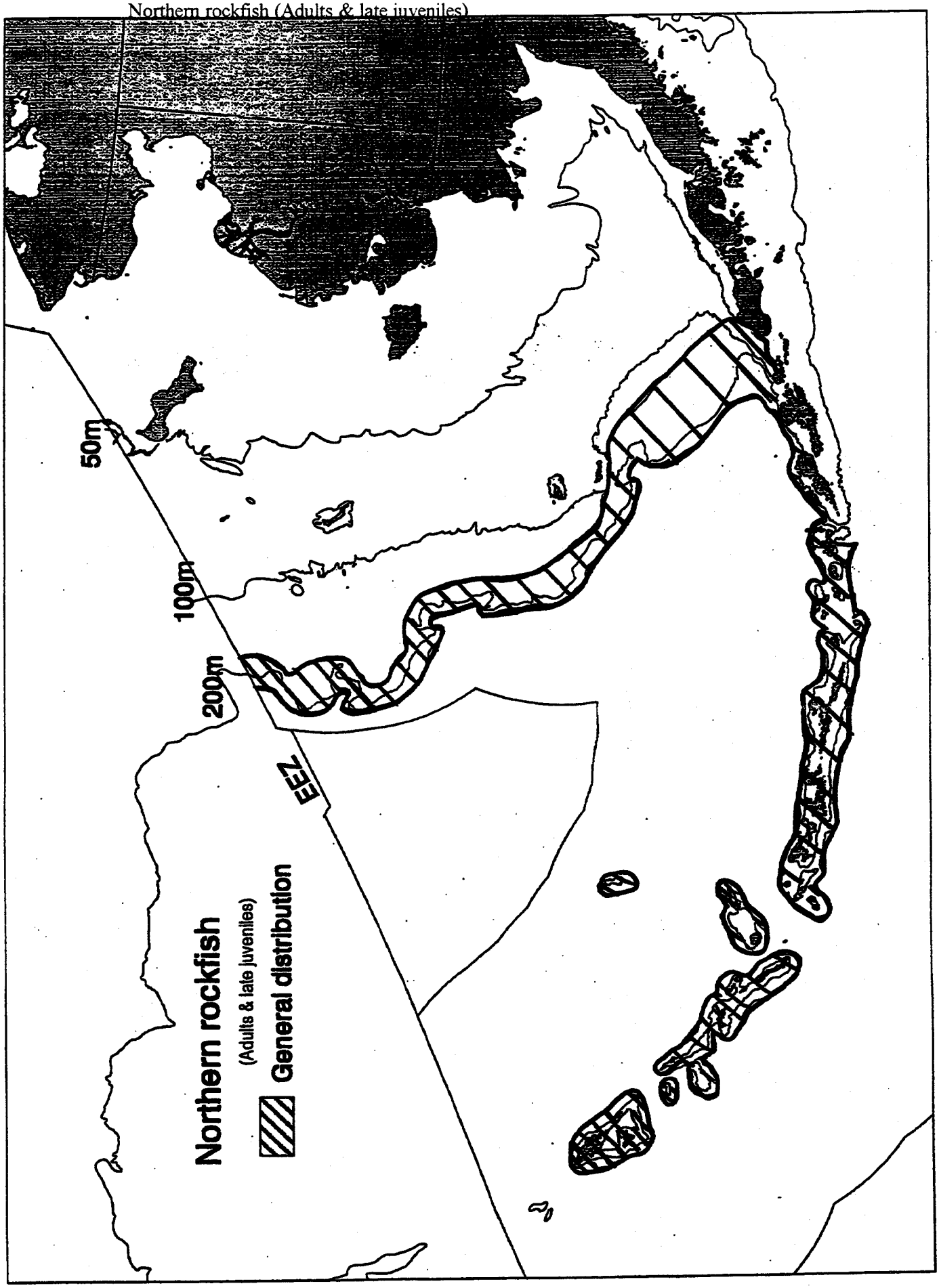
Pacific ocean perch (Adults & late juveniles)



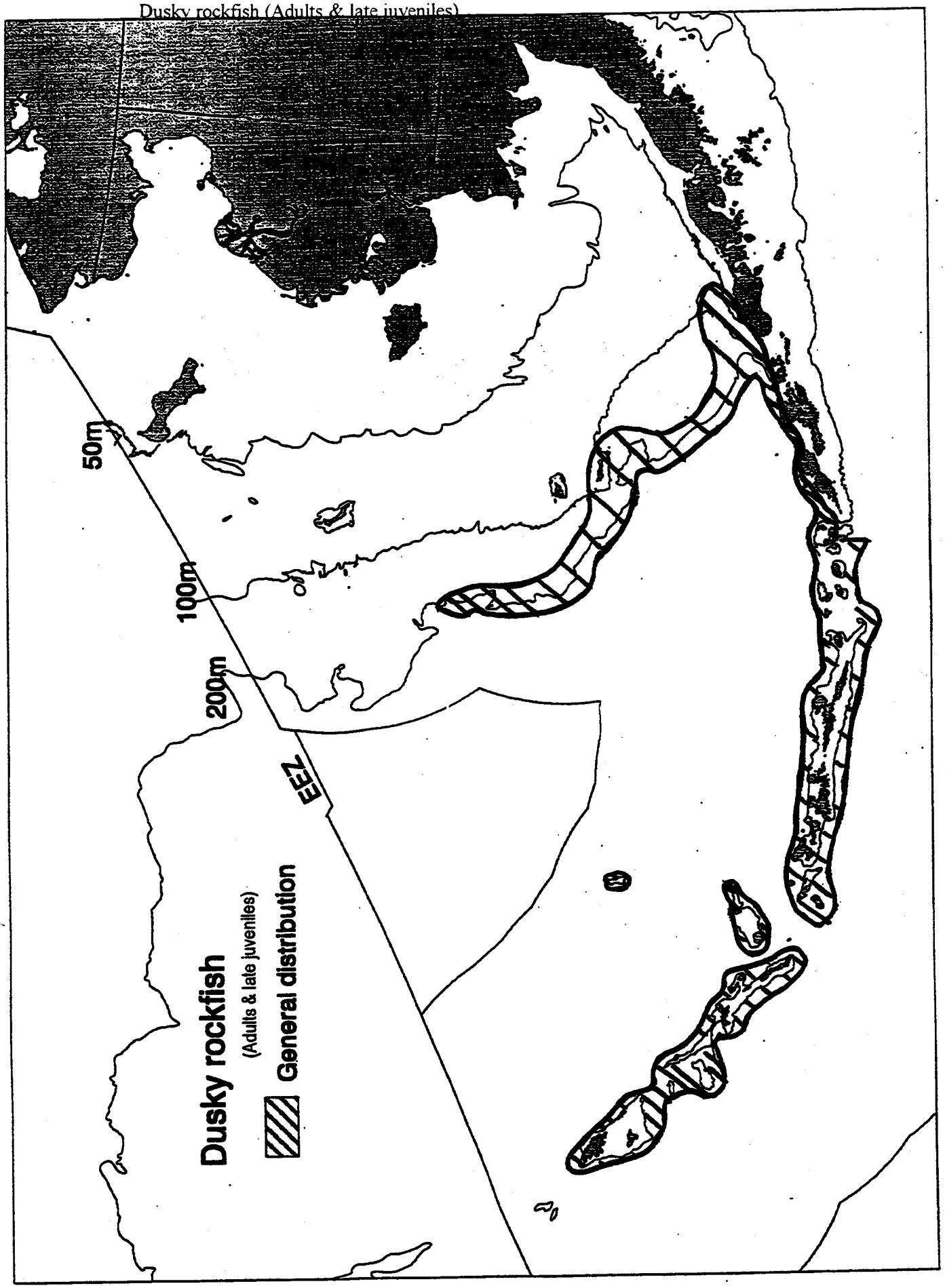
Shortraker and Rougheye rockfish (Adults & late juveniles)



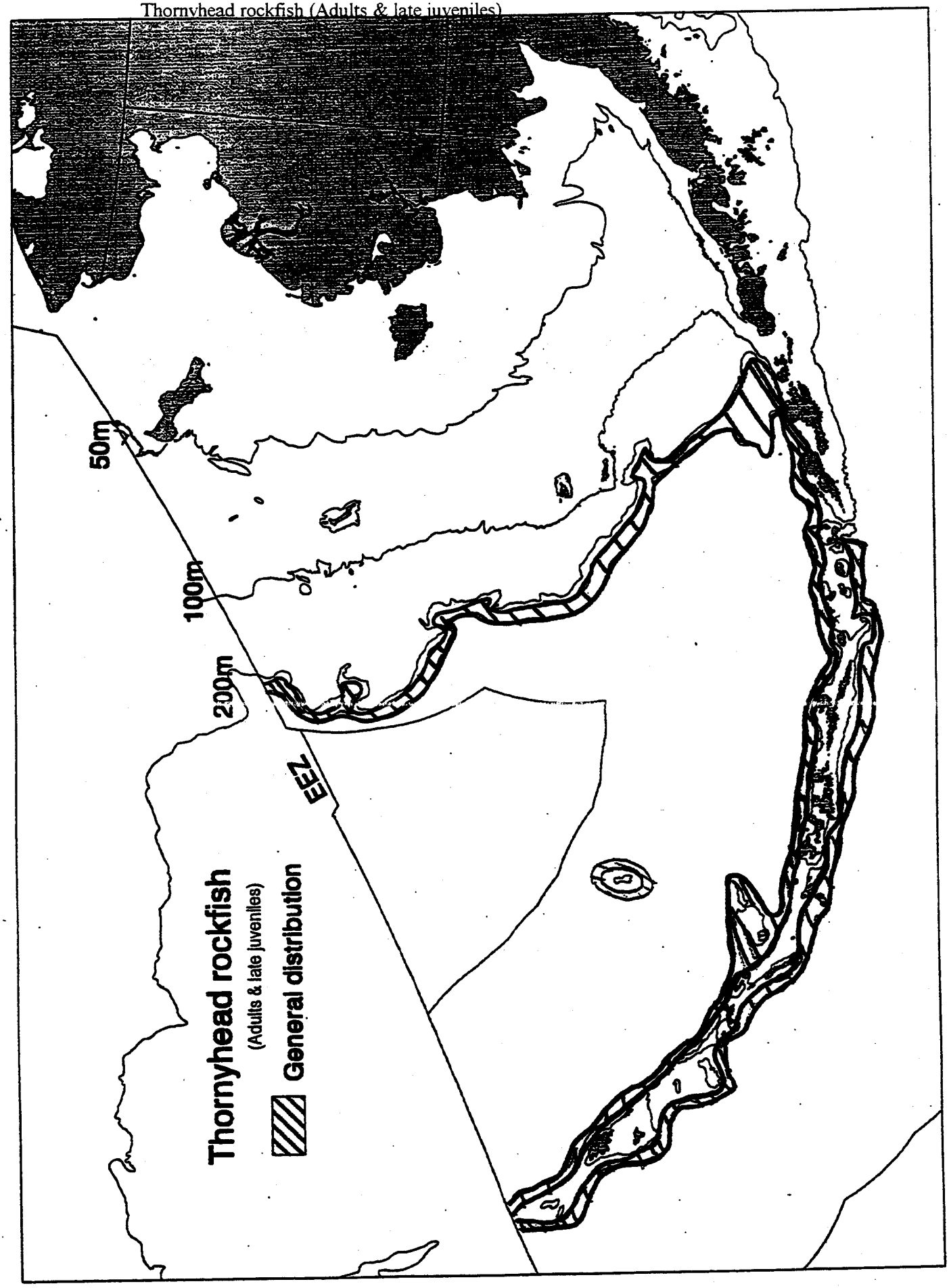
Northern rockfish (Adults & late juveniles)



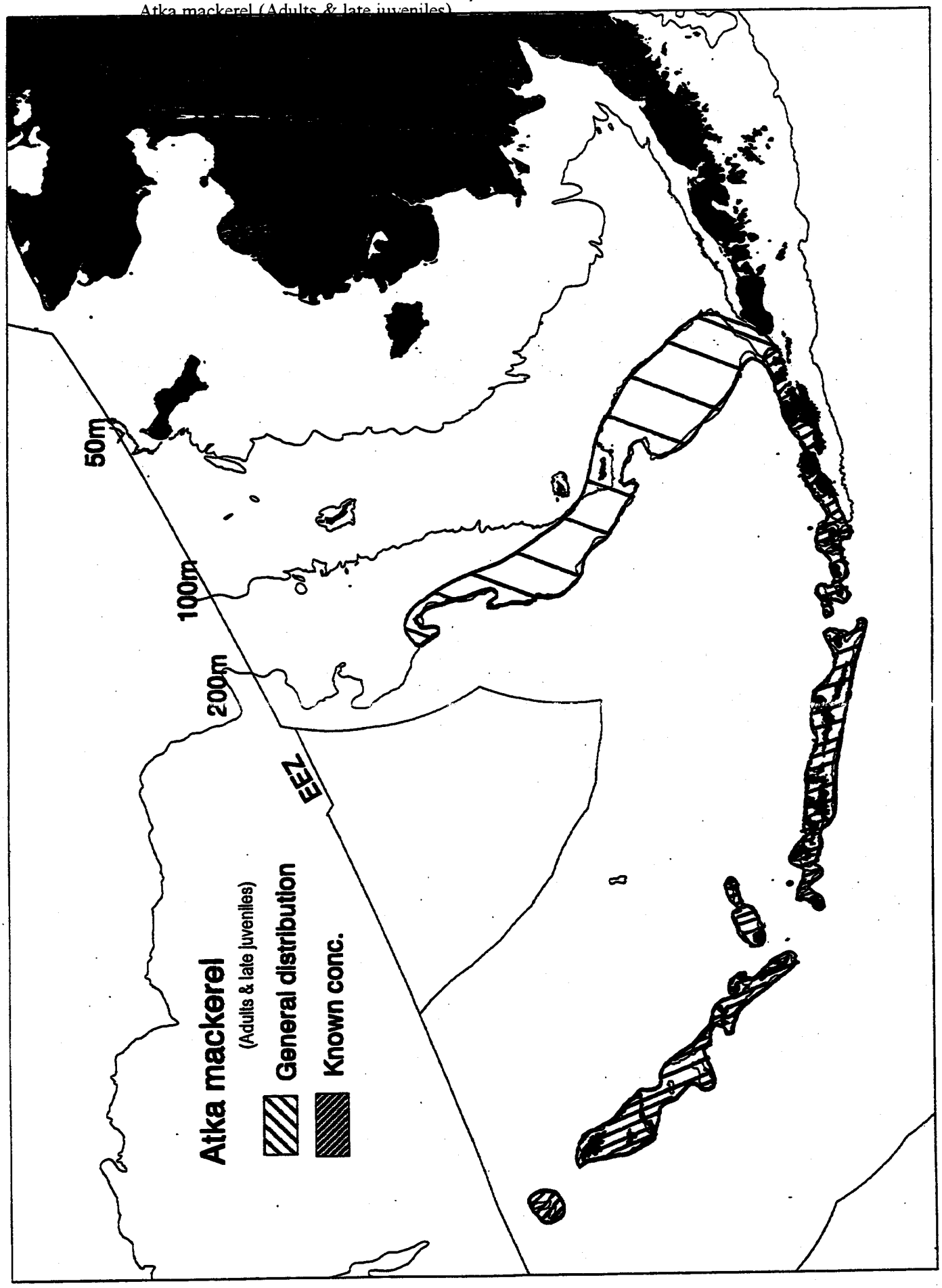
Dusky rockfish (Adults & late juveniles)



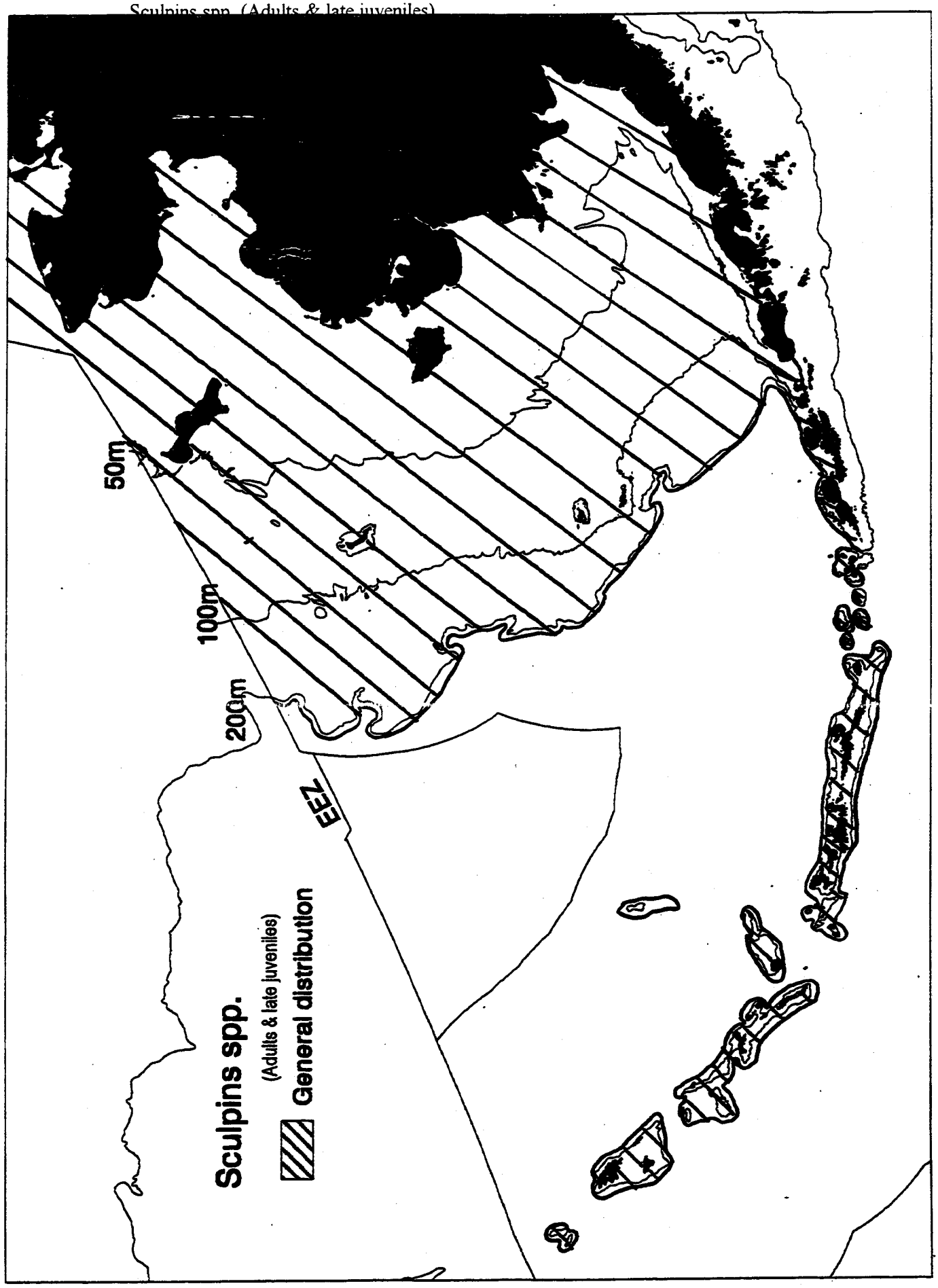
Thornyhead rockfish (Adults & late juveniles)



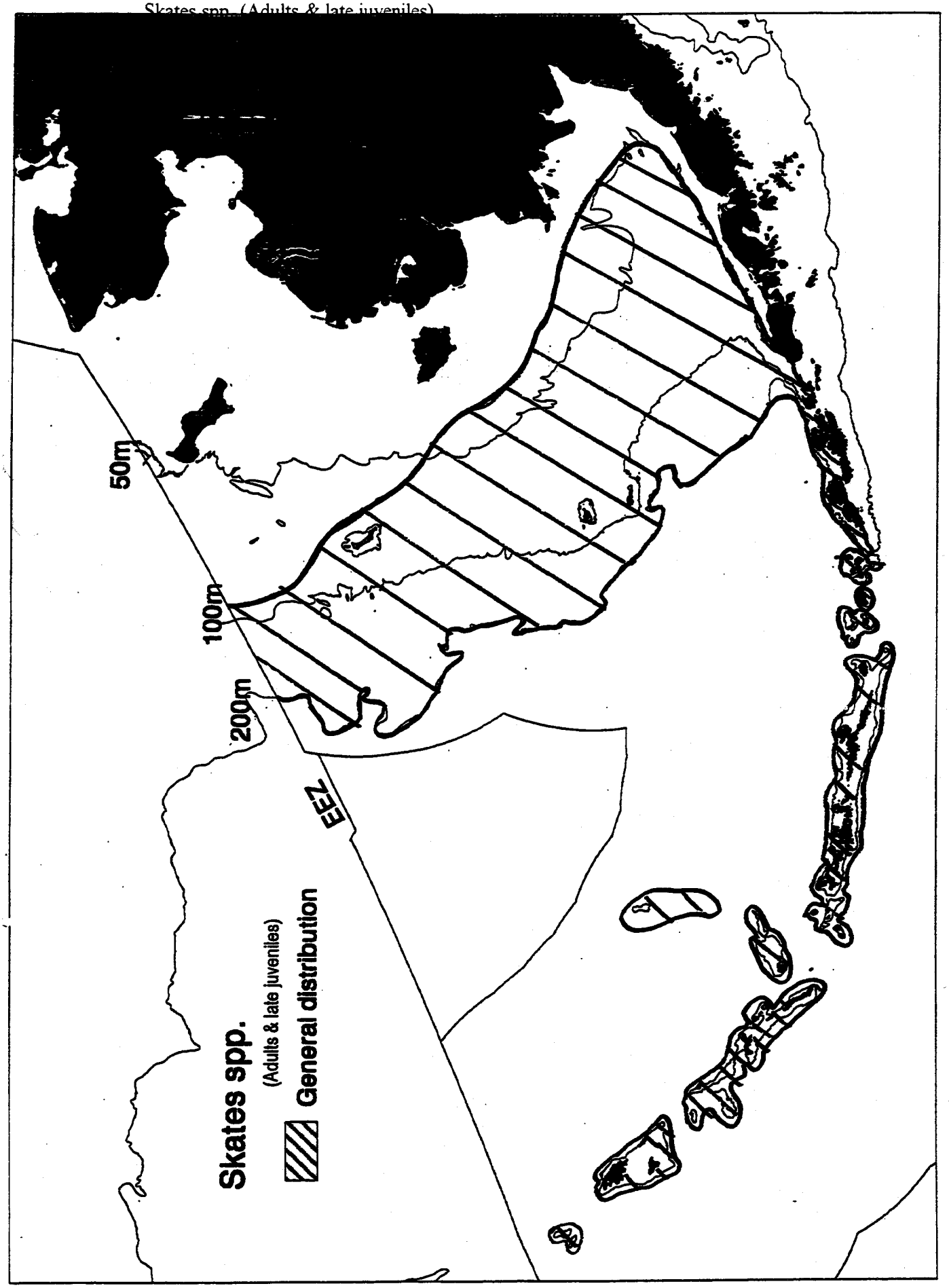
Atka mackerel (Adults & late juveniles)



Sculpins spp. (Adults & late juveniles)



Skates spp. (Adults & late juveniles)

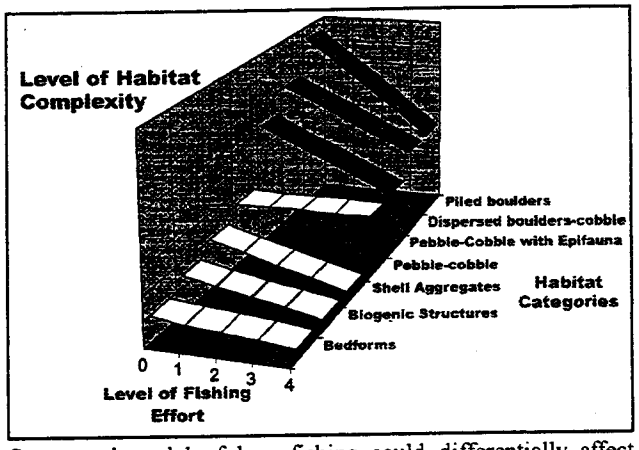


8.10 Fishing Activities that may adversely affect EFH

8.10.1 The Indirect Effects of Fishing: An Executive Summary

A paper entitled "The Indirect Effects of Fishing" was prepared by Peter Auster and Richard Langton under contract from the American Fisheries Society. The paper summarizes and reviews the current literature on fishing impacts as they relate to EFH. A first draft was released for peer review on January 2, 1998 and a final draft released in April, 1998. Interested persons may obtain this paper and other cited documents from the Council office.

The paper discusses the studies within four broad subject areas: effects of gear on non-landed target species, effects on structural components of habitat, effects on benthic community structure, and effects on ecosystem level processes. Although a vast majority of the scientific studies on gear impacts have focused on trawl gear, the authors have attempted to analyze the impacts of habitat disturbance, rather than focus on the impacts of each gear type on habitat. Towards that end, the authors have developed a conceptual model to assist managers with understanding how fishing gear could impact different habitats. The adjacent figure illustrates this. In very complex habitats, such as piled boulders or cobble with epifauna (corals, bryozoans, anenemones, etc.), even relatively low levels of fishing effort can drastically alter the habitat. On more simple habitats, such as bedforms (such as sand or silt bottoms), fishing has a relatively minor effect on the habitat complexity. An abstract of the Auster and Langton paper is provided below.



Conceptual model of how fishing could differentially affect habitat depending on its complexity.

Abstract

The Sustainable Fisheries Act of 1996 mandates that regional fishery management Councils designate essential fish habitat (EFH) for each of the species which are managed, assess the effects of fishing on EFH, and develop conservation measures for EFH where needed. This synthesis of effects of fishing on fish habitat was produced to aid the fishery management councils in assessing the impacts of fishing activities. A wide range of studies were reviewed that reported effects of fishing on habitat (i.e., structural habitat components, community structure, and ecosystem processes) for a diversity of habitats and fishing gear types. Commonalities of all studies included immediate effects on species composition and diversity and a reduction in habitat complexity. Studies of acute effects were found to be a good predictor of chronic effects. Recovery after fishing was more variable, depending on habitat type, life history strategy of component species, and the natural disturbance regime. The ultimate goal of gear impact studies should not be to retrospectively analyze environmental impacts but ultimately to develop the ability to predict outcomes of particular management regimes. Synthesizing the results of these studies into predictive numerical models is not currently possible. However, conceptual models are presented which coalesce the patterns found over the range of observations. Conceptual models can be used to predict effects of gear impacts within the framework of current ecological theory. Initially, it is useful to consider fishes' use of habitats along a gradient of habitat complexity and environmental variability. A model is presented of gear impacts on a range of seafloor types and is based on changes in the structural habitat values. Disturbance theory provides the framework for predicting effects of habitat change based on spatial patterns of disturbance. Alternative community state models, and type 1-type 2 disturbance patterns, may be used to predict the general outcome of habitat management. Primary data are lacking on the spatial extent of fishing induced disturbance, the effects of specific gear types along a gradient of fishing effort,

and the linkages between habitat characteristics and the population dynamics of fishes. Adaptive and precautionary management practices will therefore be required until empirical data becomes available for validating model predictions.

8.10.2 The Effects of Fishing Gear on Benthic Communities

Portions of the following section have been excerpted from the following paper:
Vining, I., D. Witherell, and J. Heifetz. 1997. The effects of fishing gear on benthic communities. p.13-25. Ecosystem Considerations for 1998. North Pacific Fishery Management Council, Anchorage, Alaska.

In recent years, there has been a growing awareness and concern about the effects of resource extraction on ecosystems. Fishery managers around the world are beginning to incorporate, or at a minimum acknowledge, the effects of fishing on marine ecosystems. The groundfish fisheries in Alaska are no exception. Concern has been expressed by scientists, conservationists, fishermen, and others about potential negative effects of fishing gear on bottom habitat, particularly with regard to habitat alteration. In this chapter, we provide a review of scientific studies done to date on the effects of fishing gear on benthic communities of the Gulf of Alaska, Bering Sea, and Aleutian Islands areas.

Fisheries in the North Pacific are numerous and utilize different gear types. The fisheries and associated gear for the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska fisheries (GOA) are listed in the adjacent table. Federal regulation § 679.2 specifies the following authorized gear types: dive, fixed gear, hook-and-line, jig, longline, longline pot, non-pelagic trawl, pelagic trawl, pot-and-line, scallop dredge, and troll gear. In this section, we summarize potential effects only for primary gears used in the groundfish, scallop, and crab fisheries.

Fishing Gear used in the North Pacific, by fishery.

FMP	Fishery	Gear
BSAI and GOA	groundfish	trawl, longline, jig, pot
BSAI and GOA	halibut	longline, hook&line, troll, jig
BSAI and GOA	scallop	dredge
BSAI	crab	pot
BSAI and GOA (State managed)	salmon	gill net, seine, troll line, fish wheels, or spears
non-FMP (State)	herring	trawl, seine, gill net, pound net
non-FMP (State)	shrimp	pots, trawls
non-FMP (State)	razor clam	shovel, fork
non-FMP (State)	sea urchin	handpicking, aided by diving gear or abalone iron
non-FMP (State)	octopus	pot
non-FMP (State)	abalone	diving gear and abalone iron
non-FMP (State)	sea cucumber	handpicking, aided by diving gear

If the gear, habitat, and communities were homogeneous, studies designed to measure the effect of fishing on benthic communities would be much simpler. However, there is heterogeneity in all aspects of fishing, as well as the habitat and communities affected by fishing gear. When studying gear effect, many questions need to be answered, such as: Do all gears have similar effects? How much actual damage is being done? How long will the damage last? How will damage be measured? Does the extent and longevity of damage depend on bottom type? Does the fishing affect all organisms in the community equally? The purpose of this section of the Ecosystems Chapter is to review the completed work or the work in progress to answer some of these questions, and summarize conclusions. A summary of literature used for this paper is provided in Table 1.

Trawl Gear

Concerns over the effects of trawling are not new, nor limited to the North Pacific. Trawling was an issue, as early as 1350, when it was banned in the United Kingdom to protect fry of fish (de Groot 1984). Since 1938, studies have been conducted on the east coast of Canada and United States, to evaluate possible effects of trawling on the benthic communities (Ketchen 1947; Graham 1955; Messieh et al. 1991). There has also been an extensive investigation in the North Sea by the Netherlands Institute for Sea Research evaluating the effects of beam-trawl fisheries on the bottom fauna (BEON-RAPPORT 8 1990; Bergman and Hup 1992). The effects of trawling are also being studied in New Zealand and Australia, with special attention being paid to hard-bottom trawling (Hutchings 1990; Jones 1992).

There are people who considered the negative effect of trawl gear "common sense" and "intuitive," and have written articles pointing to likely ways the gear is having a negative effect on the environment (Apollonio 1989; McAllister 1991; Russel 1997). The scientific community, in general, also tends to accept that trawling alters the bottom habitat (Auster et al. 1996). The root of the problem and the cause of controversy lies in the definition of "negative effect" and the degree of change in the benthic habitat or communities before the change is "destructive."

The otter trawl is the principle gear used in bottom trawl fisheries in the GOA and BSAI, and advancements in fishing gear and vessel technology have made gear more efficient. These advances mean that heavier nets are dragging over seabeds, and possibly altering the sea-floor more than was observed in earlier studies. Also, larger ships, with greater horsepower and larger, stronger nets are exploring and fishing areas not previously available to the industry (Auster et al. 1996). A further consideration is the domestication of the groundfish industry in the GOA and BS since the Magnuson Act of 1976, which changed the character of trawling in Alaska from large foreign factory vessels to a mixture of a domestic catcher-processors and numerous smaller catcher vessels.

Physical effects of trawling include plowing and scraping the sea-floor, resuspension of sediment, and lowering of habitat complexity. Plowing and scraping effects depend on towing speed, substrate type, strength of tides and currents, and gear configuration (Jones 1992). It has been found that otter doors tend to penetrate the substrate 1 cm - 30 cm; 1 cm on sand and rock substrates, and 30 cm in some mud substrates (Krost et al. 1990; Jones 1992; Brylinsky et al. 1994). Another factor which will cause variation in the depth of the troughs made by the otter doors is the size (weight) of the doors, i.e., the heavier the doors the deeper the trough (Jones 1992). These benthic troughs can last as little as a few hours or days in mud and sand sediments, over which there is strong tide or current action (Caddy 1973; Jones 1992), or they can last much longer, from between a few months to over 5 years, in seabeds with a mud or sandy-mud substrate at depths greater than 100 m, with weak or no current flow (Krost et al. 1990; Jones 1992; Brylinsky et al. 1994).

Another aspect of plowing and scraping is the alteration done by the footrope. Once again, different types of footropes will cause more or less alteration. Those footropes which are designed to roll over the sea-floor (the type generally on soft bottoms, employed in the GOA and BS), cause little physical alteration, other than smoothing the substrate and minor compression (Brylinsky et al. 1994; Kaiser and Spencer 1996). However, since a trawler may re-trawl the same area several times, these minor compressions can cause a "packing" of the substrate (Schwinghammer et al. 1996). Further compression of the substrate can occur as the net becomes full and is dragged along the bottom.

The trawling of an area can cause resuspension of both inorganic and organic sediments. Churchill (1989) found that trawling can be a significant contributor to the time-averaged suspended sediment load over heavily trawled areas, especially at depths where bottom stress due to tidal and current action is generally weak. In the GOA, there is relatively weak current and tidal action near the sea-floor over much of the groundfish fishing grounds, with a variety of seabed types such as gravely-sand, silty-mud, and muddy to sandy gravel, as well as areas of hard-rock (Hampton et al. 1986). The BS has relatively weak currents, on the other hand, with relatively strong tidal action (currents) accounting for up to 95% of all flow as deep as 200 m, with principally gravely-sand and silty-sand seabed (National Research Council 1996).

The reduction in habitat complexity can be examined in two broad categories: (1) small localized changes, and (2) larger area changes. The small localized changes refer to the smoothing of patchy biogenic depressions and movement of boulders (Auster et al. 1996). The broader area changes refer to the general reductions in habitat complexity with increases in trawling activity (Auster et al. 1996; Schwinghammer et al. 1996).

Mortality can be incurred to those organisms incidentally captured (bycatch), and discarded back into the sea. The mortality rate of the bycatch depends on the species, age and size of a species, the type of gear, the time and type of shipboard handling, and the size of the haul, along with ocean and atmospheric conditions (Hill and Wassenberg 1990; Stevens 1990; Fonds 1991). It is difficult to generalize the fate of bycaught benthic organisms returned to the sea or compare results from different studies on this subject. In addition, studies have only focused on the survival of fish and crab discards.

Several studies have examined the mortality of crabs taken as bycatch in North Pacific trawl fisheries. In one study, a standard sole trawl (with roller gear) in a subarctic area (Bering Sea) caught king and Tanner crabs while fishing for sole, sorted the catch with the time on deck being between .5-1.5 hours, then placed the crabs in holding tanks for 48 hours; the resulting mortality rate was 79% for king crab and 78% for Tanner crab (Stevens, 1990). Blackburn and Schmidt (1988) made observations on instantaneous mortality of crab taken by domestic trawl fisheries in the Kodiak area. They found mortality for soft-shell red king crab averaged 21%, hard-shelled red king crab 1.2%, and 12.6% for Tanner crab. Another trawl study indicated that trawl induced instantaneous mortalities aboard ship were 12% for Tanner crab and 19% for red king crab (Owen 1988). Fukuhara and Worlund (1973) observed an overall Tanner crab mortality of 60-70% in the foreign Bering Sea trawl fisheries. They also noted that mortality was higher in the summer (95%) than in the spring (50%). Hayes (1973) found that mortality of Tanner crab captured by trawl gear was due to time out of water, with 50% mortality after 12 hours. Natural Resource Consultants (1988) reported that overall survival of red king crab and Tanner crab bycaught and held in circulation tanks for 24-48 hours was <22%. In analyses of groundfish plan amendments, the estimated mortality rate of trawl bycaught red king crab and Tanner crab was assumed to be 80% (NPFMC 1993).

Damage or mortality of benthic organisms can occur due to the passage of the trawl over the seabed without actually catching the organisms. Non-retained organisms may be subject to mortality from contact with trawl doors, bridles, footrope, or trawl mesh, as well as exposure to silt clouds produced by trawl gear. Mortality of fish escaping from trawl codends may range from none to 100%, and may depend on numerous factors, including fish species, tow size and duration, the size and type of mesh used (Sangster 1992). Mortality can occur due to contusions, a build-up of lactic acid, scale loss and mucus removal, and skin damage due to abrasion and collision with net walls (Sangster 1992; Chopin and Arimoto 1995).

Studies of fish escapement mortality have exhibited a wide range of results. Very low escapement mortality was observed for Alaskan pollock under experimental conditions (Efanov and Istomin 1988). Main and Sangster (1988) observed that mortality of haddock passing through a diamond mesh codend exhibited delayed mortality: 33% mortality after 11 days and 82% mortality after 108 days. DeAlteris and Reifsteck (1993) observed escapement mortality of scup (Stenotomus chrysops) to be 0% to 50%, and less than 4% for winter flounder (Plueronectes americanus) tested by an experimental codend. Bergman et al. (1989) studied the mortality of fishes escaping from commercial beam trawls, and observed mortalities of dab (Limanda limanda), plaice, and sole totaled 44%, 15%, and 0%, respectively, after being held in a cage for 24 hours. Van Beek et al. (1989) also studied the mortality of sole escaping from beam trawls, and their results indicated that 40% of the sole died after escaping through the meshes. Mortality of herring (Clupea harengus) escaping from trawl codends can be higher than for groundfish. Suuronen et al. (1992) observed mortality of codend escapees to be very high (85-90%), with most deaths occurring 3-8 days after escape. Another study of herring showed lower mortality (3-30%) for herring escaping from codends (Efanov 1981).

Besides direct mortality from being caught and handled, there will be further mortality due to relocation into unsuitable habitat and predation while returning to the sea floor. This type of mortality will also depend on many conditions such as depth, type of species, age and size of species, predator concentration and oceanic conditions. Although there are few studies which have considered these sources of mortality, neither relocation nor predation will likely result in 100% mortality (Hill and Wassenberg, 1990).

Similar to the mortality of bycatch, the survival of benthic organisms in the path of the trawl will depend on several factors. The mortality rate will depend on the species, species age and size, the type of gear, the size of the haul, substrate morphology, and ocean conditions. The most severe damage done to benthic organisms by otter trawls is from the trawl doors, especially sedentary organisms that live in the upper 5 cm of the seabed (Rumohr and Krost, 1991). Rumohr and Krost (1991) further found that thin-shelled bivalves such as *Syndosmya alba*, *Mya* sp. and *Macoma calcarea*, as well as starfish sustain heavy damage due to the trawl doors, whereas thick-shelled bivalves such as *Astarte borealis* and *Corbula gibba* were less likely to be damaged. In one another experiment, hard-shelled red king crab were tethered in the path of an Aleutian combination trawl (Donaldson 1990). Only 2.6% of the crabs that were interacted with the trawl, but not retained, were injured, suggesting a low mortality rate. Other organisms found to be affected by the passage of trawls and specifically the trawl doors are diatoms, nematodes and polychaetes (Brylinsky et al. 1994).

The immediate effect of trawling on hard-bottom seabeds can be intense in certain vulnerable habitats. It was found that from a single tow using roller gear, 3.9% of the octocorals and 30.4% of the stony coral were damaged, as well as 31.7% of the sponges (van Dolah et al., 1987). A similar study in Florida found that 80% of the stony coral and 38% of the soft corals were damaged, as well as 50% of the sponges. However, the trawls in this study were a ridged roller gear assemblage (Tilmant 1979). Both of these studies were in sub-tropical areas. No studies were found assessing trawling in temperate or subarctic hard-bottom habitat, however current work on this is being carried out in the GOA (Heifetz 1997).

Although mortality from bycatch or trawl passage appears to be fairly high for various organisms, some studies have found recolonization can occur over a relatively short time period. Nematodes and polychaetes returned to their pre-trawled levels in less than 7 weeks and diatoms increased in abundance in trawl troughs within 80 days (Brylinsky et al., 1994). Small epibenthic species that have been resuspended can recover to pre-trawl densities in 24 hours (Rumohr and Krost, 1991). The sponges and most of the corals damaged in the hard-bottom studies, returned to their pre-study levels in approximately a year.

One of the principle concerns associated with trawling is the potential effects on benthic organisms that fish depend on for food. At least in the short term, prey items immediately available to fish do not appear to be reduced. Caddy (1973) found that fish and crabs were attracted to the trawl path, presumably to feed on exposed or dead benthos, within 1 hour after fishing. Other studies have also observed increases in scavenging in the wake of beam-trawls (Kaiser and Spencer 1994; Kaiser and Spencer 1996a). Furthermore, the densities of some of the species examined in the study, were 30 times greater than outside the trawl tracks. In Kiel Bay (Baltic Sea), it was believed that cod fed extensively on Arctica islandica which were crushed or broken by trawl doors (Rumohr and Krost 1991; Jones 1992).

Minor short-term changes in individual species distribution are not likely to greatly affect the entire ecosystem, excessively. The ecosystem is in a constant flux, with many natural phenomena making changes to the environment (de Groot 1984; Brylinsky et al. 1994). The specific question is whether fishing causes long-term changes (negative) in the benthic community structure.

There have been changes to benthic communities from trawling due to habitat alteration. The trawl doors may be the most damaging to benthic organisms on a short-term basis. However, even in deep areas where the troughs may be recognized after long periods (5 years), the doors do not likely have an excessive long- term effect on the overall area, because the relatively small trough is between 0.2 - 2 m (Krost et al. 1990; Rumohr and Krost 1991; Brylinsky et al. 1994). The greater long-term damage to the habitat may be caused by the net and footrope due to their much larger width at 3-166 m (1.5-90 fathoms), with many between 20-50 m (Grahm 1955, Chris Blackburn, Alaska Groundfish Databank, Kodiak, AK, personal communications). The smoothing caused by multiple trawls (as discussed earlier) removes patchy biogenic depressions and moves boulders, both of which are extremely important habitat to juvenile fish and crustaceans (Armstrong et al. 1993; Auster et al.

1996). Multiple trawls in an area also pack down and lower the complexity of the substrate which will likely reduce the exchange capacity and lead to less species diversity (Jones 1992; Kaiser and Spencer 1996b; Schwinghamer et al. 1996). Some studies have concluded that trawling tends to favor fast-growing, fast-reproducing and relatively short-lived (r-selected) species, such as polychaetes, at the expense of slow-growing, slow-reproducing and relatively long-lived (k-selected) species such as crustaceans (Reise 1982; de Groot 1984; Kaiser and Spencer 1996b).

Sediment resuspension, as discussed above, has an effect on the benthic communities as well. Increased sediment suspension can cause reduction of light levels on the seabed, smother benthos following resettlement, create anaerobic conditions near the seabed, and reintroduce toxins that may have settled out of the water column (Churchill 1989; Jones 1992, Messieh et al. 1991).

Dredge Gear

Dredging for scallops may affect habitat by causing unobserved mortality to scallops and other marine life, mortality of discards, and modification of the benthic community and sediments. Similar to trawling, dredging places fine sediments into suspension, bury gravel below the surface and overturn 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 resuspended 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). For some scallop species, it has been demonstrated that dredges may adversely affect substrate required for settlement of young to the bottom (Fonseca et al. 1984; Orensanz 1986). 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 (mollusks) 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.

Several studies have addressed mortality of scallops not captured by dredges. In Australia, this type of fishing gear typically harvests only 5-35% of the scallops in their path, depending on dredge design, target species, bottom type, and other factors (McLoughlin et al. 1991). Of those that come in contact with the dredge but

are not captured, some elude the passing dredge and recover completely from the gear interaction. Some injuries may occur during on board handling of undersized scallops that are returned to the sea or during gear interactions on the sea floor (Caddy 1968; Naidu 1988; Caddy 1989), and delayed mortality can result from siltation of body cavities (Naidu 1988) or an increased vulnerability to disease (McLoughlin et al. 1991) and predation (Elner and Jamieson 1979). Caddy (1973) estimated incidental dredge mortality to be 13 to 17%, based on observations of broken and mutilated shells of Atlantic sea scallops. However, a submersible study of sea scallops from the mid-Atlantic indicated that scallop dredges capture with high efficiency those scallops which are within the path of the scallop dredge and cause very low mortality among those scallops that are not captured (NEFMC 1988). Murawski and Serchuk (1989) made submersible observations of dredge tracks and found a much lower mortality rate (<5%) for Atlantic sea scallops. The difference in mortality between these two studies can be attributed to the substrate on which the experiments were conducted. Caddy's work was done in a sandy/gravelly area and Murawski and Serchuk worked on a smooth sand bottom. Shepard and Auster (1991) investigated the effect of different substrate types on dredge induced damage to scallops and found a significantly higher incidental damage on rock than sand, 25.5% versus 7.7%. For weathervane scallops, mortality is likely to be lower as this species prefers smoother bottom substrates consisting of mud, clay, sand, or gravel (Hennick 1970a, 1973).

Atlantic sea scallop beds and the benthic community associated with scallop fishing grounds in the Bay of Fundy were assessed in 1969 (Caddy 1976). During the intervening years, the area has seen great changes in fishing pressure with recent effort amounting to more than 90 vessels of over 25 GRT continuously fishing the grounds with Digby drags for days at a time (Kenchington and Lundy 1991). Since 1969, there have also been dramatic fluctuations in scallop abundance, including both record highs and lows for this century. In particular, scallop abundance rose to over 1000 times "normal" levels with the recruitment of two strong year-classes in 1985 and 1986. This information indicates that extensive dredging does not affect the recruitment of scallops to a productive ground.

Observations from scallop fisheries across the state suggest that mortality of crab bycatch may be lower on average than those taken in trawl fisheries, perhaps due to shorter tow times, shorter exposure times, and lower catch weight and volume. For crab taken as bycatch in the Gulf of Alaska weathervane scallop fishery, Hennick (1973) estimated that about 30% of Tanner crabs and 42% of the red king crabs bycaught in scallop dredges were killed or injured. Hammerstrom and Merrit (1985) estimated mortality of Tanner crab at 8% in Cook Inlet. Kaiser (1986) estimated mortality rates of 19% for Tanner crab and 48% for red king crab bycaught off Kodiak Island. Urban et al. (1994) recorded that in 1992, 13-35% of the Tanner crab bycaught were dead or moribund before being discarded with the highest mortality rate occurring on small (<40 mm carapace width, CW) and large (>120 mm CW) crabs. Delayed mortality of Tanner crab resulting from injury or stress has not estimated. Mortality in the Bering Sea appears to be lower than in the Gulf of Alaska, in part due to different sizes of crab taken. Observations from the 1993 Bering Sea scallop fishery indicated lower bycatch mortality of red king crab (10%), Tanner crab (11%) and snow crab (19%) (Barnhart et al. 1996). As with observations from the Gulf of Alaska, mortality appeared to be related to size, with larger and smaller crabs having higher mortality rates on average than mid-sized crabs (Barnhart et al. 1996). Delayed mortality was not estimated. In one groundfish plan amendment analysis, all sources of crab mortality were examined; in this analysis a 40% discard mortality rate for all crab species was assumed for scallop fisheries (NPFMC 1993).

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' 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 HP vessel pulling a trawl with

a 150' 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.

Longline Gear

Very little information exists regarding the effects of longlining on benthic habitat. Observations of halibut longline gear made by NMFS scientists during submersible dives off southeast Alaska provide some information (NPFMC 1992). The following is a summary of these observations: "Setline gear often lies slack on the sea-floor and meanders considerably along the bottom. During the retrieval process, the line sweeps the bottom for considerable distances before lifting off the bottom. It snags on whatever objects are in its path, including rocks and corals. Smaller rocks are upended, hard corals are broken, and soft corals appear unaffected by the passing line. Invertebrates and other light weight objects are dislodged and pass over or under the line. Fish, notably halibut, frequently moved the groundline numerous feet along the bottom and up into the water column during escape runs disturbing objects in their path. This line motion was noted for distances of 50 feet or more on either side of the hooked fish."

Some crabs are caught incidentally by longline gear in pursuit of groundfish, and a portion of these crabs die. No field or laboratory studies have been made to estimate mortality of crab discarded in longline fisheries. However, based on condition factor information from the trawl survey, mortality of crab bycatch has been estimated and used in previous analyses (NPFMC 1993). Discard mortality rates were estimated at 37% for red king crab and 45% for *C. bairdi* Tanner crab taken in longline fisheries. No observations had been made for snow crab, but mortality rates may be similar to Tanner crab.

Mortality of groundfish discarded in longline fisheries has not been studied extensively in Alaska. Studies with Pacific halibut have shown that discards may have high mortality if not released carefully from hooks. Additionally, some species such as rockfish may not survive changes in pressure when they are hauled up quickly from the bottom. Mortality of discarded halibut has been estimated to be about 15% for most longline fisheries (Williams 1997).

Pot Gear

Pot gear is used in the North Pacific to harvest crabs and groundfish. This gear type likely affects habitat during the process of setting and retrieving pots; however, no research has been conducted to date.

Like other fisheries, pot fisheries incur some bycatch of incidental fish and crab. The groundfish pot fishery targets Pacific cod, but takes other species such as crab and flatfish which are discarded. Mortality of bycaught fish in groundfish pot fisheries has not been studied, with the exception of Pacific halibut. Based on viability data, it has been estimated that mortality of halibut bycaught in groundfish pot fisheries averages about 7% (Williams 1997). Bycatch in crab pot fisheries includes crabs, octopus, Pacific cod, halibut, and other flatfish (Tracy 1994). Crab bycatch includes females of target species, sublegal males of target species, and non-target crab.

There are a variety of effects caused by handling, ranging from sublethal (reduced growth rates, molting probabilities, visual acuity from bright lights, and vigor) to lethal effects. Several laboratory and field studies have been conducted to determine mortality caused by handling juvenile and female crab taken in crab fisheries. -Studies have shown a range of mortality due to handling based on gear type, species, molting stage, number of times handled, temperature, and exposure time (Murphy and Kruse 1995). Handling mortality may have contributed to the high natural mortality levels observed for Bristol Bay red king crab in the early 1980s (65%

for males and 82% for females) that, along with high harvest rates, resulted in stock collapse (Zheng et al. 1995). However, another study concluded that handling mortality was not responsible for the decline on the red king crab fishery (Zhou and Shirley 1995a). Byersdorfer and Watson (1992, 1993) examined red king crab and Tanner crab taken as bycatch during the 1991 and 1992 red king crab test fisheries. Instantaneous handling mortality of red king crab was <1% in 1991, and 11.2% in 1992. Stevens and MacIntosh (1993) found average overall mortality of 5.2% for red king crabs and 11% for Tanner crabs on one commercial crab vessel. Authors recommend these results be viewed with caution, noting that experimental conditions were marginal. Mortality for red king crab held 48 hours was 8% (Stevens and MacIntosh 1993, as cited in Queirolo et al. 1995). A laboratory study that examined the effects of multiple handling indicated that mortality of discarded red king crabs was negligible (2%), although body damage increased with handling mortality (Zhou and Shirley 1995a).

Delayed mortality of crabs due to handling does not appear to be influenced by method of release. In an experiment done during a test fishery, red king crab thrown off the deck while the vessel was moving versus those gently placed back into the ocean showed no differences in tag return rates (Watson and Pengilly 1994). Handling methods on mortality has been shown to be non-significant in laboratory experiments with red king crab (Zhou and Shirley 1995a, 1995b) and Tanner crab (MacIntosh et al. 1995). Although handling did not cause mortality, injury rates were directly related to the number of times handled.

Mortality of crabs is also related to time out of water and air temperature. A study of red king and Tanner crabs found that crabs exposed to air exhibited reduced vigor and righting times, feeding rates (Tanner crabs), and growth (red king crabs) (Carls and Clair 1989). Cold air resulted in leg loss or immediate mortality for Tanner crabs, whereas red king crabs exhibited delayed mortality that occurred during molting. A relationship was developed to predict mortality as the product of temperature and duration of exposure (measured as degree hours). Because BSAI crab fisheries occur during November through February, cold exposure could cause significant handling mortality to crabs not immediately returned to the ocean. However, Zhou and Shirley (1995) observed that average time on deck was generally 2 to 3 minutes, and they concluded that handling mortality was not a significant source of mortality.

Salmon Fishing Gear

Directed fisheries on salmon in Alaska include marine commercial and recreational hook-and-line fisheries; marine commercial gill-net and seine fisheries; and estuarine and riverine gill-net (both set-net and drift), recreational, personal use, and subsistence fisheries. Two types of impacts can occur: (1) direct effects of the fishing gear on habitat; and (2) by-catch or entanglement of non-target species. In the marine fisheries, direct impact of the gear on marine habitats is limited, but some localized effects can occur, such as trolling weights damaging coral or purse seines damaging kelp beds or benthic structure. By-catch and entanglement of non-target species can occur in the marine fisheries, such as by-catch of demersal rockfish in hook-and-line fisheries, and entanglement of seabirds and marine mammals in net fisheries. In the estuarine and riverine fisheries, direct impacts on riparian vegetation and channel morphology can occur from fishing activities, such as damage to the stream bank from boat wakes and removal of woody debris to provide access. Trampling of stream banks and the stream channel can also damage salmon habitat. Where use levels are high, this type of impact may require restoration or management initiatives. An example is the Kenai River where restoration work was needed to repair damage from recreational fishing for chinook salmon and other salmonids.

Summarv of the Impacts of Fishing on Habitat

Alterations to natural communities are inevitable when harvesting marine organisms with any gear type. The removal of any organism has , by itself, an effect. It has been suggested that though there is some alteration due to fishing, it is simply a necessity to harvest the resource (de Groot 1984). Furthermore, some studies have

shown that the community will return to relatively pristine conditions in a relatively short time period following a fishing closure, if there was an effect at all (Graham 1955; van Dolah et al. 1987; Rumohr and Krost 1991; Jones 1992; Brylinsky et al. 1994). On the other hand, there is also the suggestion that pre-fishing, "pristine" conditions are not known, since almost all study areas have had some form of fishing prior to the study (Auster et al. 1996). Lastly, there are also studies that conclude that trawling, in some situations, may cause long-term changes in habitat and community structure (Auster et al. 1996; Kaiser and Spencer 1996b; Schwinghamer et al. 1996).

To further confuse the issue, nothing is static. The fishing industry makes regular alterations to gear and fishing techniques. The oceanic and atmospheric conditions change continually, on both local and global scales, all of which may affect groundfish or the benthic communities upon which they depend. Lastly, other human induced actions such as pollution, mining and petroleum exploration can affect benthic communities as well. However, declines of some fisheries being observed around the world have served to emphasize that all sources of potential effects should be considered by managers aiming for sustainability.

Table 1. Summary of literature cited. Those studies done in Alaska are shown in bold.

Authors	Year	Gear Type	Location	Fishery	Main Emphais of Citation
Apollonio	1989	Otter Trawl	Northwest Atlantic	Groundfish	Habitat and Benthic Alterations
Armstrong, et. al.	**1993**	**Bottom Trawl**	**Bering Sea**	**Groundfish**	**Bycatch**
Auster, et.al.	1996	Otter Trawl	Gulf of Maine	Groundfish	Habitat and Benthic Alterations
BEON-Rapport 8	1990	Beam Trawl	North Sea	Groundfish	Habitat and Benthic Alterations
Bergman and Hup	1992	Beam Trawl	North Sea	Groundfish	Habitat and Benthic Alterations
Bergman, et. al.	1989	Beam Trawl	North Sea	Groundfish	Habitat and Benthic Alterations
Blackburn and Schmidt		**1988**	**Otter Trawl**	**GOA (Kodiak area)**	**Survey Bycatch**
Brylinsky, et. al.	1994	Otter Trawl	Bay of Fundy	Flounder	Habitat and Benthic Alterations
Caddy	1973	Otter Trawl	Gulf of St. Lawrence	Groundfish	Habitat and Benthic Alterations
Churchill	1989	Otter Trawl	Mid-Atlantic Bight	Groundfish	Sediment Resuspension
de Groot	1984	Beam+Otter Trawl	North Sea	Groundfish	Habitat and Benthic Alterations
Efanov and Istomin	1988				Bycatch
Fonds, M.(ed.)	1991	Beam Trawl	North Sea		Bycatch
Fukuhara and Worlund	1973	Otter Trawl	Bering Sea	Groundfish	Bycatch
Gibbs, et. al.	1980	Otter Trawl	New South Wales	Shrimp	Habitat and Benthic Alterations
Graham	1955	Otter Trawl	North Sea	Plaice	Habitat and Benthic Alterations
Heifetz (ed.)	1997	Otter Trawl	BSAI/GOA	Groundfish	Habitat and Benthic Alterations
Hill and Wassenberg	1990	Otter Trawl	South Pacific	Shrimp	Bycatch
Hutchings	1990	Otter Trawl	Australia	Shrimp	Habitat and Benthic Alterations
Jones	1992	Beam +Otter Trawl	World Wide	Multiple	Habitat, Bycatch, Alterations
Kaiser and Spencer	1994				Bycatch
Kaiser and Spencer	1996	Beam Trawl			Bycatch
Kaiser and Spencer	1996	Beam Trawl	Europe Shelf	Groundfish	Habitat and Benthic Alterations
Ketchen	1947	Otter Trawl	Western N. Atlantic	Groundfish	Habitat and Benthic Alterations
Krost, et. al.	1990	Otter Trawl	Western Baltic	Groundfish	Habitat and Benthic Alterations
Main and Sangster	1988	Otter Trawl	North Atlantic	Groundfish	Bycatch
Mayer et.al.	1991	Otter Trawl	Gulf of Maine	Groundfish	Sediment Resuspension
McAllister	1991	Trawls (in general)	World Wide	Groundfish	Habitat and Benthic Alterations
Messich, et.al.	1991	Otter Trawl	Eastern Canada	Groundfish	Habitat and Benthic Alterations
NRC	**1988**	**Otter Trawl**	**Bering Sea**	**Groundfish**	**Bycatch**
Owen	**1988**	**Otter Trawl**	**GOA(Kodiak area)**	**Survey**	**Bycatch**
Rumohr and Krost	1991	Trawls (in general)	Western Baltic	Groundfish	Habitat and Benthic Alterations
Russell	1997	Trawls (in general)	Georges Bank	Groundfish	Habitat and Benthic Alterations
Sangster	1992				Bycatch
Schwinghamer et.al.	1996	Otter Trawl	Grand Banks	Groundfish	Habitat and Benthic Alterations
Stevens	**1990**	**Otter Trawl**	**Gulf of Alaska**	**Sole**	**Bycatch**
Suuronen et.al.	1993				Bycatch
van Beek et.al.	1989	Otter+Beam Trawls	North Sea	Flatfish	Bycatch
van Dolah et.al.	1987	Roller Trawl	Coast of Georgia	Survey	Habitat and Benthic Alterations
Williams	**1997**	**Otter Trawl**	**BSAI/GOA**	**Groundfish**	**Bycatch**

8.10.3 Literature of Scientific Studies on Fishing Threats to Habitat

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8.11 Non-fishing related activities that may adversely affect EFH

8.11.1 Identification of non-fishing adverse impacts to EFH in Alaska

An ***Adverse Impact***, by definition, means any impact which reduces quality and/or quantity of Essential Fish Habitat (EFH). A reduction of quality and/or quantity of EFH can be described by a direct, cumulative, and/or natural adverse impact. A ***direct impact*** to a defined essential fish habitat will result in loss of its ability to provide specific habitat for a species. ***Cumulative impacts*** are linked to the quantity and location of impacts within a given geographic area. For the purposes of this analysis, cumulative impacts are impacts on the environment that result from the incremental impact of an action when added to other past, present and reasonable foreseeable future action or threat[2], regardless of who undertakes such action. Impacts like these can build on one another, especially in developed areas or communities. Equally important are ***natural adverse impacts***, such as storm damage or climate-based environmental shifts, that can also contribute to the loss of EFH. Significant loss of EFH will reduce the species ability to reproduce, survive, or exist.

Species dependent on coastal areas during various stages of their life, particularly during juvenile rearing and adult reproduction, are more vulnerable to habitat alterations than are species that remain offshore. Also, the effects of habitat alteration on offshore species are not as apparent as they are in coastal areas. Concern is warranted, however, to the degree that (1) the offshore environment is subject to habitat degradation from either inshore activities or offshore uses, and (2) to the extent that some species living offshore depend directly or indirectly on coastal habitats for a critical life stage such as reproduction or as a source of food.

This section discusses types of activities that have a potential to cause habitat degradation that could affect fishery populations. This discussion is designed to identify those areas of uncertainty that may reasonably deserve attention in the future and not to be a conclusive review of impacts to EFH. Whether the likelihood and level of these activities or events cause harm to species habitats can be decided when the details of a proposed activity's location, magnitude, timing, and duration are more fully known. At present, human activities that adversely affect habitats are found near commercial fishing efforts, industrial growth areas, and community developments.

Dredging, Fill, Excavation

Potential impacts: excavation and maintenance of channels (includes disposal of excavated materials); construction of ports, mooring and cargo handling facilities; construction and operation of ship repair facilities; and construction of channel stabilization structures such as jetties and revetments.

Specific projects involving offshore marine disposals may directly impact EFH by overburdening and covering marine habitats. Because of the desirability of finding protection from Bering Sea storms, suitable port development sites often are valuable to the fishery fleet infrastructure. Recently, once such project in King Cove, Alaska, potentially could impact 20+ acres of marine habitat. This site was investigated and found not to be EFH for two species of crab, nevertheless the impact warranted investigation. Construction of a port facilities are planned for the City of Nome, Sand Point, and St. Paul, Alaska. In other areas, shallow water depth requires construction of long structures projected seaward in order to provide direct access from the uplands to deeper-draft ocean going vessels. These causeways alter the physical processes of the shoreline such as currents and disruption of fish migration. Another project in the village of Unalaska, required an extension of the airport runway into water depths approximately 50-feet, and received the necessary permits for

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[2] See attached **Non-fishing Adverse Impacts to Habitat** worksheet. The worksheet is an professional interpretative summary of broad category threats that are described in further detail throughout the Non-fishing Adverse Impacts Section.

construction. Beyond these specific projects, development activity in the coastal areas of the Bering Sea and the Aleutian Islands has been largely limited to construction of erosion control measures and breakwaters (e.g., the city of Bethel). As human population increase, so will the desire to have new harbor developments. In Alaska, there are over 40 known Ports of Call. Many villages lack large enough harbors for trade and therefore are not a port. All these require routine dredging ranging from 1-20 year intervals.

From a broad perspective, the environmental effects of dredging can include:

- Direct removal/burial of organisms as a result of dredging and placement of dredged material.
- Turbidity/siltation effects, including increased light attenuation from turbidity.
- Contaminant release and uptake, including nutrients, metals, and organics.
- Release of oxygen consuming substances.
- Noise disturbance to aquatic and terrestrial organisms.
- Alteration to hydrodynamic regimes and physical habitat.

Port expansion has become an almost continuous process due to economic growth, competition between ports, and significant increases in vessel size. Elimination or degradation of aquatic and upland habitats are commonplace since port expansion almost always requires the use of open water, submerged bottoms, and riparian zones. Ancillary port related activities and development often utilize even larger areas, many of which provide water quality and other functions needed to sustain living marine resources. Vessel repair facilities utilize highly toxic cleaners, paints, and lubricants that can contaminate waters and sediments. Modern pollution containment and abatement systems and procedures can prevent or minimize toxic substance releases; however, constant and diligent pollution control efforts must be implemented.

Even with the use of approved practices and disposal sites, ocean disposal of dredged materials is expected to cause environmental harm since contaminants will continue to be released, productive bottoms will still be filled, and localized turbidity plumes and reduced oxygen zones will persist. Dredging discharge increases turbidity and sediment--this is considered by some to be the most prevalent form of pollution in Alaska waters (Lloyd et al. 1987) and has contributed to the absence of grayling in some streams (LaPerriere et al. 1985). The effects of new disposal techniques such as creation of near shore berms and such "beneficial uses" of dredged material as creation of shallow water habitats and emergent wetlands are, in many cases, unclear and resulting long-term geomorphological and ecological change could be harmful to certain species and environments.

Return of materials dredged from the ocean to the water column is considered a discharge activity. Depending upon the chemical constituency of the local bottom sediments and any alterations of dredged materials prior to discharge, living marine resource in the area may be exposed to elevated levels of heavy metals. For example, scallop populations are vulnerable to pollution, even in offshore habitats where dumping and runoff can have an effect (Gould and Fowler 1991). Ocean dumping of sediments mat bury or damage scallops by abrasion and gill clogging (Larsen and Lee 1978). Scallops are efficient at concentrating PCB's and heavy metals, including silver, copper, and nickel (Pesch et al. 1979), mercury (Klein and Goldberg 1970), cadmium (Vattutone et al. 1976), chromium (Mearns and Young 1977). At certain levels of concentration, heavy metals can be lethal or have adverse effects at lesser concentrations. Sublethal concentrations of copper produced substantial kidney and gonad damage in sea scallops, whereas cadmium induced hormonal changes such as early gonad maturation (Gould et al. 1985).

Natural deposits of mercury are know to occur in marine bottom sediments. The levels of mercury in Norton Sound (Nelson et al. 1975) exceed the 3.7 ug/l set by the EPA Marine Quality Standards as the maximum allowable concentration. Wood (1974) demonstrated that mercury available to the aquatic environment in any form can result in steady-state concentrations of methyl, dimethyl, and metallic mercury through microbial catalysis and chemical equilibrium. Large-scale gold dredging projects in eastern Norton Sound will result in the discharge and resuspension of sediments that could introduce mercury to the water column.

Marine Mining

Potential threats include: removal of substrates that serve as habitat for fish and invertebrates; creation (or conversion) of habitats to less productive or uninhabitable sites such as anoxic holes or silt bottom; burial of productive habitats in the vicinity of the mine site or 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; adverse modification of hydrologic conditions so as to cause erosion of desirable habitats.

Mining activity, such the extraction of gravel and gold in the Bering Sea, and placer mining spread throughout the state, can lead to the direct loss of EFH for certain species. Gravel is obtained by mining gravel beaches along the Bristol Bay coast (e.g., Goodnews Bay, Kangirlvar Bay) and in the lower reaches of the Yukon and Kuskokwim Rivers. Mining of large quantities of beach gravel can significantly affect the removal, transport, and deposition of sand and gravel along shore, both at the mining site and down current. During mining, water turbidity increases and 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. Neither the future extent of this activity nor the effects of such mortality on the abundance of marine species is known.

Dredging for gold has been attempted at various sites along the Aleutians and the world's largest mechanical dredge was operated offshore near the city of Nome. A similar proposal, which has received all of the necessary permits to proceed, will entail dredging 21,000 acres of sea bottom in Norton Sound for the purpose of recovering gold. Such activity has the potential to cause physical damage directly and indirectly to benthic habitat, juvenile fish, and adult life stages.

Mining practices that can impact EFH include physical and chemical impacts from intertidal dredging and chemicals such as flocculates. However, tailings and discharge waters from settling ponds can result in loss of EFH and life stages of managed species. Placer mining can introduce levels of heavy metals and arsenic that are naturally found within the stream bed sediments. The impact degrades the water quality and levels can become high enough to prove lethal.

The number of individual mining operations for a given area must be monitored. For instance, three mining operations in an intertidal area could impact EFH, whereas one may not. Also, disturbance of previously contaminated mining areas threaten an additional loss of EFH.

Fish Processing Waste - Shoreside and Vessel Operation

Potential threats include: direct and/or non-point source discharge of nutrients, chemicals, fish by-products, and stick water; overburdening of original habitats; particle suspension.

Fish waste from shore side and vessel processing has occurred in marine waters since the 1800's. It is a direct impact to the marine environments by degrading water quality factors. Some fish waste is biodegradable such as heads, viscera, and bones. Other fish parts that are ground to fine particles and become suspended. Another byproduct of processing is fish meal waste called stick water, which is a fine gel or slime. Stick water can

concentrate on surface waters and move onshore to cover intertidal areas. Seafood processing has been conducted for years in processing ports in Alaska. Crab and fish have been processed in various ports such as Kodiak, Dutch Harbor, St. Paul, and Akutan by floating and shore side processors with little impact upon habitat for crab and other species. However, localized damage to benthic environment consisting of up to several acres of bottom being driven anoxic by rotting processing waste and piles of waste up to 26 feet deep have been recorded. Discharges from these processors now require National Pollutant Discharge Elimination System (NPDES) permits from the Environmental Protection Agency. At-sea floating processors are covered by a general NPDES permit which requires that processing waste be ground into finer than one-half inch particles and discharged below the surface (Personal Communication, Dr. Bruce Duncan, U.S. Environmental Protection Agency, 701 C Street, Box 19, Anchorage, AK 99513).

Although seafood has been processed at sea by foreign fishing vessels in the past without apparent harm to the marine habitat, there has been one instance reported of unusual quantities of fish carcasses (not ground in conformance with the general NPDES permit) accompanied by dead scallops brought up in scallop dredges (Capt. Louie Audet, F/V Shayline Nicholas). It will be important to be alert to similar possible perturbations of the environment resulting from at-sea processing discharges.

Over time, suspended particles will accumulate. Juvenile and adult stages of flatfish are drawn to these areas for food sources. One effect of this attraction may lead to increased predation on juvenile fish species by other flatfishes, diving seabirds, and marine mammals drawn to the food source. However, due to the difficulty in monitoring these outfalls, impacts to species can go undetected.

Fish waste disposal at marinas can also degrade water quality where large numbers of fish are landed and cleaned, or where fish landings are limited but water circulation is poor (USEPA 1993). In sufficient quantity, fish waste disposal can cause dissolved oxygen depression, contamination, and odor problems in coastal waters (USEPA 1993).

Timber Harvest

Potential threats include: increase in bedload suspended sediments and turbidity from construction of logging roads, in-water stream crossings, exposed slope erosion, removal of streamside vegetation; alter streamflow; introduce excessive nutrients, decrease large woody debris; increase streambank erosion; alter temperature, and have toxic effects on biota.

Forest road construction can destabilize slopes and increase erosion and sedimentation. This erosion occurs in two forms, as mass soil movement (i.e., landslides) and as surface erosion. Both types can introduce debris and sediment into adjacent streams for many years after initial construction. Erosion is most severe where poor construction practices are allowed, inadequate attention is paid to proper road drainage, and where construction occurs in inclement weather. After construction, unpaved logging roads can be a chronic source of sediment to streams. Juvenile salmon avoid habitat areas with suspended sediment (Bisson and Bilby 1982)

Stream crossings by forest roads may block fish migration. Culverts are often installed as an economical alternative to bridges, although bridges are usually less disruptive to the stream environment. Culverts are a serious threat to salmon unless specifically designed, installed, and maintained to accommodate fish passage.

Removal of streamside vegetation during timber harvest activities increases solar radiation to the stream and results in warmer water during summer, especially in small streams. The magnitude of temperature change depends on the amount of timber harvested adjacent to the stream (Meehan et al, 1969; Brown and Krygier, 1970) and time for regrowth of riparian areas. In Southeast Alaska, Meehan et al., (1969) found that maximum temperature in logged streams exceeded those of unlogged control streams by up to 5°C, but the

temperature did not reach lethal levels. The increased water temperature, however, frequently exceeded the optimum for pink and chum salmon documented by Reiser and Bjornn (1979).

High summer air temperature has been associated with adult salmon mortality. The Alaska Department of Fish and Game compiled a list of 43 streams that had mortality of pink and chum salmon in 1977 associated with high water temperature and low flow. The largest clear-cut in Alaska is located in the Staney Creek watershed. In 1979, 15,000 pink salmon died there before spawning, a result of warm water and low oxygen. In northern areas, the removal of riparian vegetation may cause lower stream temperature during winter, increasing the formation of frazil and anchor ice.

By removing vegetation, timber harvest temporarily reduces transpiration losses from the watershed, thereby elevating water content of soil and increasing run-off during base-flow periods. The elevated water content can reduce soil strength and destabilize slopes, causing increased sediment and debris inputs to streams (Swanston 1974). Sediment deposition in streams can reduce benthic community production (Culp and Davies, 1983) and can cause mortality of incubating salmon eggs and alevins, and habitat loss for juvenile salmon (Heifetz et al. 1996). Cumulative sedimentation from logging activities can significantly reduce the egg-to-fry survival of coho and chum salmon (Cederholm et al. 1981; Cederholm and reid 1987; Hartman et al. 1987). Where egg-to-fry survival is impaired by habitat deterioration escapement goals may have to be increased to offset the effect of decreased spawning success.

Converting large portions of old-growth forests to rapidly growing second-growth forests can permanently reduce summer stream flows and thus permanently reduce salmonid production (Myren and Ellis, 1984). The studies of streams in second-growth forests have demonstrated that the input of large, potentially stable debris (logs and stumps) into salmon habitat from second-growth is reduced relative to inputs from old growth stands (Bisson et al. 1987). Further, the initial high productivity of prey organisms in streams running through open canopy (clear-cut) is short-lived and eventually the quantity of food organisms declines as the canopy closes (Sedell and Swanson, 1984).

Non-point Source Pollution and Urbanization

Potential threats: direct and/or non-point source discharge of fill, nutrients, chemicals, cooling water, air emissions, and surface and ground waters into streams, rivers, estuaries and ocean waters; conversion of wetlands to sites for residential and related purposes such as roads, bridges, parking lots, commercial facilities; elevation in inorganic and organic nutrient loading in estuarine and coastal waters; coastal development effects to adjacent and downstream ecosystems through modification of the hydrology, chemistry, and biology of streams, lakes, bays, estuaries, and the associated wetlands; and cumulative and synergistic effects caused by association of these and other developmental and non-developmental related activities.

People are moving to the coasts in increasing numbers. A major factor in the threat posed by urban and suburban development is that of non-point source (NPS) discharges of the chemicals used in day to day activities, in operating and maintaining homes and business, for maintaining roads, and for fueling vehicles. Sustainable coastal development from a fishery habitat perspective will need to combine responsible developmental practices at the local and state levels with scientific oversight of environmental conditions in the coastal zone. This can only be accomplished through long-term ecological research and education programs that allow assessment of the combined impacts of exploiting fishery stocks and habitat degradation. The results of such investigations should be used to inform the public and elected officials of the economic and social importance of healthy and productive coastal fishery habitats.

Coastal regions can experience substantial change due to rapid population growth and urbanization. Major point source and non-point source discharges have been linked to industrial/municipal facilities, abandoned hazardous waste sites, and runoff from agriculture and urbanization. Regional monitoring studies in South Carolina that measured chemical contaminants in surface waters, sediments, and biota indicated linkage between elevated levels of chemical contaminants including polycyclic aromatic hydrocarbons (PAHs) from roadways and marinas and chlordane from housing (Scott et al 1996). Similarly a correlation between elevated levels of coliform bacteria in coastal waters and urbanization was demonstrated (Scott et al 1996).

A consequence of increased human populations is an elevation in inorganic and organic nutrient loading in estuarine and coastal waters. This process can result in transient increased productivity and standing crop of phytoplankton, decreased levels of dissolved oxygen, and shifts in species composition. Higher phytoplankton production and biomass, although potentially beneficial as a food source, may cause decreases in light penetration needed for production by benthic algae, submerged aquatic vegetation and, subsequently, benthic animals. Increased nutrients also can lead to shifts in the species composition of the phytoplankton community where fewer and less desirable organisms may become prevalent. Significant depletion of dissolved oxygen has been shown to occur in association with large algal blooms and significant fish kills have been linked to this process. Nutrient loading has also been linked to noxious algal and dinoflagellate blooms that produce toxins which may be harmful to aquatic organisms and humans. Nutrient loading of scallop populations can cause low dissolved oxygen (hypoxic) conditions (Sindermann 1979), and an increase in bacterial infections (Liebovitz et al. 1984), or algal (Wassman and Ramus 1973) and dinoflagellate blooms (Shumway 1990), all of which can be detrimental to their population.

Urbanization and associated coastal development can effect adjacent and downstream ecosystems through modification of the hydrology, chemistry, and biology of streams, lakes, bays, estuaries, and the associated wetlands. Those aquatic features provide many essential ecological functions including flood and erosion control, diverse biological productivity, and as buffers to physicochemical changes in associated water bodies. Prior to the 1960s, most untreated organic and industrial wastes were dumped directly into streams, lakes or estuaries. Environmental damage from such uncontrolled waste discharge was evident from fish kills, oxygen depletion, massive blooms of nuisance algae, and public health problems. Pacific salmon were most evidently affected by pollution from raw sewage, pulp mill effluents, and acid and metal wastes. Strict regulation of point source discharges of municipal and industrial waste continue to improve that situation. Some toxins from previous unregulated discharges, however, remain trapped in bottom sediments and can be disturbed by current activities.

In urban areas, wetlands are easily degraded or lost by dredging, filling, diking, or draining to provide harbors and building sites. When wetlands are filled, their function of buffering physicochemical changes in adjacent and downstream water bodies is often lost. Development activities can, therefore, have severe impacts on anadromous fish, as well as other wetland-dependant species. Wetlands stabilize hydrology, improve water quality, and increase biological diversity in anadromous fish habitat. Wetlands store and control runoff, thereby decreasing flood peaks and erosion and providing greater base flows in downstream areas. With highly variable runoff, anadromous fish habitat may be eroded during floods and left dry during periods of low runoff. Salmon may be prevented from migrating due to velocity barriers or low water. Spawning areas may be scoured during high water or dry up or freeze during low water. Rearing salmon may be flushed into poor habitat during freshets or trapped in drying areas at low flows. Wetlands can improve water quality as nutrients and pollutants are removed through biological and chemical processes.

Point Source Pollution

Potential threats include; overburdening of bottom habitat near the location of outfall; degradation; degradation of water quality and habitat from storm water and industrial discharges; pollution effects that

may be related to changes in water flow, PH, hardness, dissolved oxygen, and other parameters that affect individuals, populations, and communities; atmospheric pollution dispersal and mixing.

Point source discharges from municipal sewage treatment facilities or storm water discharges are controlled through U.S. Environmental Protection Agency mandated regulations under the Clean Water Act and by state water quality 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. Small quantities of industrial and household pollutants have the potential to become large impacts. Storm drains are contaminated from communities with settling and storage ponds, street runoff, harbor activities, and honey buckets. Sewage outfall lines also can significantly alter ph levels of saline waters.

Industrial wastewater effluent is regulated by the U.S. Environmental Protection Agency through the National Pollutant Discharge Elimination System (NPDES) permitting program. This program provides for issuance of waste discharge permits as a means of identifying, defining, and controlling virtually all point source discharges. The complexity and the magnitude of effort required to administer the NPDES permit program limit overview of the program and federal agencies such as the NMFS and the Fish and Wildlife Service generally do not provide comments on NPDES permit notices. For these same reasons, it is not possible to presently estimate the singular, combined, and synergistic effects of industrial (and domestic) discharges on aquatic ecosystems.

At certain concentrations, point source discharges can alter the following properties of ecosystems and associated communities: diversity, nutrient and energy transfer, productivity, biomass, density, stability, connectivity, and species richness and evenness (Carins 1980). At certain concentrations, point source discharges may alter the following characteristics of finfish, shellfish, and related organisms: growth, visual acuity, swimming speed, equilibrium, feeding rate, response time to stimuli, predation rate, photosynthetic rate, spawning seasons, migration routes, and resistance to disease and parasites. In addition to direct effects on plant and animal physiology, pollution effects may be related to changes in water flow, PH, hardness, dissolved oxygen, and other parameters that affect individuals, populations, and communities (Carins 1980). Sewage, fertilizers, and de-icing chemicals (e.g., glycols, urea) are examples of common urban pollutants that decompose with high biological or chemical oxygen demand. Zones of low dissolved oxygen from their decomposition can retard growth of salmon eggs, larvae, and juveniles and may delay or block smolt and adult migration. Sewage and fertilizers also introduce nutrients into urban drainages that drive algal and bacterial blooms which may smother incubating salmon or produce toxins as they grow and die. Thermal effluents from industrial sites and removal of riparian vegetation from streambanks allowing solar warming of water can degrade salmon habitat. Heavy metals, petroleum hydrocarbons, chlorinated hydrocarbons, and other chemical wastes can be toxic to salmonids and their food, and they can inhibit salmon movement and habitat use in streams. Mining, ore processing, smelting, and refining operations often produce heavy metals as waste products that may effect the movement of salmon, causing migration delays. Petrochemicals and chlorinated compounds, such as those in herbicides and pesticides, are toxic or have long-term effects on survival, stamina, and reproduction in salmonids. Peripheral effects of pollution may include forcing rearing fish into areas of high predation or less than optimal salinity for growth.

Contaminants that are emitted into the atmosphere by incinerators, fossil fueled power plants, automobiles, and industry may be transported various distances and directly and indirectly deposited into aquatic ecosystems (Baker et al 1993). As such, the regulation of surface water contamination from atmospheric pollution may require local, regional, and international efforts. Atmospheric linkage of pollutants from local, regional, and remote sources is also possible and, accordingly, the types and levels of contaminants reaching surface waters may vary. Although the magnitude and effect of atmospheric pollution dispersal and mixing may be difficult to assess, it is clear that atmospheric contaminants are routinely deposited in coastal and estuarine waters.

Hazardous Material / General Litter

Potential impacts include: introduction of hazardous and toxic materials from at sea ocean disposal; disposal of contaminated dredged material; illegal dumping of trash, wastewater, and unwanted cargo; accidental disposal of material; "short dumping" of dredged material before permitted disposal area; introduction of general litter such as plastics, derelict fishing gear, and miscellaneous detrital matter.

Under provisions of the Marine Protection Research and Sanctuaries Act (MPRSA), ocean disposal of hazardous and toxic materials, other than dredged materials, is prohibited by U.S. flag vessels and by all vessels operating in the U.S. territorial sea and contiguous zone. The U.S. Environmental Protection Agency (EPA) may issue emergency permits for industrial waste dumping into ocean waters if an unacceptable human health risk exists and no other alternative is feasible. The MPRSA assigns responsibility the ocean disposal of dredged material to the EPA and the U.S. Army Corps of Engineers (COE). This involves: designating ocean sites for disposal of dredged material; issuing permits for the transportation and disposal of the dredged material; regulating times, rates, and methods of disposal and the quantity and type of dredged material that may be disposed of; developing and implementing effective monitoring programs for the sites; and evaluating the effect of dredged material disposed at the sites.

Dumping of trash, wastewater, and unwanted cargo is more likely to occur on the open seas since it is less observable here than in inshore waters. Prior to passage of the Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987 (PL 100-220) an estimated 14 billion pounds of garbage was being dumped into the ocean each year. Of this amount more than 85 percent was believed to have come from the world's shipping fleet in the form of cargo associated wastes.

In the absence of MPRSA and MPPRCA repeal or weakening, major dumping threats to EFH within federal waters should theoretically be limited mostly to illegal dumping and accidental disposal of material in unapproved locations. In reality, the present era of reduced government action and involvement many agencies lack sufficient staff and funds to carry out mandated responsibilities and the opportunity for unobserved illegal and accidental dumping may be substantial. This includes disposal of all types of materials as well as "short dumping" of dredged material whereby dumping takes place between the dredge site and the designated dump site.

The Act to Prevent Pollution from Ships (MARPOL ANNEX V) places limitations on ships to prohibit discharging or depositing any refuse matter, hazardous substance, oil, plastics and dunnage and will lessen impacts to EFH. Persistent plastic debris is introduced into the marine environment from offshore vessels and commercial fisheries, as well as from general shore activities. Debris includes synthetic netting, pots, longline gear, packing bands, and rope. Estimates of debris have been based on observations of debris at sea and on beaches, and occasional reports of accidental or deliberate discards of fishing gear. Studies by Merrell (1984) and others have shown that much of the observed entanglement debris consists of fragments of trawl web. Some trawl web gets discarded overboard following net repair, but most probably gets lost during normal fishing operations (e.g., fishing over rough bottoms, foul weather). Deliberate discharge at sea of all plastics are now prohibited by MARPOL Annex V.

Debris discarded at sea can entangle or be ingested by marine mammals, fish, shellfish, sea birds, and sea turtles. The persistent nature of plastics can pose a hazard to marine life for years. Other lost or discarded gear, such as crab pots continue to fish indefinitely. Neither the extent of debris-related mortality nor population effects on various species are known.

Mariculture and Introduction of exotic species

Potential threats include: introduction of genetic variance into juvenile and adult populations from hatchery fish stocks; transfer and introduction of exotic and harmful organisms through ballast water discharge.

Mariculture can have adverse effects on habitat because of over-enrichment of water and benthic habitat by uneaten food, feces, or other organic materials (Faris 1987). Accumulations on the bottom can create anaerobic conditions near mariculture sites and degrade foraging areas for juvenile salmon (Phillips et al. 1985). Additional threats include introductions of exotic species or domestic strains which might prey upon, compete with, or interbreed with wild stocks, and the spread of disease from culture facilities. Habitat can also be affected from the development of ancillary facilities, such as access roads, floating processing plants, or caretaker residences.

With recent introduction of the zebra mussel into the Great Lakes and its rapid dispersal into other waters considerable attention is being directed at the introduction of exotic species into U.S. waters via discharge of ship's ballast. According to one estimate (Carlton, 1985) two million gallons of foreign ballast water are released every hour into U.S. waters -- possibly representing the largest volume of foreign organisms released on a daily basis into north American ecosystems. The introduction of exotic organisms threatens native biodiversity and could lead to changes in relative abundances of species and individuals that are of ecological and economic importance. The social and economic implications of zebra mussel introduction into North American waters and the introduction of the comb jelly *Mnemiopsis* into the Sea of Azov in Russia -- which has helped decimate the region's anchovy fishery -- point out the seriousness of this threat.

Oil and Natural Gas Activities

Potential threats include: elimination or damage to bottom habitat due to drill holes and positioning of structures such as drilling platforms, pipelines, anchors, etc;, release of harmful and toxic substances from extracted muds, oil, and gas; and from materials used in oil and gas recovery; damage to organisms and habitats due to accidental spills; damage to fishing gear due to entanglement with structures and debris; and damage to fishery resources and habitats due to effects of blasting (used in platform support removal); and indirect and secondary impacts to near shore aquatic environments affected by product receiving, processing, and distribution facilities.

Information can be found in Berg (1977); Deis (1984); OCSEAP Synthesis Reports on the St. George Basin (1982), the Navarin Basin (1984), and the North Aleutian Shelf (1984); Thorsteinson and Thorsteinson (1982); and the University of Aberdeen (1978). The Alaska offshore area comprises 74 percent of the total area of the U.S. continental shelf. Because of its size, the Alaska outer continental shelf (OCS) is divided into three subregions—Arctic, Bering Sea, and Gulf of Alaska. Areas where oil and gas leases have occurred or are scheduled in the BSAI area include the Navarin Basin (1989)(Morris, 1981), St. George Basin (1990)(NMFS, 1979), North Aleutian Basin (1990)(NMFS, 1980) and the Shumagin Basin (1992) (Morris, 1987).

If a commercial quantity of petroleum is found, its production would require construction of facilities and all the necessary infrastructure from pipelines to onshore storage and shipment terminals or for building offshore loading facilities. It is believed that Bering Sea oil would be pipelined to shore and then loaded on tankers for transportation from Alaska. In the Navarin Basin, however, offshore-loading terminals may be more feasible. Unlike exploration, production would continue year-round and would have to surmount the problems imposed by winter sea-ice in many areas. Norton Basin and perhaps Navarin Basin would require ice-breaking tanker capabilities. There are also occasional proposals for tankering oil from Arctic fields via the Bering Sea, which would also require ice-breaking capabilities.

Oil and gas related activities have the potential to cause pollution of habitats, loss of resources, and use conflicts. Physical alterations in the quality and quantity of existing local habitats may occur because of the siting and construction of offshore drilling rigs and platforms, loading platforms, or pipelines.

Accidental discharge of oil can occur during almost any stage of exploration, development, or production on the OCS or in near shore base areas. Oil spills may result from many possible causes including equipment malfunction, ship collisions, pipeline breaks, human error, or severe storms. Oil spills may also be attributed to support activities associated with product recovery and transportation. In addition to crude oil spills, chemical, diesel, and other oil-product spills can occur in association with OCS activities. Of the various potential OCS-related spill sources, the great majority are associated with product transportation activities (USDOI, MMS, 1996).

The 1989 *Exxon Valdez* oil spill in Prince William Sound, the largest oil spill ever in U.S. waters, contaminated 2,000 km of coastal habitat (Spies et al. 1996). It spilled 42 million liters of crude oil which had immediate acute effects and longer-term impacts on fish and wildlife. Beached oil penetrated deeply into cobbled beaches and still persists in some areas beneath the surface layer of rocks and under mussel beds. Contamination of intertidal spawning areas for pink salmon caused increased embryo mortality and possible long-term developmental and genetic damage (Bue et al. in press). Wild pink salmon spawn in intertidal stream deltas, and therefore, are susceptible to marine oil spills. The embryo is a critical stage of salmon development and is vulnerable to pollution because of its long incubation in intertidal gravel and its large lipid-rich yolk which will accumulate petroleum hydrocarbons from low-level, intermittent exposures (Heintz et al., unpub.).

Residual oil from a spill can remain toxic for long periods because the most toxic components are the most persistent. Petroleum is a complex mixture of alkanes and aromatic hydrocarbons, of which the alkyl-substituted and multi-ring polynuclear aromatic hydrocarbons (PAH) are the most toxic and persistent. These large PAH predominate in weathered oil. Because of low solubility in water, the large PAH probably contribute little to acute toxicity of oil-water solutions. Lipophilic PAH, however, may cause physiological injury if they accumulate in tissues after lengthy exposure (Heintz et al., unpub.).

Chronic small oil spills are also a potential problem because residual oil can build up in sediments and affect living marine resources. Low levels of PAH from such chronic pollution can be accumulated in salmon tissues and cause lethal and sublethal effects, particularly at the embryo stage. Demonstrated effects from low-level chronic exposure include increased embryo mortality, reduced marine growth, and increased straying in returning adults.

Many factors determine the degree of damage from an oil spill. The most important variables are the type of oil, size and duration of the spill, geographic location, season, and oceanographic conditions. Habitats most sensitive to oil pollution are typically located in coastal areas with low physical energy (e.g., estuaries, tidal marshes). Exposed rocky shores and ocean surface waters are high-energy environments where physical processes more rapidly remove spilled oil. Benthic and scallop species can also be affected by oil spills, via decreased gill respiration, but the effects are considered to be sort lived (Gould and Fowler 1991). Spiny scallops were found to be moderately sensitive to acute exposures (96 hour) to Cook Inlet crude and No. 2 oil (Rice et al. 1979).

After a large spill, aromatic hydrocarbons would generally be at toxic levels to some organisms within this slick. Beneath and surrounding the surface slick, there would be some oil-contaminated waters. Vertical mixing and current dispersal acts to reduce the oil concentrations with depth and distance. If the oil spill trajectory moves toward land, habitats and species could be affected by the loading of oil into contained areas of the near shore environment. In the shallower waters, an oil spill could be mixed by wave action throughout the water column and contaminate subtidal sediment. Suspended sediment can also act to carry oil to the

seabed. In the *Exxon Valdez* oil spill, 13% of spilled oil was deposited in subtidal sediments where it was available to deposit-feeding organisms (Spies et al. 1996).

Oil mixed into bottom sediments persists for years and becomes a long term source of low level pollution. Cold temperature slows the evaporation biodegradation processes, so toxic hydrocarbons persist longer. Oil can also be trapped by ice. Toxic aromatic fractions mixed to depth under the surface slick could cause mortalities and sublethal effects on salmon.

Tainting of salmon and fishing gear flesh is a potential problem in areas subject to either chronic or acute oil pollution. The *Exxon Valdez* oil spill, for example, caused the closure of fisheries for black cod, shrimp, herring,
and salmon. Although sockeye salmon were not directly affected by the spill, the fishery in upper Cook Inlet was closed to forestall fouling of gear and public perception of tainting. The sockeye fishery closure caused over-escapement to some freshwater spawning and rearing lakes and subsequent poor production of fry and smolts.

Large oil spills are the most serious potential source of oil and gas development-related pollution. Offshore oil and gas development will inevitably result in some oil entering the environment. Most spills are expected to be of small size, although there is a potential for large spills to occur. Chronic oil spills which build up in the sediments around rigs and facilities are also a problem. In whatever quantities, lost oil can affect habitats and living marine resources. Many factors determine the degree of damage from a spill; the most important variables are the type of oil, size and duration of the spill, geographic location of the spill, and the season. Although oil is toxic to all marine organisms at high concentrations, certain species are more sensitive than others. In general, the early life stages (eggs and larvae) are most sensitive; juveniles are less sensitive, and adults least so (Rice, et al. 1984).

Habitats most sensitive to oil pollution are typically located in those coastal areas with the lowest physical energy because once oiled, these areas are the slowest to repurify. Examples of low energy environments include tidal marshes, lagoons, and seafloor sediments. Exposed rocky shores and ocean surface waters are higher energy environments where physical processes will more rapidly remove or actively weather spilled oil.

It is possible for a major oil spill (i.e., 50,000 bbls) to produce a surface slick covering up to several hundred square kilometers of surface area. Oil would generally be at toxic levels to some organisms within this slick.. Beneath and surrounding the surface slick, there would be some oil-contaminated waters. Mixing and current dispersal would act to reduce the oil concentrations with depth and distance. If the oil spill trajectory moves toward land, habitats and species could be affected by the loading of oil into contained areas of the near shore environment. In the shallower waters, an oil spill could be mixed throughout the water column and contaminate the seabed sediments. Suspended sediment can also act to carry oil to the seabed. It is believed up to 70 percent of spilled oil may be incorporated in seafloor sediments where it is available to deposit feeding organisms (crab) and their prey items.

Toxic fractions of oil mixed to depth and under the surface slick could cause mortalities and sublethal effects to individuals and populations. However, the area contaminated would appear negligible in relation to the overall size of the area. For example, Thorsteinson and Thorsteinson (1982) calculated that a 50,000 barrel spill in the St. George Basin would impact less than 0.002 percent of the total size of this area. Even if concentrations of oil are sufficiently diluted not to be physically damaging to marine organisms or their consumers, it still could be detected by them, and alter certain behavior patterns. If an oil spill reaches near shore areas with productive nursery grounds or areas containing high densities of fish eggs and larvae, a year class of a commercially important species of fish or shellfish could possibly be reduced, and any fishery dependent on it may be affected in later years. An oil spill at an especially important habitat (e.g., a gyre where

larvae are concentrated) could also result in disproportionately high losses of the resource compared to other areas. Additional concern is the unknown impact of an oil related event near and/or within ice. The water column adjacent to the ice edge is stable. This stabilization (or stratification) would allow relatively quick transport of oil to the seafloor. Additionally, oil trapped in ice could impact habitat significantly after the initial event, months or years later, and even into a different region or country.

Other sources of potential habitat degradation and pollution from oil and gas activities include the disposal of drilling muds, fluids, and cuttings to the water and seabed, and dredged materials from pipeline laying or facilities construction. Naturally occurring sediments or introduced materials may contain heavy metals or other chemical compounds that would be released to the environment, but the quantities are generally low and only local impacts would be expected to occur.

Areas that are currently and historically influenced by oil and gas production operation facilities: Arctic Ocean/ North Slope, Chukchi Sea, Bering Sea/Navarin Basin, Gulf of Alaska/Yakutat Basin, Cook Inlet, and Prince William Sound.

Hydroelectric Projects, Dams and Impoundments

Potential impacts include: detrimental effects on salmon and their habitat; transformation of a river from its natural free-flowing state to an impoundment fundamentally alters that environment; decline or loss of original species; change in temperature regime; change in circulation and flow patterns.

Dams are a significant barrier to upstream and downstream migrations of salmon, and have probably caused the greatest loss of salmon habitat due to human activities in the lower 48 states. Dependence on technology to provide passage around dams has seldom been successful. Fishway design and flow are important to attract and guide adult salmon into passage facilities. Poorly designed fishways can inhibit upstream movement of adults, causing migration delays, increased pre-spawning mortality, and reduced reproductive success in fish that eventually reach their spawning grounds (U.S. Bureau of Reclamation 1985; Hallock et al. 1982). Dams also present obstacles to downstream passage of juveniles, and passage through turbines or over spillways can result in migration delays, increase predation, and direct mortality.

Major adverse effects on salmon stocks and habitat caused by dams have been avoided or mitigated in Alaska, as managers have learned from mistakes made in the lower 48 states. A more complete discussion of effects of dams on salmon can be found in the Habitat Appendix of the Eighth Amendment to the Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California Commencing in 1978 (PFMC 1987).

Existing Federal Energy and Regulatory Commission (FERC) hydroelectric projects within Alaska include (Name Project #): Beaver Falls (# 01922), Black Bear Lake (#10440), Blind Slough (#00201), Blue Lake (# 02230), Bradley Lake (#08221), Burnett River Hatchery (#10773), Chignik (# 00620), Cooper Lake (#02170), Dry Spruce (# 01432), Goat Lake (# 11077), Green Lake (#02818), Humpback Creek (#08889), Jetty Lake (#03017), Ketchikan Lakes (#00420), Pelican (#10198), Power Creek (#11243), Salmon Creek (#02307), Skagway-Dewey Lakes (#01051), Solomon Gulch (# 02742), Swan Lake (#02911), Terror Lake (#02743), Tyee Lake (#03015). Recent interests for new projects include: Twin Lake and Old Harbor on Kodiak Island; Silver Lake and Power Creek in Prince William Sound.

FERC projects can have concerns regarding upstream and downstream passage; provision of adequate instream flow regimes for spawning, rearing, and migration; maintenance of water quality for anadromous fish. Each of these areas is discussed below.

Fish passage for both upstream and downstream migrating salmon, steelhead, and other anadromous fish must be provided to avoid delay, injury, and excessive stress. Required passage facilities must be installed during project construction and must be operated at all times that fish are present. In order to satisfy these objectives, it is necessary to develop a proposal for fish passage facilities. The proposal should define type, location, size, method of operation, and other pertinent facility characteristics. It should reflect state and federal fisheries agency input and design criteria.

Upstream passage facilities are generally required at any project feature which impairs natural passage conditions. At some projects this may require a fish collection system with fishway entrances correctly located and adequate attraction flows, a fish ladder, and an exit structure to return adults to the stream at an appropriate location upstream from the project. At other projects, less extensive facilities are required depending upon the degree of passage obstruction and other site-specific characteristics.

For downstream migrating juveniles, the basic need is to screen turbine intakes to prevent the fish mortalities associated with passage through the turbines by excluding fish from the intake flow. Requirements concerning screen areas and mesh sizes must be satisfied to assure acceptable operation. A bypass flow to safely carry fish from in front of the screens to an appropriate location below the project is a fundamental need. Frequently a system of ports and bypass pipes is necessary. Passage facilities must be designed and maintained to function properly through the full range of flows normally occurring during fish migration periods.

Construction impacts include: siltation of spawning gravels; timing; temperature elevation or reduction which may cause reduced fish growth or disease; gas super-saturation which may occur due to plunging water and result in fish gas-bubble disease; reservoirs which tend to be nutrient traps may cause decreased fish production downstream by reducing available food supplies; silt-laden reservoir releases which decrease invertebrate production and salmon egg survival.

Construction and operation of the project without fishery considerations could result in an interruption/diversion of water supply to and degradation of water quality. The interruption/diversion could be in terms of destruction of incubating eggs, alevins, and fry in the system. Disrupted flows and/or water quality could also result in alteration of migration and spawning habitat. Construction of the dam, powerhouse, and penstock structures could increase turbidities downstream with potential impacts to migration, spawning and rearing of salmon. Construction of the dam, powerhouse, and penstock structures could also result in erosion and increased input of particulate matter into the creek with adverse impacts to migration, spawning, incubation, and rearing salmon.

Adequate flow regimes and water quality are critical for anadromous fish. Consequently, flow regimes and water quality sufficient for successful spawning, incubation, rearing, and migration must be established and maintained through and downstream of project area where needed. If flow reduction, diversion, or modification of flow regimes are anticipated in the operation scenario for the project, anadromous fisheries could be adversely affected not only in the immediate project area but in the entire system downstream of the facility. Examples of this include the diversion of water from the creek/river to a powerhouse which results in a decrease of water which reaches downstream spawning gravel and rearing habitat and tailrace water discharges that could attract and divert returning adult fish from creek/river, thereby decreasing egg deposition and jeopardizing future returns. To address these matters, flow studies must be performed to determine flow regimes that will conserve and protect stocks of anadromous fish in the river system.

Marine Traffic and Transportation

Potential threats include: potentially harmful vessel operations activities include, but are not limited to: discharge or spillage of fuel, oil, grease, paints, solvents, trash, wastes (including sanitary discharges), and

cargo into coastal and tributary waters; alteration of aquatic habitats by the operation of marinas, piers, and docks; disturbance and damage to living marine resources and their habitats by waves, noise, propellers, water jets and other vessel related operations such as anchoring and grounding; exacerbation of shoreline erosion due to wakes.

Routine vessel traffic, discharges, and accidents are potential threats to EFH. The Far East Trade Route takes vessels north by northwest out of the Straits of Juan De Fuca, across the North Pacific and Gulf of Alaska, then through Unimak Pass, Alaska en route to the Far East. Cargo, bunker sea, tanker, freighter, fishing, and recreational vessels make up the vast fleet that transit these waters. In recent times, the freighter vessel Swallow, tanker vessel Exxon Valdez, and freighter vessel Kiroshima grounded and the resulting oil spills proved lethal to marine life and ecosystems. Oil tug and barge traffic is common and their route transits to the major fueling ports of Unalaska, St. Paul, and other coastal cities. In addition, summer vessel traffic increases in the offshore waters with tug and tow traffic bound for the North Slope developments. Other increased traffic seasons coincide with commercial fishery openings, which usually end with at least one vessel grounding or sinking. EFH loss from hazardous cargo is ever present. Other direct impacts from vessels include pollutants such as raw sewage, bilge oil discharge, plastics, and food wastes.

The chronic effects of vessel grounding, prop scarring, and anchor damage are generally more problematic in conjunction with recreational vessels. While grounding of ships and barges is less frequent, individual incidents can have significant localized effects.

Marinas and other sites where vessels are moored are often plagued by accumulation of anti-fouling paints in bottom sediments, by fuel spillage, and overboard disposal of trash and wastewater. A study of marinas found that they may contribute to increases in fecal coliforms, sediment oxygen demand, and chlorophyll a, and decreases in dissolved oxygen.(NC Department of Environment, Health, and Natural Resources 1990)

In the Coastal Zone Management Act of 1972, as amended, Congress declared it to be national policy that state coastal management programs provide for public access to the coasts for recreational purposes. Clearly, boating and adjunct activities (e.g., marinas) are an important means of public access. When these facilities are poorly planned or managed, however, they may pose a threat to the health of aquatic systems and may pose other environmental hazards (USEPA 1993). Since marinas are located at the water's edge, there is often no buffering of the release of pollutants to waterways. The USEPA (1993) identifies the following adverse environmental impacts as possibly being related to marinas and associated activities:

(1) Pollutants discharged from boats;
(2) Pollutants generated from boat maintenance activities on land and in the water;
(3) Exacerbation of existing poor water quality conditions;
(4) Pollutants transported in storm water runoff from parking lots, roofs, and other impervious surfaces; and
(5) The physical alteration or destruction of wetlands and of shellfish and other bottom communities during the construction of marinas, ramps, and related facilities.

Marina related impacts to aquatic systems include lowered dissolved oxygen, increased temperature, bioaccumulation of pollutants by organisms, water contamination, sediment contamination, resuspension of sediments, loss of SAV and estuarine vegetation, change in photosynthesis activity, change in the nature and type of sediment, loss of benthic organisms, eutrophication, change in circulation patterns, shoaling and shoreline erosion. Pollutants that result from marinas include nutrients, metals, petroleum hydrocarbons, pathogens, and polychlorinated biphenyls (USEPA 1993).

Marina personnel and boat owners use a variety of boat cleaners, such as teak cleaners, fiberglass polish, and detergents and cleaning boats over the water, or on adjacent upland, creates a high probability that some cleaners and other chemicals will entering the water (USEPA 1993). Copper-based antifouling paint is released into marina waters when boat bottoms are cleaned in the water (USEPA 1993). Tributyl-tin, which was a major environmental concern, has been largely banned except for use on military vessels. Fuel and oil are often released into waters during fueling operations and through bilge pumping. Oil and grease are commonly found in bilge water, especially in vessels with inboard engines, and these products may be discharged during vessel pump out (USEPA 1993).

Boats propellers can also impact fish and fish habitat by direct damage to multiple life stages of associated organisms, including egg, larvae, juveniles, and through water column de-stratification (temperature and density), resuspending sediments, and increasing turbidity (Stolpe 1997; Goldsborough 1997).

Grounding tends to be an infrequent occurrence on fishery habitats such as seagrass beds and coral reefs. The degree of damage is related to the size of the grounded vessel. Large vessels that ground in shallow water seagrass beds may cause considerable localized damage especially when propeller force is used break free. Crushing damage is usually minimal. Grounding on coral reefs may cause extensive to the reef structure since most coral is highly susceptible to breakage and crushing, and recovery is slow.

One of the most conspicuous byproducts of boating activity and human occupation of coastal environments is the presence of marine debris or trash in the coastal waters, beaches, intertidal flats, and vegetated wetlands. The debris ranges in size from microscopic plastic particles (Carpenter et al. 1972), to mile-long pieces of drift net, discarded plastic bottles, bags, aluminum cans, etc.

Sewage and other wastes discharged from recreational boats may be most problematic in marinas and anchorage sites where vessels are concentrated. Despite existing federal and state regulations involving discharges of sewage and other materials, detection and control of related activities is difficult and some discharges still occur. According to the 1989 American Red Cross Boating Survey, there were approximately 19 million recreational boats in the United States (USEPA 1993). About 95 percent of these boats were less than 26 feet in length and a large number of these boats used a portable toilet, rather than a larger holding tank. Given the large percentage of smaller boats, facilities for the dumping of portable toilet waste should be provided at marinas that service significant numbers of boats under 26 feet in length (USEPA 1993).

Increased recreational boating activity may contribute significantly to pollution of coastal waters by petroleum products. All two-cycle outboard engines require that oil be mixed with gasoline, either directly in the tank or by injection. That portion of the oil that does not burn is then ejected, along with other exhaust products, into the water.

Natural Adverse Impacts *include potential threats from geophysical and seismic activity such as volcanoes, earthquakes, shelf vents; natural occurring elements such as oil seeps and coal outcrops; coastal and inland storms can cause severe acute and chronic perturbations including habitat erosion, burial by deposition of sediment on deepwater habitats and wetlands; creation of strong currents that alter habitats and remove biota; damage by wind and waves; elevation of turbidity that can cause physiological damage and disrupt feeding, spawning migration, and other vital processes; and abrupt changes in salinity and other water quality characteristics such as fecal coliform levels. Changes in marine habitat may also be the result of the activities of marine animals.*

Long-term climatological changes can bring about similar changes by altering weather patters. Large scale ecological changes may also occur where temperature changes favor or harm a particular species or group. Changes that cause relocation of frontal boundaries, weed lines, and stratification and temperature boundaries

may also cause substantial and undesirable environmental change These events potentially can eliminate EFH for any species without any indication or warning. Impacts range from alteration of habitat from undersea landslides to introduction of exotic prey species following a favorable current. Events as such can be theorized but hard to foresee and manage.

Ocean-atmospheric physics is hypothesized to cause variation in recruitment of several crab stocks in the North Pacific Ocean and Bering Sea with the decadal shifts in barometric pressure indices, sea level, sea surface temperature and ecosystem conditions (Zeng and Kruse, MS). In years of strong Aleutian Lows, warm incubation temperatures promote crab egg hatching too early to match the spring bloom reducing survival of first feeding larvae. A strong Aleutian Low also promotes a more diverse assemblage of species in the phytoplankton community and adversely effects larvae of red king crab. Wind stress causing advection of very specific stocks of crab larvae may also be important to the crab recruitment process.

The activities of some marine animals also alter benthic habitat. California grey whales "till the soil" when feeding on amphipods. In the Chirikof Basin and the area south of St. Lawrence Island, gray whales created pits averaging 2.5 meters long, 1.5 meters wide, and 10 centemeters deep. Creation of these pites are estimated to suspend 172 million metric tons of sediment a year -- three times the amount of suspended sediment discharged annually by the Yukon River (Nelson and Johnson 1987). Pacific walrus make furrows (averaging 47 meters long, 0.4 meters wide, and 0.1 meters deep) in the benthic habitat while searching for clams and are estimated to disturb around 100 million metric tons of sediment per year (Nelson and Johnson 1987; Sease and Chapman 1988). Sea otters, by preying on sea urchins, allow kelp beds to increase which increases siltation rates reducing habitat for barnacles, mussels, sea stars and hermit crabs (Palmisano and Estes 1977). Sun stars *(Pycuopodia helianthoides)* using their suckers like conveyor belts are able to dig holes up to 12 inches deep in their search for clams (Mauzen et al. 1968).

Although the issue of global warming is controversial, all models predict some temperature increases, especially in the higher latitudes of the Northern Hemisphere (USDC 1997). According to the U.S. Department of Commerce, significant Arctic warming, particularly after 1920, may be related to increased solar radiation, increased volcanic activity, and other naturally occurring factors (USDC 1997a). Human induced increases in greenhouse gas concentrations combined with natural conditions to cause unprecedented warming in the Arctic in the 20th century and between 1840 and the mid-20th century the Arctic warmed to the highest level in the past four centuries.

Global temperature increases of a degree or two can cause sea level rise if melting of permafrost and ice cap follow. Possible effects include: significant loss of coral reefs, salt marshes, and mangrove swamps that are unable to keep up with sea level rise; loss of species whose temperature tolerance ranges are exceeded (this could be especially problematic for corals); elevated nutrient and sediment loading due to Tundra run-off; saltwater intrusion into freshwater ecosystems such as freshwater marshes and forested wetlands; invasion of warmer water species into areas occupied by cooler habitat species; and physical changes in the Arctic Seas that could have much broader implications by altering flows, food chains, and climate (USDC 1997). The severity of impact on natural resources, including certain essential fish habitat will be determined by natural and human obstruction to inland habitat shifts, resilience of species and populations to withstand changes in environmental conditions, and the rate of environmental change (USDC 1997a).

Table 10.1

Summary of Non-fishing Adverse Impacts to Habitat

Threats	HABITAT ALTERATION	Alteration of original or normal habitat	Loss of offshore habitat	Loss of pelagic habitat	Loss of nearshore habitat	Loss of benthic habitat	Loss of aquatic vegetation	Loss of wetland value	Loss of original sediment type	Detrital matter introduction	TOPOGRAPHIC ALTERATION	Change in original feature or structure	Accretion \ Overburden of original feature	Erosion \ Dispersal of feature	ORGANISM ALTERATION	Physical damage to organism	Mortality	Spatial alteration	Gene pool deterioration	Introduction of exotic species	Introduction of pathogens/disease	Change in photosynthetic regime	OCEANOGRAPHIC ALTERATION	Change in temperature regime	Change in salinity	Change in circulation pattern	WATER QUALITY ALTERATION	Change in dissolved oxygen content	Eutrophication, nutrient loading	Water contamination	Suspended sediments, turbidity	Atmospheric deposition
Excavation																																
Dredging		X			X	X	X	X	X			X	X	X		X	X					X		*	*	*		*	X	X	X	
Dredge Material Disposal		X	X		X	X	X	X	X	X		X	X			X	X	X			X	X		*	*	*		*	X	X	X	
Marine Mining		X	X			X			X	X		X	X	X		X	X				X	X		X	X	X		*	X	X	X	
Nearshore Mining		X			X	X	X		X	X		X	X	X		X	X				X	X		*	*	*		*	X	X	X	
Recreational Uses																																
Boating				X	X	X	X			X						X	X			X	X			*	*	*		*	*	X	X	X
Stream Bank Over-usage		X						X	X	X		X	X	X		X	X				X	X							X	X	X	
Fish Waste Processing																																
Shoreside Discharge		X			X	X	X		X	X		X	X								X	X		X	X			*	X	X	X	
Vessel Discharge				X		X				X											X	X						*	X		X	
Aquaculture					X		X			X								X	X	X	X	X		X	X	X		*	X	X	X	
Petroleum Production																																
Production Facility		X	X		X	X	X	X	X	X		X	X	X			X	X			X	X		X	X	X				X	X	X
Exploration		X	X		X	X	X	X				X	X	X		X	X				X	X				X				X	X	X
Oil Spill		X	X		X	X	X	X	X	X						X	X		X		X	X			*			X		X	X	X
Hydrological																																
Hydroelectric Dams									X								X				X	X						X			X	
Impoundments		X					X	X	X			X	X	X		X	X				X	X						X	X		X	
Flood Erosion/Control		X			X		X	X	X			X	X	X		X	X					X						X	X			

Table 10.1 (continued)

Threats	Agricultural	Agricultural/Farming	Insect Control	Forestry	Water Diversion/Withdrawl	Harbors/Ports/Marinas	Port Construction	Port Development	Artifical Reefs	Municipal and Industrial	Non-point Source	Coastal Urbanization	Sewage Treatment	Storm Water Runoff	Environmental	Climatic Changes/Shifts	Toxic Algal Bloom	Introduction of Exotic Species	Marine Transportation	Vessel Groundings	Ballast Water	Marine Debris
HABITAT ALTERATION																						
Alternation of original or normal habitat		X		X	X		X	X	X			X	X							X		X
Loss of offshore habitat																						
Loss of pelagic habitat											X					X					X	X
Loss of nearshore habitat		X	X	X	X		X	X	X		X	X	X	X		X				X		X
Loss of benthic habitat									X		X	X	X							X	X	X
Loss of aquatic vegetaion		X	X	X	X		X	X			X	X				X				X		X
Loss of wetland value		X	X	X	X		X	X			X	X										
Loss of original sediment type		X		X			X	X			X	X								X		X
Detrital matter introduction		X		X			X	X			X	X	X	X						X		X
TOPOGRAPHIC ALTERATION																						
Change in original feature or structure		X		X	X		X	X	X			X								X		
Accretion \ Overburden of original feature		X		X	X		X	X	X		X	X	X			X						X
Erosion \ Dispersal of feature		X		X	X		X	X	X			X				X				X		
ORGANISM ALTERATION																						
Physical damage to organism			X	X			X	X			X	X	X	X			X	X		X	X	X
Mortality			X				X	X			X	X	X	X			X	X		X	X	X
Spatial alteration		X		X			X	X	X		X	X						X				X
Gene pool deterioration											X	X	X	X			X	X			X	
Introduction of exotic species											X	X	X					X		X	X	
Introduction of pathogens\disease		X	X				X				X	X	X	X			X	X		X	X	X
Change in photosynthetic regime		X	X	X	X		X	X	X		X	X	X	X		X	X				X	X
OCEANOGRAPHIC ALTERATION																						
Change in temperture regime		*		X	*		*		X		X	X	X	X		X					X	
Change in salinity		*		*			*		X		X	X	X	X		X	*				X	
Change in circulation pattern					X		X	*	X			X				X						
WATER QUALITY ALTERATION																						
Change in dissolved oxygen content		X			X		*	*			X	X	X	X			X					
Eutrophication, nutrient loading		X			X						X	X	X					X				
Water contamination		X	X	X	X		X	X			X	X	X	X				X		X	X	X
Suspended sediments, turbidity		X		X	X		X	X			X		X					X				
Atmospheric deposition			X									X	X			X						

* - short term Impact

8.11.2 References

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8.12 Cumulative Effects on EFH from Fishing and Non-Fishing Activities

The NPFMC and the Secretary of Commerce have taken appropriate actions when threats to fish habitat have been identified. These include cumulative effects from fishing activities and non-fishing activities. Cumulative effects have been examined in the Stock Assessment and Fishery Evaluation (SAFE) reports, which are produced annually for the crab, scallop, and groundfish fisheries. In addition, an Ecosystem Considerations section to the SAFE reports is prepared which identifies specific ecosystem concerns that are considered by fishery managers in maintaining sustainable marine ecosystems.

Cumulative effects from non-fishing activities relate to the amount of habitat loss from human interaction and alteration or natural disturbances. Non-fishing activities are widespread and can have localized impacts to groundfish habitats such as accretion of sediments from at-sea disposal areas, oil and gas exploration, sea floor mining, ice scouring and significant storm events. In addition to EFH consultation guidelines mandated by the MSA, NMFS reviews these types of effects during the review process required by Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for certain activities that are regulated by Federal, state, tribal or local authority. The jurisdiction of these activities is in "waters of the United States" and includes both riverine and marine habitats. To assist in understanding these widespread impacts, the development of a habitat and effect baseline database would accelerate the review process and outline areas of increased disturbance. Inter-agency coordination would prove beneficial to all.

8.13 Habitat Conservation and Enhancement Recommendations for Non-fishing Threats to EFH

8.13.1 Habitat Conservation and Enhancement Recommendations

Habitat alteration may lower both the quantity and quality of species production through physical changes or chemical contamination of habitat. Species and individuals within species differ in their tolerance to effects of habitat alteration. It is possible for the timing of a major alteration event and the occurrence of a large concentration of living marine resources to coincide in a manner that may affect fishery stocks and their supporting habitats. The effects of such events may be masked by natural phenomena or may be delayed in becoming evident. However, the process of habitat degradation more characteristically begins with small-scale projects that result in only minor losses or temporary disruptions to organisms and habitat. As the number and rate of occurrence of these and other major projects increases, their cumulative and synergistic effects become apparent over larger areas. It is often difficult to separate the effects of habitat alteration from other factors such as fishing mortality, predation, and natural environmental fluctuations. Decreasing the probability of impact will lead to the highest protection of EFH. The probability of impact directly relates to the amount human activity we introduce to an environment. The following recommendations are offered to protect EFH.

Near Shore Habitat and Waters (0-3nm)

Recommendation	Area	Species
Minimize construction of structures such as causeways or breaches that would affect local flushing, water temperatures, water quality, lateral drift, and/or migration.	Sensitive areas, special aquatic and vegetation areas	groundfish, salmon, scallop, crab
Minimize construction of structures such as docks that ground on tidal lands during low water events.	Sensitive areas, special aquatic and vegetation areas	groundfish, salmon, crab

Minimize deposition of fill in tidelands.	Sensitive areas, special aquatic and vegetation areas	groundfish, salmon, crab
Stage rapid response equipment and establish measures for accidental impacts such as oil and hazardous material spills.	ports, sensitive areas	groundfish, salmon, scallop, crab
Monitor point source pollution sites such as fish processing waste, sewage, and storm water run off outfalls.	ports, vessel processors, communities	groundfish, salmon, scallop, crab
Minimize disposal or dumping of dredge spoils, drilling muds, and municipal and industrial wastes.	known concentration of bottom species and their habitats	groundfish, salmon, scallop, crab
Test dredge spoils prior to marine disposal	port and upland sources	groundfish, salmon, scallop, crab
Establish monitoring that incorporates Federal and State regulatory agency determinations, i.e., tracking database and GIS system	area wide	groundfish, salmon, scallop, crab

Pelagic Habitat and Waters (3-12nm)

Recommendation	Area	Species
Assess cumulative oil and gas production activities.	BSAI, Chukchi Sea, OCS, Cook Inlet, GOA	groundfish, salmon, scallop, crab
Identify marine disposal sites.	area wide	groundfish, salmon, scallop, crab
Establish monitoring that incorporates Federal and State regulatory agency determinations, i.e., tracking database and GIS system	area wide	groundfish, salmon, scallop, crab
Establish no discharge zones for ballast waters to prevent introduction of non-indigenous species and chemical contaminants.	ports, known gyres areas	groundfish, salmon, scallop, crab
Minimize disposal or dumping of dredge spoils, drilling muds, and municipal and industrial wastes.	known concentration of bottom species and their habitats	groundfish, salmon, scallop, crab

Offshore Habitat and Waters (>12 nm)

Recommendation	Area	Species
Establish monitoring that incorporates Federal and State regulatory agency determinations, i.e., tracking database and GIS system	area wide	groundfish, salmon, scallop, crab
Establish no discharge zones for ballast waters to prevent introduction of non-indigenous species and chemical contaminants.	known offshore gyre areas	groundfish, salmon, scallop, crab
Minimize disposal or dumping of dredge spoils, drilling muds, and municipal and industrial wastes.	known concentration of bottom species and their habitats	groundfish, salmon, scallop, crab

8.14 Habitat Conservation and Enhancement Recommendations for Fishing Threats to EFH

Area closures to trawling and dredging in the Bering Sea and Aleutian Islands area serve to protect EFH from potential adverse impacts caused by these gear types. Other management measures, such as the Pribilof Islands Habitat Conservation Area, the Bristol Bay Closure Area and the proposed Cape Edgecumbe pinnacle closure, are designed to reduce the impact of fishing on marine ecosystems. Catch quotas, bycatch limits and gear restrictions control removals of prey species. Studies that compare seafloor habitats in areas heavily trawled with areas that have had little trawl effort and research efforts on Alaskan scallops as discussed in section 1.3.13 may reveal future habitat conservation and enhancement measures necessary to protect EFH. Additionally, the annual review of existing and new EFH information during the SAFE development process is expected to identify adverse effects to EFH from fishing and proposals to amend the FMP to minimize those adverse effects. Proposals can be submitted during the Council's plan amendment cycle.

8.15 Prey species as a component of EFH

Loss of prey is an adverse effect on EFH because one component of EFH is that it be necessary for feeding. Therefore, actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to prey species' habitat that are known to cause a reduction in the population of the prey species, may be considered adverse effects on a managed species and its EFH. Adverse effects on prey species and their habitats may result from fishing and non-fishing activities.

Section 8.1 contains tables that identify, if known, those prey species that comprise the diet of BSAI groundfish managed under the FMP. Additional information on the habitat needs of prey species that are part of the Forage Fish species category can be found at section 8.9.1.

8.16 Habitat Areas of Particular Concern

There are several habitat types in Alaska that have important ecological functions, are sensitive and vulnerable to human impacts, and are relatively rare. A summary of these habitat types is provided below.

8.16.1 Living Substrates in Shallow Waters

Habitat areas of particular concern include nearshore areas of intertidal and submerged vegetation, rock, and other substrates. These areas provide food and rearing habitat for juvenile groundfish and spawning areas of some species (e.g., Atka mackerel, yellowfin sole), and may have a high potential to be affected by shore-based activities.

Shallow inshore areas (less than 50 m depth) are very important to king crab reproduction. After molting through four larval (zoea) stages, king crab larvae develop into glaucothoe which are young crabs that settle in the benthic environment in nearshore shallow areas with significant cover, particularly those with living substrates (macroalgae, tube building polychaete worms, kelp, mussels, and erect bryozoans). The area north and adjacent to the Alaska peninsula (Unimak Island to Port Moller) and the eastern portion of Bristol Bay are locations known to be particularly important for rearing juvenile king crab.

All nearshore marine and estuarine habitats used by Pacific salmon, such as eel grass beds, submerged aquatic vegetation, emergent vegetated wetlands, and certain intertidal zones, are sensitive to natural or human induced environmental degradation, especially in urban areas and in other areas adjacent to intensive human-induced developmental activities. Many of these areas are unique and rare. The coastal zone is under the most intense development pressure, and estuarine and intertidal areas are limited in comparison with the areal scope of other marine habitats for salmon.

Herring also require shallow water living substrates for reproduction. Spawning takes place near the shoreline between the high tide level and 11 meters. Herring deposit their eggs on vegetation, primarily rockweed (Fucus sp.) and eelgrass (Zostera sp.). These "seaweeds" are found along much of the Alaska coastline, but they often occur in discrete patches.

8.16.2 Living Substrates in Deep Waters

Habitat areas of particular concern include offshore areas with substrates of high-micro habitat diversity, which serve as cover for groundfish and other organisms. These can be areas with rich epifaunal communities (e.g., coral, anemones, bryozoans, etc.), or with large particle size (e.g., boulders, cobble). Complex habitat structures are considered most readily impacted by fishing activities (see previous sections of this document).

Corals are generally considered to be very slow growing organisms, and are a habitat of particular concern. Although scientists are not quite sure of coral's importance to fish habitat, it would certainly provide vertical structure for fish to use for protection and cover. Some observations to this claim have been provided by submersible observations. Coral habitat is likely very sensitive to human-induced environmental degradation from both fishing and non-fishing threats. It is not known how much coral there is off the coast of Alaska, but it is likely to be rare relative to other habitat types.

There are several species of deepwater coral found off Alaska. Two common species are red tree coral (Primnoa willeyi) and sea raspberry (Eunephtya sp.). Although these corals are thought to be distributed throughout the Gulf of Alaska and Aleutian Islands, much of the data analysis has focused on the eastern Gulf of Alaska. NMFS trawl surveys have indicated high concentrations in the immediate vicinity of Dixon Entrance, Cape Ommaney, and Alsek Valley (Draft EA/RIR for Amendment 29 to the GOA Groundfish FMP, September 1992). In the GOA, NMFS surveys have taken red tree coral in very deep areas (125-210 fathoms), whereas sea raspberries have generally been taken in shallower areas (70-110 fathoms).

Information on coral distribution has been summarized in a 1981 report by R. Cimberg, T. Gerrodette, and K. Muzik titled, "Habitat Requirements and Expected Distribution of Alaska Coral." Though this report was written in the context of potential impacts of oil and gas exploration and development, information on habitat and distribution is relevant for our purposes. Though the report discusses coral distributions throughout Alaska, the focus here is on the information contained relevant to southeast Alaska.

The study notes that this Region probably has the largest number of coral species due tot he variety of habitats in terms of depth, substrate, temperature, and currents. Primnoa, or red tree corals, are more abundant in southeast Alaska than in any other region. Other species of fan corals have been observed as well as bamboo corals, cup corals, soft corals, and hydrocorals. The greatest number of distributional records for red tree corals are from the Gulf of Alaska, in particular from the inside waters of southeast Alaska. In southeast Alaska, red tree corals have frequently been reported in Chatham Strait, Frederick Sound, and Behm Canal. The frequency of occurrences increases toward the ocean entrances and further away from the fjords. This trend is likely due to swifter currents near the entrances and/or greater turbidity and lower salinities in the fjords. Areas of highest densities are found in regions where currents are 3/4 knots.

Distributional records were additionally analyzed relative to the depths at which they occurred. Red tree corals have been reported at depths from 10 to 800 m. The lower depth limit varied in different regions of Alaska, increasing along a geographic gradient from the Aleutians to southeast Alaska. The lower depth limit of these corals in each area corresponds with a mean spring temperature of 3.7 degrees C. The report indicates that in southeast Alaska there is a difference in the lower depth limit exhibited north of 57° latitude and that experienced south of that line (roughly running through Sitka). The data from the report indicate that, in the area of southeast Alaska north of 57°, red tree corals are predominately found between 50 and 150 meters in

depth. Significant occurrences continue to exist from 150 to 250 m, and taper off rapidly beyond 250 m. South of the 57° line, they occur over a broader depth range with equal occurrences from 50 to 450 m. The report indicates that other species of sea fans may be found deeper than Primnoa, at depths up to 2,000 m.

Bamboo corals also occur in the waters of both the inside passages of southeast Alaska and in the southeast Gulf of Alaska. These corals have a lower temperature tolerance, about 3.0 degrees C, and exist in depths from 300-3,500 m. These corals are also expected to exist in a rocky, stable substrate and have a low tolerance for sediments.

The depth distribution of soft corals is, like the red tree corals, expected to range from 10-800 m, though they may exist on a much wider range of substrates. Hydrocorals, also occurring in southeast Alaska, have a depth range of 700-950 m, though they may occur at shallower depths in southeast Alaska than in the more northern, colder waters.

The report notes (again in the context of potential disturbance by oil and gas exploration and development) that recolonization of tropical coral communities requires at least several decades to recover from major perturbations. Alaskan corals would likely take much longer to recolonize following similar disturbances. For example, given a predicted growth rate of 1 cm/year for Primnoa, a colony 1 m high would require at least 100 years to return to the pre-impacted state. This, of course, is regardless of the origin of the impact.

8.16.3 Freshwater Areas Used by Anadromous Fish

Habitat Areas of Particular Concern also include all anadromous streams, lakes, and other freshwater areas used by Pacific salmon and other anadromous fish (such as smelt), especially in urban areas and in other areas adjacent to intensive human-induced developmental activities.

8.17 Review and Revision of EFH Components of FMPs

To incorporate the regulatory guidelines requirement for review and revision of EFH FMP components the NPFMC will conduct a complete review of all the EFH components of each FMP once every 5 years and will amend those EFH components to include new information.

In between each five-year comprehensive review, the NPFMC will utilize its annual FMP amendment cycle to solicit proposals on HAPCs and/or conservation and enhancement measures to minimize the potential adverse effects from fishing. Those proposals that the NPFMC endorses should be developed independent of the five-year comprehensive EFH review cycle.

An annual review of existing and new EFH information will be conducted and this information will be provided to the BSAI 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.

9.0 OTHER CONSIDERATIONS WHICH MAY AFFECT THE FISHERY

9.1 International Pacific Halibut Commission (IPHC)

The fishery for Pacific halibut, a species that is part of this region's groundfish community, remains under the jurisdiction of IPHC and is, therefore, exempt from the provisions of this Plan. A major source of the fishing mortality on this species--that by incidental trawl catches--is, however, beyond IPHC control. As long as Council and IPHC objectives concerning halibut utilization remain identical, 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 trawl fishery developed caused by overriding halibut-saving measures--a major social, political, and, perhaps, diplomatic (because of Canadian involved 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.

9.2 Marine Mammal Protection Act of 1972

The FCMA of 1976 specifies that FMP's must be "consistent with...any other applicable law." The Marine Mammal Protection Act of 1972 is one that has a most serious impact on this FMP. There are large populations of many marine mammal species in the Bering Sea which are covered by the 1972 Act. The Act declares that marine mammals have "esthetic and recreational, as well as economic" value. To further these values, it provides that the "primary objective" of marine mammal management "should be to maintain the health and stability of the marine ecosystem." The Act further provides that "whenever consistent with this primary objective, it should be the goal to obtain an optimum sustainable population (of marine mammals) keeping in mind the optimum carrying capacity of the environment."

Pursuant to provisions of both Acts, this FMP is cognizant of the ecosystem and mammal population requirements. As reported in an earlier section on "Ecosystem Characteristics," a dynamic numerical marine ecosystem mode is currently in use to study ecosystem interactions, including those by marine mammals. The Plan Development Team of this FMP is acutely aware and is striving for an "ecosystem approach" for managing the marine resources. It will, however, be some time (3-5 years) before an appropriate ecosystem model has become far enough developed, and empirically tested, to begin to be relied upon for resource management. Until that time, single species models will be applied to the fishery resources, but in a manner that will retain balance among the various fish components, be generally conservative, and be determined to be not detrimental to current marine mammal populations. The manner in which MSY, EY, and ABC were derived for each fish stock in Annex I has indirectly taken into consideration the volume of fish needed by marine mammals for their sustenance. For example, natural mortality of fish stocks is taken into consideration in stock assessments and in its present application, includes the predation component by marine mammals.

Concerning marine mammal populations in the Bering Sea/Aleutians region, the Team has solicited expert advice from the Marine Mammal Division of the Northwest and Alaska Fisheries Center and summarized information on their distribution and migration, abundance and trends, feeding habits, and any problems induced by fisheries. Accounts of seven important species that are affected by the fisheries are given in Annex V. These species are the northern sea lion, northern fur seal, bearded seal, ringed seal, harbor seal, larga seal, and ribbon seal. Although specific ranges of optimum sustainable population has not been clearly determined for these species, the impact of fisheries can be inferred from marine mammal population trends. The Final Environmental Impact Statement on Consideration of a Waiver of the Moratorium and Return of Management of Certain Marine Mammals to the State of Alaska (DOC and DOI, 1977) considered the population of six species, other than fur seals, to be at levels above the lower level of optimum sustainable population. Northern

fur seals are managed for maximum productivity and may also be at or above the lower level of optimum sustainable population.

Of the seven species, the seal lions and fur seals might be significantly affected by groundfish harvest levels. Although the northern sea lion population in Alaska has generally increased since the early 1900s and is now at a relatively high level, a 50% decline in seal lion population has been noted since the late 1950s in the eastern Aleutian Islands. The factors that may have caused this decline are not certain but probably include (1) a westward shift in distribution since population abundance to the western Aleutians appears to be high; (2) commercial fisheries interaction since groundfish (primarily pollock) forms a significant portion of their diet; (3) disease such as leptospirosis; and (4) other unknown population control factors. This decline in abundance is of concern and should be watched more closely. The proposed total groundfish OY for 1980 for the Aleutians region is below past catch levels and if the abundance of fish is limiting for sea lions in this region, this FMP should leave more fish for sea lion consumption.

The northern fur seal is the other species that may be significantly impacted by groundfish fisheries in that fur seals compete with Man for groundfish for their sustenance. Fishes are estimated to constitute about 80% of their diet and pollock is the only groundfish species covered by this FMP which forms a dominant portion of their diet. The average size pollock observed in fur seal stomachs is 20 cm indicating that the pollock utilized by fur seals have not yet been subjected to the commercial fishery which take pollock larger than 25 cm. The actual impact of diet on the fur seal population is, however, more intricate and has not yet been quantified. Based on population size trends which became stable during the period of highest fish harvest and the proposal that pollock catches remain below historical high levels, it appears that measures in this FMP should also leave more pollock for fur seal consumption. The ecosystem modeling studies have shown that the removal of larger sized pollock from the population may actually increase the abundance of juvenile pollock as effects of cannibalism is reduced.

The other five species of marine mammals do not seem to be adversely impacted by the groundfish fishery in that these mammals feed primarily on pelagic fish, cephalopods, benthos, and crustaceans. Four of these seal (bearded, ringed, harbor, and larga) populations are known to be high and stable. The ribbon seal population is believed to be relatively low, which has been attributed to commercial hunting by the Soviet sealing fleet. In recent years, this species has been afforded increased protection by Soviet sealing regulations and its numbers may be increasing again. Some groundfish eaten by ribbon seals but little direct competition is known to exist between ribbon seals and Man for fishery resources.

Although direct competition for food fish is one of many factors that affect marine mammal populations, the other factors are not readily quantifiable. Some of these mammals may be sensitive to disturbances created by fishing activities and may leave the area under such harassments. Harbor seals and ribbon seals are known to display such sensitivity, but it is difficult to quantify the effect of fishing on their behavior and abundance. It is noted that some harassments take place, such as the use of explosives to scare away mammals during fishing operations. It is also important to note that the groundfish fishery covered by this FMP account for some marine mammal mortality by the fishing gear. Preliminary estimates of marine mammal incidental mortality due to foreign fishing vessels in 1978 (Marine Mammal Division, George Harry, pers. comm.) were 9.57 animals per 10,000 metric tons of groundfish by the Japanese fishing fleet, 1.69 by the Soviet fleet, and 9.84 in the Korean fleet. Assuming an overall incidental mortality rate of 8.57 animals per 10,000 mt of groundfish, the total incidental mortality on marine mammals, most of which are expected to be northern (stellar) sea lions, is estimated to be 1,237 animals based on a total OY of 1,443,500 mt of groundfish proposed by this FMP.

Overall, the proposed groundfish FMP should reduce competition with marine mammals for fish when compared to the past decade. The proposed total groundfish OY is about 25 percent below the average catch of 1969-76, thereby leaving more fish for marine mammal consumption.

On the other hand, restrictions on killing or harassing seals and sea lions according to the Marine Mammal Protection Act results in an unknown but probably significant economic loss to the fishermen. First, in the setline fishery, some of these seals and sea lions mutilate or remove part of the catch before it can be taken aboard. Second, large numbers of the animals often gather around trawlers and attack halibut, salmon, and crabs which, as a conservation measure, are required to be returned to the sea. Third, and of greatest import, the maintenance of large populations of marine mammals--seals, sea lions, porpoises, and whales--has a profound impact on the abundance of commercial fish species. This impact is both direct, through predation on commercial species, and indirect, through grazing on the same food organisms utilized by commercial fish species.

The effect of such interaction is being studied by an ecosystem simulation model. In order to develop the model to encompass the ecosystem approach for managing the marine resources of the region, better information on the mammals and their interactions with other components of the ecosystem must be obtained. It will take time to refine and test this management for management purposes.

All fishermen, foreign and domestic, are required under the provisions of the Marine Mammal Protection Act of 1972 to obtain a marine mammal certificate of inclusion if any marine mammals might be taken incidental to the conduct of their fishing operation.

9.2.1 Endangered Species Act

The Federal action proposed in this fishery management plan is not likely to jeopardize the continued existence of endangered or threatened species, or result in the destruction or modification of habitat critical to those species.

9.3 Potential for Habitat Alteration

This section discusses types of human activities that have a potential to cause pollution and habitat degradation that could affect groundfish populations in the Bering Sea and Aleutian Islands area. It is not intended as a statement of present conditions; rather, it is designed to identify those areas of uncertainty that may reasonably deserve Council attention in the future. Whether the likelihood and level of these activities or events may cause harm to groundfish resources and their habitats can be better judged when the details of a proposed activity's location, magnitude, timing, and duration are more fully known.

Habitat alteration may lower both the quantity and quality of groundfish products through physical changes or chemical contamination of habitat. Species and individuals within species differ in their tolerance to effects of habitat alteration. It is possible for the timing of a major alteration event and the occurrence of a large concentration of living marine resources to coincide in a manner that may affect fishery stocks and their supporting habitats. The effects of such events may be masked by natural phenomena or may be delayed in becoming evident. However, the process of habitat degradation more characteristically begins with small-scale projects that result in only minor losses or temporary disruptions to organisms and habitat. As the number and rate of occurrence of these and other major projects increases, their cumulative and synergistic effects become apparent over larger areas. It is often difficult to separate the effects of habitat alteration from other factors such as fishing mortality, predation, and natural environmental fluctuations.

Species dependent on coastal areas during various stages of their life, particularly for reproduction, are more vulnerable to habitat alterations than are species that remain offshore. Also, the effects of habitat alteration on fish species offshore are not as apparent as they are in coastal areas. Concern is warranted, however, to the degree that (1) the offshore environment is subject to habitat degradation from either inshore activities or offshore uses, and (2) to the extent that some species living offshore depend directly or indirectly on coastal habitats for reproduction and food supply.

At present, there are no indications that human activities in the Bering Sea/Aleutian Island area have had any measurable effect on the existing habitats of groundfish, though there have been localized effects. The present primary human use of the offshore area is commercial fishing. While the establishment of other activities could potentially generate user conflicts, pollution, and habitat deterioration, it is the collective opinion of the Council and NMFS that the status of the habitat in this management area is generally unaffected by other human activities at this time.

9.3.1 Offshore petroleum production

More information can be found in Berg (1977); Deis et al. (1983); OCSEAP Synthesis Reports on the St. George Basin (1982), the Navarin Basin (1984), and the North Aleutian Shelf (1984); Thorsteinson and Thorsteinson (1982); and the University of Aberdeen (1978).

The Alaska offshore area comprises 74 percent of the total area of the U.S. continental shelf. Because of its size, the Alaska outer continental shelf (OCS) is divided into three subregions--Arctic, Bering Sea, and Gulf of Alaska. The Bering Sea/Aleutian Subregion contains five planning areas where lease sales have been held or are currently scheduled - Norton Basin, St. George Basin, Navarin Basin, North Aleutian Basin, and Shumagin.

If a commercial quantity of petroleum is found in the Bering Sea, its production would require construction of facilities and all the necessary infrastructure for pipelines to onshore storage and shipment terminals or for building offshore loading facilities. It is believed that Bering Sea oil would be pipelined to shore and then loaded on tankers for transportation from Alaska. In the Navarin Basin, however, offshore-loading terminals may be more feasible. Unlike exploration, production would continue year-round and would have to surmount the problems imposed by winter sea-ice in many areas. Norton Basin and perhaps Navarin Basin would require ice-breaking tanker capabilities. There are also occasional proposals for tankering oil from Arctic fields via the Bering Sea, which would also require ice-breaking capabilities.

Oil and gas related activities in the Bering Sea and Aleutian Island area have the potential to cause pollution of habitats, loss of resources, and use conflicts. Physical alterations in the quality and quantity of existing local habitats may occur because of the siting and construction of offshore drilling rigs and platforms, loading platforms, or pipelines.

Large oil spills are the most serious potential source of oil and gas development-related pollution in the eastern Bering Sea and Navarin Basin. Offshore oil and gas development will inevitably result in some oil entering the environment. Most spills are expected to be of small size, although there is a potential for large spills to occur. In large quantities, this oil can affect habitats and living marine resources. Many factors determine the degree of damage from a spill; the most important variables are the type of oil, size and duration of the spill, geographic location of the spill, and the season. Although oil is toxic to all marine organisms at high concentrations, certain species are more sensitive than others. In general, the early life stages (eggs and larvae) are most sensitive; juveniles are less sensitive, and adults least so (Rice et al., 1984).

Habitats most sensitive to oil pollution are typically located in those coastal areas with the lowest physical energy because once oiled, these areas are the slowest to repurify. Examples of low energy environments include tidal marshes, lagoons, and seafloor sediments. Exposed rocky shores and ocean surface waters are higher energy environments where physical processes will more rapidly remove or actively weather spilled oil.

It is possible for a major oil spill (i.e., 50,000 bbls) to produce a surface slick covering up to several hundred square kilometers of surface area. Oil would generally be at toxic levels to some organisms within this slick. Beneath and surrounding the surface slick, there would be some oil-contaminated waters. Mixing and current dispersal would act to reduce the oil concentrations with depth and distance. If the oil spill trajectory moves toward land, habitats and species could be affected by the loading of oil into contained areas of the nearshore environment. In the shallower waters, an oil spill could be mixed throughout the water column and contaminate the seabed sediments. Suspended sediment can also act to carry oil to the seabed.

Toxic fractions of oil mixed to depth and under the surface slick could cause mortalities and sublethal effects to individuals and populations. However, the area contaminated would appear negligible in relation to the overall size of the area inhabited by commercial groundfish in the Bering Sea. For example, Thorsteinson and Thorsteinson (1982) calculated that a 50,000 barrel spill in the St. George Basin would impact less than 0.002 percent of the total size of this area. As a result, oil spills at sea are believed to be local and transitory, and would have only minor effects on fish populations overall. Measurable damage to fishery stocks from an oilspill would appear to be the exception rather than the rule. Even if concentrations of oil are sufficiently diluted not to be physically damaging to marine organisms or their consumers, it still could be detected by them, and alter certain of their behavior patterns. If an oil spill reaches nearshore areas with productive nursery grounds or areas containing high densities of fish eggs and larvae, a year class of a commercially important species of fish or shellfish could possibly be reduced, and any fishery dependent on it may be affected in later years. An oil spill at an especially important habitat (e.g., a gyre where larvae are concentrated) could also result in disproportionately high losses of the resource compared to other areas.

Other sources of potential habitat degradation and pollution from oil and gas activities include the disposal of drilling muds and cuttings to the water and seabed, disposal of drilling fluids and produced waters in the water column, and dredged materials from pipeline laying or facilities construction. These materials might contain heavy metals or other chemical compounds that would be released to the environment, but the quantities are generally low and only local impacts would be expected to occur. Again, these activities may be of concern if they occurred in habitats of special biological importance to a resource.

9.3.2 Coastal development and filling

Minimal developmental pressure has occurred in the coastal habitat of the Bering Sea and Aleutian area. An extension of the airport runway at the village of Unalaska into water approximately 50-feet in depth has received the necessary permits but has not yet been constructed. Construction of a large-scale port facility is planned for the city of Nome and a smaller-scale harbor is currently under construction on St. Paul Island. Beyond these specific projects, development activity in the coastal areas of the Bering Sea and the Aleutian Islands has been largely limited to construction of erosion control measures and breakwaters (e.g., the city of Bethel). Because of the desirability of finding protection from Bering Sea storms, suitable port development sites often are valuable to fishery resources for similar related reasons. Without special considerations these facilities could affect local flushing, water temperatures, water quality, and access by fishes. In other areas, shallow water depth requires construction of long structures projected seaward in order to provide direct access from the uplands to deeper-draft ocean going vessels. These causeways could alter both along-shore physical processes and the migration and movement of fish in the area.

9.3.3 Marine mining

At present, mining activity has been limited to extraction of gravel and gold in the Bering Sea and the Aleutian peninsula. Gravel is needed for almost all construction projects throughout the area and is relatively unavailable from upland sources. Consequently, gravel is obtained by mining gravel beaches along the Bristol Bay coast (e.g., Goodnews Bay, Kangirlvar Bay) and in the lower reaches of the Yukon and Kuskokwim Rivers. Mining of large quantities of beach gravel can significantly affect the removal, transport, and deposition of sand and gravel along shore, both at the mining site and at other more distant areas. During mining, water turbidity increases and the resuspension of organic materials could affect less motile organisms (i.e., eggs and recently hatched fishes), and displace the more motile species from the area. Spawning and rearing habitats could be damaged or destroyed by these actions. Neither the future extent of this activity nor the effects of such mortality on the abundance of marine species is known.

Dredging for gold has been attempted at various sites along the Aleutians and there are several current proposals for the offshore mining of gold near the city of Nome. One such proposal, which has received all of the necessary permits to proceed, will entail dredging 21,000 acres of sea bottom in Norton Sound for the purpose of recovering gold. Such activity has the potential to cause physical damage directly and indirectly to benthic habitat and to fish during certain juvenile life stages.

9.3.4 Ocean discharge and dumping

At present, there are only two areas in the Bering Sea/Aleutian Islands area where the ocean discharge of materials is known to occur on a large scale. Both of the areas are dredged material disposal sites near the city of Nome and have been in use for approximately 50 years. Recently, the two areas were given final designation as ocean dredged material disposal sites by the Environmental Protection Agency. Use of these sites presents no new habitat concerns.

The return of materials dredged from the ocean to the water column is considered a discharge activity. Depending upon the chemical constituency of the local bottom sediments and any alterations of dredged materials prior to discharge, living marine resources in the area may be exposed to elevated levels of heavy metals. For example, natural deposits of mercury occur in eastern Norton Sound and elemental mercury, measured as reaching levels ranging from 250-1300 ug/l, has been identified in marine sediments in that area (Nelson et al., 1975). The levels of this heavy metal exceed the 3.7 ug/l set by the EPA Marine Quality Standards as the maximum allowable concentration; although no measurements of the more toxic methyl and dimethyl forms of mercury have been made in this area, Wood (1974) demonstrated that mercury available to the aquatic environment in any form can result in steady state concentrations of methyl, dimethyl, and metallic mercury through microbial catalysis and chemical equilibrium. Large-scale gold dredging projects proposed in eastern Norton Sound would result in the discharge and resuspension of sediments that could introduce mercury to the water column.

Accumulation of heavy metals in fish is usually natural, but also may be an indication of habitat deterioration. The Federal Drug Administration's (FDA) safety limit for mercury is presently 1.0 ppm of methyl mercury or about 1.1 ppm of mercury. In Hall, et al (1976) a sample of sablefish caught in the Bering Sea and in the vicinity of Kodiak Island contained levels of mercury (0.02 - 0.11, $\bar{x}$ 0.04 ppm)--well below the FDA limit. Levels found in the natural environment or the fish pose no problem at present.

9.3.5 Derelict fragments of fishing gear and general litter

The introduction of debris into the marine environment occurs when commercial fisheries take place. The debris includes netting, pots, longline gear, packing bands, and other material. Because of the lack of a monitoring program, estimates of debris have been based on 1) observations of debris at sea and on beaches, and 2) occasional reports of accidental or deliberate discards of fishing gear. Studies by Merrell (1984) and others have shown that much of the observed debris consists of fragments of trawl netting. Much of this netting may be discarded carelessly at the time nets are repaired.

The quantity of marine debris that is produced by commercial fisheries depends on a variety of factors including the types and amount of gear used and the efforts fishermen make to reduce both accidental and deliberate discards. It is not known how the type and amount of gear used will change or how such change will affect the level of debris.

Debris may result in the mortality of marine fish, marine mammals, and birds that become entangled in or ingest it. Discarded trawl netting that floats at the surface is not a threat to most fish, but it has been identified as a source of mortality for marine mammals and birds. Similarly, discarded packing bands have been identified as a source of mortality for marine mammals. Other discarded gear including pots continue to function unattended for varying lengths of time. Neither the extent of debris related mortality nor the effects of such mortality on the abundance of various species is known.

9.3.6 Benthic habitat damage by bottom gear

Bottom trawls are presently the predominant gear used for groundfish in the Bering Sea/Aleutian Island management area, and are likely to continue as the major gear for the flatfish and Pacific cod fisheries of the Bering Sea shelf. The generally flat and uniform bottom composed of sand and mud presents a good substrate for bottom trawling.

Any effect of gear dragged along the bottom depends on the type of gear, its rigging, and the type of bottom and its biota. In addition to the target species, movement of a bottom trawl through an area primarily affects the slow moving macrobenthic fauna such as seastars and sea urchins. Some bivalves can also be damaged. It is possible for demersal eggs such as rock sole and Pacific cod to be disturbed by the passage of trawls. Although little is known of the effects these disturbances and damages have on the affected species or their local communities, only minor impacts are suspected.

Numerous studies to determine these impacts have been conducted (notably in European waters) since World War II. Most of the studies and their results have been summarized in a report by Natural Resource Consultants (1984) titled "Trawl Evaluation Study". The consensus of these investigators is that the overall effect of trawling on sea bottom may not be harmful, and may in fact be beneficial. They found, for example: that trawl doors on sand and soft bottom stir up sand and silt which settle quickly. On muddy bottoms, the stirred up mud settles in a few hours, depending on the current speed and resulting turbulence near the bottom. Trawls have not been observed to kill flatfishes. The damaged organisms, as well as the infauna which might have been dug up by the trawl are quickly preyed upon by fish and crabs. Similar findings originate from a study of hydraulic clam dredges in the southeastern Bering Sea, where yellowfin sole quickly concentrated in the dredge wake feeding on exposed organisms. Several researchers observe that fishing by trawls with tickler chains has not resulted in any apparent effects on the sea bed or its biota (Hempel, 1979).

9.4 Bio-economic Factors

U.S. fishery interests have suggested that development of a domestic groundfish fishery in the Bering Sea will be based on the production of fillets and that the size of fish necessary to economically produce fillets is greater than that needed for such products as fish sausage and meal which form a large part of the output of the foreign fisheries.

The average size of pollock caught in the Bering Sea has decreased through the history of the fishery. During the early years (1964-69), the average size of fish taken by Japan varied between 42 and 44 cm (16.5 and 17.3 inches). Subsequently, average size decreased to 40 cm (15.7 inches) in 1972 and as low as 31 cm (12.2 inches) in 1975 before recovering to 33 cm (13 inches) in 1976. Current average size may be too small for efficient machine filleting.

The cohort analysis technique has been used to quantify the growth of a pollock year-class to is maximum biomass and subsequent decay as mortality overtakes growth. In theory, a year-class of pollock is subject to natural death (which reduces the number) and growth (which increases individual weight). The combined effect of these factors is that the cohort biomass will increase to a maximum and then decrease thereafter. Utilizing these concepts one can determine the age when a pollock cohort is maximized and what gain or loss in biomass from the theoretical maximum occurs from restructuring the population. In this analysis, species interactions are not taken into consideration; the analysis is concerned only with material change to the pollock population.

In order to explore the growth and decay phases of pollock cohort, the equation (Alverson & Carney, 1975) is used:

$$P_t = (N_o e^{-Mt}) W_{oo} (1-e^{-Kt})b$$

where P_t is the population weight at any specific time,

Noo is the beginning number of individuals, W_{oo} is the maximum weight at the maximum average theoretical size where Woo = aLb_{oo} (a = constant, Loo = maximum length, b = exponent),

M is the instantaneous natural mortality rate,
K is the Von Bertalanffy growth factor, and
t is time.

The sources of data used in the equation are as follows:

Von Bertalanffy growth parameters -- Yamaguchi and Takahashi (1972)

Male	Loo = 75.40	K = -0.165	to = 0.273
Female	Loo = 76.20	K = -0.163	to = 0.291

Length-weight relationship parameters

Male	a = 0.00952	b = 2.916
Female	a = 0.00820	b = 2.958

Other input parameters

No = 10,000 (any assumed number)
M = 0.43 (best estimate of M) (M = 0.35, 0.375, 0.4, 0.45, 0.5, 0.6 were also investigated)

ratio of male to female = 1:1

Results of the cohort analysis (Appendix II) show that a pollock cohort (both exes combined) maximizes its biomass at about age 4 (average size = 38 cm or 15 inches, average weight - 393 gm or 0.9 lbs) when M = 0.43. If that cohort is exploited at later ages, the exploitable biomass will decrease as follows:

Age	Biomass (% of maximum)	Average Length (inches)	Average Weight (lbs)
4	100	15.1	0.9
5	98	17.3	1.3
6	86	19.2	1.8
7	71	20.8	2.2
8	56	22.2	2.7
9	42	23.3	3.1
10	31	24.3	3.5

Exploitable biomass will, theoretically, decrease to about 50% of the maximum if average length is maintained at 22.2 inches (average age = 8; average weight = 2.7 pounds) instead of at 15 inches (the average length when yield is maximized).

Two other factors which appear to bear on this matter have been tentatively identified in a developing, numerical ecosystem model (Laevastu et al. 1976)[3]. A major source of natural mortality within the pollock population is cannibalism. Therefore, maintenance of large numbers of large fish would result in a high rate of cannibalism of young which would, in turn, decrease recruitment and exploitable biomass, and ultimately lead to violent, self-generating cycles in total abundance and size structure of the population.

9.5 Crab-bait Trawl Fishery

The only domestic trawl fishery which occurs in the Bering Sea/Aleutians region at present is a relatively small effort for crab bait. This activity is pursued by a few crab vessels, using very small (as required by State of Alaska regulation) trawl nets and by 1-3 otter trawlers which sell their catches directly to crab vessels on the grounds. Total trawl catches for bait are estimated to have been about 450 mt in 1977 and 900 mt in 1978. Although a groundfish fishery, this trawl operation is more properly considered as an adjunct of the U.S. Bering Sea king and Tanner crab fishery. Because of this close relationship, the potential for gear conflicts--which is high when mobile KEYBOARD()(trawl) and fixed (crab pot) gear is used on the same grounds--is negligible in this unique situation.

[3] Laevastu, T., F. Favorite and B. McAlister. 1976. A dynamic numerical marine ecosystem model for evaluation of marine resources in eastern Bering Sea. Northwest & Alaska Fisheries Center, Natl. Mar. Fish. Serv. Processed report, 69 p.

10.0 OPTIMUM YIELD (OY) AND TOTAL ALLOWABLE CATCH (TAC)

10.1 Maximum Sustainable Yield (MSY) of the Groundfish Complex

The groundfish complex and its fishery are a distinct management unit of the Bering Sea. The complex has more than 10 commercially important species and many others of lesser or no commercial importance. 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. Therefore, the productivity and MSY of groundfish should be conceived for the groundfish complex as a unit rather than for many individual species groups.

The MSY of the groundfish complex is the range of 1.7 to 2.4 million mt. This is calculated by summing the MSYs of each target species and of the "other species" category, as defined in Section 13.2.2 of this plan, that are derived from species-by-species analysis. A reasonable verification of the MSY for the groundfish complex is derived by averaging the 1968-1977 catches when the fishery went through periods of growth, peak, decline, and some stability (see Section 5.2 on History of Exploitation). The average catch was 1.8 million mt with a range of 1.1 to 2.4 million mt.

An ecosystem model of the Bering Sea developed by the Northwest and Alaska Fisheries Center (Laevastu and Larkins, 1981) shows that the mean exploitable biomass for the groundfish species covered by this FMP is about 9.3 million mt. This ecosystem model, the Prognostic Bulk Biomass (PROBUB) model, simulated the principal components of the ecosystem (mammals, birds, demersal fish, semi-demersal fish, pelagic fish, squid, crabs, and benthos) and considered their fluctuations in abundance caused by predation, natural mortality, environmental anomalies, and fishing. The magnitude of the mean exploitable biomass (9.3 million mt) suggests that the annual yield from it is probably much higher than the 1.7 to 2.4 million mt range estimated conservatively by the single species approach.

The ecosystem consideration also indicates that MSY of the groundfish complex may change if the present mix of species is altered substantially from the present period. Therefore, as changes take place, MSY for the complex may have to be reexamined.

10.2 Optimum Yield of the Groundfish Complex

The optimum yield (OY) of the groundfish complex is set equal to 85% of the MSY 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 MSY reflects the combined influence of biological and socioeconomic factors. The important biological factors indicate that:

1. When considering condition of individual species within the complex, the OY range encompasses the summed Acceptable Biological Catches (ABC) of individual species for 1978-1981 (Low, et al. 1978; and Bakkala, et al. 1979, 1980, and 1981). This sum may be used as an indicator of the biological productivity of the complex, although it is not completely satisfactory, because multi-species/ecosystem interactions cannot be adequately taken into account. The 15% reduction of MSY reduces the risk associated with relying upon incomplete data and questionable assumptions in assessment models used to determine the condition of stocks.

2. When considering multi-species/ecosystem models, the OY range is probably a conservatively safe level for the groundfish complex. The mean exploitable biomass of 9.3 million mt for the species

groups (Laevastu and Larkins, 1981) suggests that the harvest level can be considerably higher than the OY range.

Although the multi-species/ecosystem models suggest that the harvest level can be higher than 2.0 million mt, it would only be so if the proper combination of exploitation rates by individual species commensurate to the natural balance of the groundfish complex is applied. This combination may not be desirable to the fishermen because the industry prefers only certain species. The recent catch history indicates that the present mix of species is socio-economically acceptable and that the groundfish complex should probably not be exploited at levels higher than 2.0 million mt at this time.

All of the socioeconomic considerations indicate that:

1. The OY range is not likely to have any significant detrimental impact on the industry. On the contrary, this range, when compared to the annual determination of OY, is more desirable because it creates a more stable management environment where the industry can consistently plan its activities with a minimum expectation of OY being equal to 1.4 million metric tons.

2. The OY range also covers actual catch levels during 1974-76 when the foreign fishery operated profitably before the MFCMA was implemented and is slightly higher than actual catches since then. It will allow the foreign fishery to operate near historic levels and yet offer considerable opportunities for domestic fishery expansion.

Therefore, the range of 1.4 to 2.0 million mt of the target species and "other species" categories, to the extent it can be harvested consistently with the management measures prescribed in this FMP, plus the incidental harvest of nonspecified species, will be the OY of the Bering Sea/Aleutian Islands groundfish complex covered by this FMP unless the plan is amended. An amendment will be made when the status of the groundfish complex changes substantially from the present condition or when socioeconomic considerations dictate that OY should fall outside the present range. OY may also have to be reexamined if substantial change from the present mix of species occurs or is desired of the groundfish complex.

10.3 Total Allowable Catch (TAC)

The Secretary, after receiving recommendations from the Council, will determine TACs and apportionments thereof among DAP, JVP, TALFF, and reserves for each target species and the "other species" category by January 1 of the new fishing year, or as soon as practicable thereafter , by means of regulations implementing the FMP. The Secretary will implement one-fourth of the preliminary TACs and apportionments thereof on or about January 1 of each year on an interim basis. They will be replaced by final TACs as approved by the Secretary following the Council December meeting.

Notwithstanding designated target species and species groups listed in Section 13.2B.2 on page 14-1, the Council may consider whether splitting or combining species in the target species category for purposes of establishing new TACs is desirable based on commercial importance of a species or species group and whether sufficient biological information is available to manage a species or species group on its own biological merits.

Prior to making recommendations to the Secretary, the Council will make available to the public for comment as soon as practicable after its September meeting, a preliminary Stock Assessment and Fishery Evaluation (SAFE) and preliminary specifications of ABC and TAC for each target species and the "other species" category, and apportionments thereof among DAP, JVP, TALFF, and reserves. At a minimum the SAFE will contain information listed in Section 10.3.1.

At its December meeting, the Council will review the final SAFE and comments received. The Council will then make final recommendations to the Secretary.

10.3.1 The Stock Assessment and Fishery Evaluation

For purposes of supplying scientific information to the Council for use in utilizing the above procedure, a The Stock Assessment and Fishery Evaluation (SAFE) is prepared annually. The SAFE will, at a minimum, contain or refer to the following:

(1) Current status of Bering Sea and Aleutian Islands area groundfish resources, by major species or species group.
(2) Estimates of maximum sustainable yield (MSY) and acceptable biological catch (ABC).
(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 (PSCs) for prohibited species and fully utilized species with supporting justification and rationale.
(8) Any other biological, social, or economic information which may be useful to the Council.

When the TACs for the complex and species groups are determined, Domestic Annual Harvest (DAH) and Total Allowable Level of Foreign Fishing (TALFF) are updated in accordance with Section 10.4 and Annex II.

10.3.2 Reserves

The groundfish reserve at the beginning of each fishing year shall equal the sum of 15% of each target species and the "other species" category TAC. When the TAC for the groundfish complex is determined by the Council, 15% of the TAC is set aside as a reserve. This reserve is used for: (a) unexpected expansion of the domestic fishery, (b) correction of operational problems of the domestic and foreign fishing fleets, promoting full and efficient use of groundfish resources, (c) adjustments of species TACs according to the condition of stocks during the fishing year, and (d) apportionments.

The reserve is not designated by species or species groups and will be apportioned to the fishery during the fishing year by the Regional Director in amounts and by species that 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 Director finds that the socioeconomic considerations listed above or specified fishery operational problems dictate otherwise. Except as provided for in the National Standard Guidelines for Fishery Conservation and Management, the Regional Director must also find that the apportionment of reserves will not result in overfishing as defined in the guidelines. The Regional Director may withhold reserves for conservation reasons.

10.3.3 Apportionments to Fishery

When the TAC for each target species and the "other species" category is determined, it is reduced by 15% to form the reserve, as described above. The remaining 85% of each TAC is then apportioned to DAP, JVP, and TALFF (in that order) by the Regional Director as described in Section 10.4.

10.4 Derivation of DAH and TALFF Amounts

Amounts of DAH (= DAP + JVP) for each species or species group established for the beginning of the fishing year shall equal the amount of those species harvested by domestic fishermen during the previous year plus any additional amounts the Regional Director projects to be necessary to satisfy the needs of the growing domestic fishery during the coming year. These supplemental amounts will be based on projected increases in U.S. harvesting and processing during the coming year. In making these projections, the Regional Director shall rely upon the latest available information, including industry surveys and market data, that he finds to be sound. The initial TALFF amounts for each target species and the "other species" category will be established from the following equation: TALFF = TAC - (DAH + Reserve) (see Table 22a for an example). The TALFF for the "nonspecified species" category is the amount of that category caught incidentally to the harvest of target species and the "other species" category. The Regional Director shall make proposed DAP, JVP and TALFF figures available for public comment, along with recommended TACs as stated in Section 10.3 above.

10.5 Reapportionments of Reserve and Unneeded DAP and JVP

The Regional Director may assess the DAP and JVP at any time and apportion to them any amounts from the reserve that he finds will be taken by U.S. vessels. As the fishing season progresses, should the initial DAP exceed subsequent expectations of actual harvest, the Regional Director shall reapportion the excess to JVP, if needed, or to TALFF.

If the initial JVP exceeds subsequent expectations of actual harvest, the Regional Director shall reapportion the excess to DAP, if needed, or to TALFF. The Regional Director shall apportion to TALFF as soon as practicable after April 1, June 1, and August 1, and on such other dates as he determines appropriate any portion of the reserve, JVP and/or DAP that he determines will not be harvested by U.S. fishing vessels during the remainder of the fishing year.

When the Regional Director determines that apportionment is required on dates other than those scheduled or that immediate action is necessary to increase DAP, JVP, or TALFF, he may decide that such an adjustment is to be made without affording a prior opportunity for public comment. Public comments on the necessity for, and the extent of the apportionment shall then be submitted to the Regional Director for a number of days after the effective date that will be specified in a notice announcing such action.

Table 22a. An example of the Total Allowable Catch (TAC), Domestic Annual Harvest (DAH) and Total Allowable Level of Foreign Fishing (TALFF) (metric tons)

Species Group	Areas 1/	Example TAC 2/ 3/	Reserve 4/	Initial DAH 5/	Initial TALFF 5/
Target Species Category					
Pollock	I+II+III	1,200,000	180,000	74,500	945,500
	IV	100,000	15,000	-0-	85,000
Pacific Ocean Perch	I+II+III	1,000	150	850	-0-
	IV	2,600	390	1,380	830
Other Rockfish	I+II+III	11,000	1,650	775	8,575
	IV	11,000	1,650	775	8,575
Sablefish	I+II+III	2,000	300	700	1,000
	IV	900	135	700	65
Pacific Cod		168,000	25,200	43,265	99,535
Yellowfin Sole		214,500	32,175	31,200	151,125
Turbots		76,500	11,475	1,075	63,950
Other Flatfish		92,500	13,875	11,200	67,425
Atka Mackerel		24,800	3,720	14,500	6,580
Squid		10,000	1,500	50	8,450
"Other Species" Category		55,300	8,295	7,800	39,205
TOTAL		1,970,100	295,515	188,770	1,485,815

1/ Fishing areas of the Bering Sea/Aleutian region, unless stated otherwise. See Figure 26a for map.

2/ From Section 11.3. Figures are examples, based on the 1981 single species ABCs. See Bakkala, et al., 1981.

3/ The TAC for the "nonspecified species" category equals the amount of that category caught during the fishing year in the course of harvesting the TACs for the target species and "other species" categories.

4/ Reserves are 15% of the TACs.

5/ To be determined, figures are examples only.

10.6 Seasonal Apportionment of Pollock JVP[4]

The annual apportionment of pollock to JVP in the Bering Sea and Aleutian Islands will be released in two parts during the fishing years 1988 and 1989. Part One will be equivalent to 40 percent of the following sum: initial JVP plus 15 percent of the TAC for pollock. Part One will apply to the period January 15 through April 15. Part Two will be equivalent to the remaining pollock JVP. Part Two will apply to the period April 16 through December 31.

10.7 Prohibited Species Catch Limits for Fully Utilized Groundfish Species

The timing of actions and procedure to be taken in establishing prohibited species catch limits (PSCs) of fully utilized groundfish species are as follows:

(1) September. Following the initial determination of TACs for all managed groundfish species as described in Section 10.3, the plan team will identify those groundfish species that are fully utilized by the domestic fishery. For those species, initial PSC limits will be calculated for joint venture and foreign fisheries using the best available bycatch rates obtained by NMFS observers from the respective fisheries and applying them to initial joint venture (JVP) and foreign (TALFF) TAC apportionments.

(2) September Council meeting. Council will review and approve preliminary PSCs and release the SAFE for 30-day public review.

(3) October 1. As soon as practicable after October 1 the Secretary, after consultation with the Council, will publish a notice in the Federal Register specifying the proposed PSCs for JVP and TALFF. Public comments on the proposed PSCs will be accepted by the Secretary for 30 days after the notice is published.

(4) November. Plan Team prepares final SAFE.

(5) December Council meeting. Council reviews public comments, takes public testimony and makes final decisions on annul PSC limits.

(6) By January 1 the Secretary will publish a notice of final PSC limits in the Federal Register.

(7) January 1. Annual PSC limits take effect for the current fishing year.

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[4] Example of seasonal pollock JVP apportionment:

Assume Pollock TAC equal to	1,000,000 mt
Subtract a 15% "reserve"	150,000 mt
	850,000 mt.
Assume DAP apportionment of	350,000 mt
	500,000 mt initial JVP

(Initial JVP + "reserve") x 0.40 equals Part One (500,000 + 150,000) x 0.40 = 260,000 mt
Part One 260,000 mt minus allowances for pollock bycatch equals JVP pollock target for January 15 through April 15. If additional bycatch during the first period is necessary it will be counted against Part Two.

11.0 CATCH AND CAPACITY DESCRIPTORS

11.1 Domestic Annual Capacity

11.1.1 Domestic Commercial Processing Characteristics

Since the domestic groundfish fishery in the Bering Sea and Aleutians consists of a part time trawl operation for king and Tanner crab bait, and a few weeks of longlining for halibut each year, there essentially is no industry to describe. The information presented is more of a description of the latent groundfish capacity of the current shellfish industry including some expansion plans.

A survey was made of the majority of the companies which process shellfish in the eastern Aleutian Islands (Unalaska and Akutan) and the western end of the Alaska Peninsula. The central and northeastern Alaska Peninsula and Bristol Bay plants, except as they might represent investment and contribute to gross sales of the parent companies with operations further west, were not considered because of their inability to be operated year round either because of ice or specialization for summer salmon processing.

Representatives of ten companies with sixteen operations in the Aleutians and western Alaska Peninsula were contacted. Responses to all questions were not obtained due to the tentative nature and lack of completeness of plans for groundfish operations in 1979, or because company policy precluded divulging certain information.

Seven of the companies with operations in the area indicate gross annual sales of a total of 192.5 million dollars. This amounts to 43% of the total first wholesale value of all fisheries products processed in Alaska in 1976, the latest year for which data are available.

Since several of Alaska's major processing companies are represented in the relatively small number of companies with operations in the area, an average gross expanded to include all operators is not included in this section because it would likely provide an inflated representation of the size of the marketing structure of the westward processors.

Of the fifteen companies known to have operations in the western Alaska Peninsula-Aleutian Islands, nine indicated current plant investments totaling 61.5 million dollars. As in the case of total sales, this is considered a typical since almost all the major companies operating in Alaska are represented in the sample.

It should be noted however, that the companies with operations in the area are heavily involved in the fish processing business in Alaska through plant investment, and account for a substantial portion of the resources processed in the state.

The processing industry in westward Alaska is highly dependent upon transient labor. The small villages of Unalaska and Akutan have inadequate workforces to handle the catches of the large, modern Bering Sea crab fleet. In the early period of the fishery, workers from the Pribilof Islands and the coastal Eskimo villages were recruited for processing work. While the industry still depends on Alaskan help to a considerable extent, the expansion of processing capacity as a result of the growing Tanner crab fishery and the displacement of the Japanese and Russian king crab fisheries in the Bering Sea have necessitated increased recruitment from the other states.

One of the problems processors have had to cope with is processing the crabs, especially king crab, fast enough to get the catcher boats turned around and back to the fishing grounds. As the fleet grows in size and efficiency, the processor is faced with a shorter season in which to get enough product to make a profit, while

keeping the "turn-around" time for the vessels delivering crab short so that the skippers do not find it in their best interest to seek markets elsewhere.

The solution to these particular problems has been to create a large transient work force and the facilities to house it. Shoreside and shipboard bunkhouse facilities in the eastern Aleutians currently have the capacity to house approximately 2,400 workers.

To the extent that the current and planned capacity would be suitable for groundfish, the daily freezing and holding capacity has been used as an indication of the domestic processor's groundfish capacity.

Plans for 1979 include some processing capacity at Unalaska which will be dedicated entirely to groundfish. There are indications that such plans are being considered, by several companies, but target dates are indefinite. Several of the company representatives interviewed believed that groundfish and crab operations are not compatible, i.e., groundfish cannot be processed in a vacant corner of a crab plant, nor can crab processing lines be torn out or modified for short periods of time to convert a plant to finfish processing. The consensus seemed to be that if there were to be a serious attempt to process groundfish on a production basis, the plant would have to be planned and built from the ground up in order to provide for the efficiency necessary to profit from a high volume-low priced product. None of the shellfish processors indicated that groundfish could be handled while the crab season is open, for reasons discussed above.

Estimates of freezing and holding capacities, and the percentage of time a plant would be available for processing groundfish were obtained from seven companies involving eleven operators. Estimates of from 20% to 50% were made of the plants' annual capacity that would be available for diversification.

The seven companies represent a cumulative daily freezing capacity of 520 mt. This capacity would be available 37% of the year, on the average. Therefore, if it is assumed, as it was for the Gulf of Alaska groundfish fishery, that a processing plant can operate 250 days a year, then

$$520 \text{ mt} \times .37 \times 250 = 48{,}100 \text{ mt}$$

would represent the estimate annual capacity of the processors in the area during the crab off-season. Since there is some question as to the ability to process and freeze groundfish during crab seasons, no attempt has been made to estimate capacity during those periods of time.

In addition to the estimated off-season capacity in the shellfish fishery, there are plans to have 6,250 mt of capacity exclusively designed for groundfish. Total estimated capacity would then be 54,350 mt.

Nine processors indicated a cumulative holding capacity of 13,900 mt. This would hold about a twenty day run of the off-season freezing capacity in the area.

11.1.2 Commercial Fishing Fleet

A projection of domestic annual capacity for groundfish in the Bering Sea is limited by the fact that to date there has been virtually no effort directed at the harvesting of groundfish in the Bering Sea by U.S. fishermen. Since a domestic trawl fishery has yet to be developed, an estimate of domestic capacity must rely upon a determination of the types of existing vessels that are likely to succeed in the fishery and how much fishing time will be available to them.

NORFISH, a Sea Grant program at the University of Washington, has been involved in an analysis of the shellfish fleet in the state of Alaska, with reference to the future development of a domestic trawl fishery. A

classification system was developed for characterizing shellfish vessels on the basis of such characteristics as length, horsepower, hull type and gear types employed[1/]. Certain types of shellfish vessels are likely candidates for entry into a trawl fishery, based on their trawling capability and other features. In particular, combination crabber-trawler type vessels (classes 8.1 to 8.5) have the largest potential fishing power of the existing shellfish vessels for the harvesting of groundfish. Subsequent estimates of capacity are based on these vessel classes, since they are expected to provide most of the initial future capacity.

An initial estimate of domestic harvest capacity can be obtained by examining the hold capacity of the combination vessels, shown in Table 23. This estimate assumes a packing factor of 40 pounds of iced fish per cubic foot of space. Also included are the number of vessels in each class which have made shrimp landings and provide a minimum estimate of the number of combination vessels currently equipped to trawl. Table 24 indicates the change in number of combination vessels between 1975 and 1977. The net increase in number of combination vessels has resulted in an overall increase in total hold capacity of 10% over the past two years.

Another factor affecting capacity is the amount of fishing time available. If it can be assumed that the domestic trawl fishery will begin primarily as an off-season fishery for shellfish fishermen, currently unused fishing time within the fleet would provide an estimate of time available for harvest of groundfish. To determine if there is unused capacity within the combination vessel classes, an analysis of the landing record of each vessel was performed.[5] The frequency distribution of interlanding times was used to derive an estimate of maximum trip length for each species fished. The maximum trip length was adjusted to take into consideration the limitation of holding time on board for various species. Allowing for a layup of 60 days per vessel, the number of additional fishing trips available by vessel class and trip length were calculated.

Given the current limitations in holding catches on board, particularly in the case of pollock, a 4- to 7-day trip length seems reasonable to expect. If 20-30 mt per day is a realistic catch rate in the Bering Sea, then the domestic annual capacity could be expected to be about 157,000 mt. This estimate was calculated by ignoring 1- to 3-day intervals and adding in the appropriate number of 4- to 7-day trips which could be made from within the longer time intervals.

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[5] NORFISH Technical Report #61. The Classification, Enumeration, Characteristics and Economic Performance of Alaskan Fishing Vessels, NEPAC Progress Report II. 1976. 23 pp.

Table 23. Hold Capacity of Combination Crabber-Travwler Vessels.

NORFISH Class	No. of registered vessels	Keel length (feet)	Ave. hold capacity (cu.ft.)1/	Total capacity (40lbs/cu.ft.)	Class total (lbs.)	Number to trawl shrimp
8.1	30	50.1-70.	2800	112,000	3,360,000	11
8.2	65	70.1-82.	3000	120,000	7,800,000	24
8.3	38	82.1-90.	3500	140,000	5,320,000	8
8.4	32	90.1-100.	5500	220,000	7,040,000	1
8.5	14	100.1-100.	7500	300,000	4,200,000	0
	179				27,720,000 (or 12,375 mt)	

1/ Revised figures provided from shellfish research group sessions held by Alaska Commercial Fisheries Entry Commission, 1977.

Table 24. Changes in Number of Registered Shellfish Vessels, Western Alaska, 1975-1977.

Class	No. registered 1975	No. boats gained	No. boats lost	Net gain	No. registered 1977	No. registered 1/ SE AK 1977
8.1	25	5	1	4	29	1
8.2	65	9	10	-1	64	1
8.3	31	4	0	4	35	3
8.4	28	4	0	4	32	0
8.5	13	3	2	1	14	0

1/ Southeast Alaska vessels were tabulated seperately since the 1975 survey did not include them.

It should be noted that this estimate of domestic annual capacity assumes that all combination vessels are currently equipped to trawl. In fact, perhaps half of the fleet would require extensive modification beforehand. This figure is also high considering unused effort that might be directed towards Gulf of Alaska groundfish fisheries instead of the Bering Sea. Conversely, if trawling for groundfish in the Bering Sea proves to be more profitable than participating in alternative fisheries, the estimate of domestic annual capacity would need to be adjusted upward.

11.2 Expected Domestic Annual Harvest (DAH)

Expected domestic annual harvest (DAH) is the estimated portion of the U.S. groundfish harvest which will be utilized by domestic processors (DAP), which includes those amounts of groundfish "processed" for use as bait or for personal consumption, and the estimated portion, if any, delivered to foreign processors (JVP) which are permitted to receive U.S. harvested groundfish in the Fishery Conservation Zone and internal waters.

The estimate of DAP will be updated annually based upon the previous year's production and projected increases in U.S. processing. JVP is the U.S. harvested portion of the OY in excess of the estimated amount to be utilized by U.S. processors or for which actual domestic markets are not available, that will be delivered to foreign processors who are authorized to receive such U.S. harvested fish in the Fishery Conservation Zone and internal waters. Estimates of utilization in this category are updated annually based upon the previous year's catch and projected increases in catch anticipated by the various joint venture companies.

Estimates of future production by processors are difficult, if not impossible, to make accurately. It is generally recognized by those processors making the estimates that their figures are optimal and based on assumptions that sometimes do not materialize. Machinery or installation delays, changes in markets, better than normal alternative fisheries for the fishing fleets (or processors) may all affect their actual production. Therefore, a DAH reassessment system and release mechanism is established through this plan and by regulation to allow adjustments in DAH during the plan year.

Production by U.S. fishermen and processors shall be reassessed periodically based on:

1. catch and production to date during the year;
2. current fishing and production activity; and
3. projections for additional catch and production during the remainder of the year based on demonstrated capacity.

Releases from DAH to TALFF shall be made by the NMFS Regional Director as described in Section 10.5. No release or transfer shall be made if such release is likely to have a significant adverse biological, economic, or social consequence.

12.0 ALLOCATIONS BETWEEN FOREIGN AND DOMESTIC FISHERMEN

12.1 Reserve

U.S. participation in the fishery in the near future is expected to consist of a relatively modest catch for crab bait, a growing Pacific cod fishery, expanding joint ventures for yellowfin sole, pollock, and Atka mackerel and limited efforts for other bottomfish production.

In order to prevent the TAC established for the target species and "other species" categories from being exceeded without preventing unexpected domestic fishery development; i.e., an unanticipated increase in U.S. catching or processing, 15% of the TAC established for these categories will be held in reserve, as described in Section 10.3.1.

The reverse will be released by the Regional Director in accordance with Section 10.5.

12.2 Total Allowable Level of Foreign Fishing (TALFF)

The initial TALFF for each species shall be determined by the equation: Initial TALFF = TAC - (DAH + Reserves).

The final TALFF for each target species and for the "other species" category shall be determined as the fishery progresses and may be increased over the initial TALFF as described in Section 10.5.

The procedure for deriving initial DAH and TALFF is prescribed in Section 10.4.

All allocations to TALFF are subject to the management measures prescribed in this FMP, including, in the case of TALFF, prohibited species catch restrictions.

13.0 MANAGEMENT REGIME

13.1 Management Objectives

Five priority objectives dictate the philosophy of management for the groundfish fishery in the region:

(1) Provide for rational and optimal use, in a biological and socioeconomic sense, of the region's fishery resources as a whole;
(2) Minimize the impact of groundfish fisheries on prohibited species and continue the rebuilding of the Pacific halibut resource;
(3) Provide for the opportunity and orderly development of domestic groundfish fisheries, consistent with (1) and (2) above; and
(4) Provide for foreign participation in the groundfish fishery, consistent with all three objectives above, to take the portion of the TAC not utilized by domestic fishermen.
(5) Seek to maintain the productive capacity of the habitat required to support the Bering Sea/Aleutian Islands groundfish fishery.

13.2 Area, Fisheries, and Stocks Involved

This Fishery Management Plan and its management regime governs:

A. Fishing by foreign and United States vessels in the U.S. Fishery Conservation Zone of 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, and of the Eastern Bering Sea (See Figure 26).

The FMP area is divided into five fishing areas as shown in Figure 26a and described in Appendix III.

For the purpose of spatially allocating TAC's, Area IV, the Aleutian Islands Management Area, is divided into three districts, defined as follows:

Eastern District -- That part of the Aleutian Islands Management Area between 170° W longitude and 177° W longitude.

Central District -- That part of the Aleutian Islands Management Area between 177° W longitude and 177° E longitude.

Western District -- That part of the Aleutian Islands Management Area west of 177° E longitude.

B. 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 4.2.A, above.

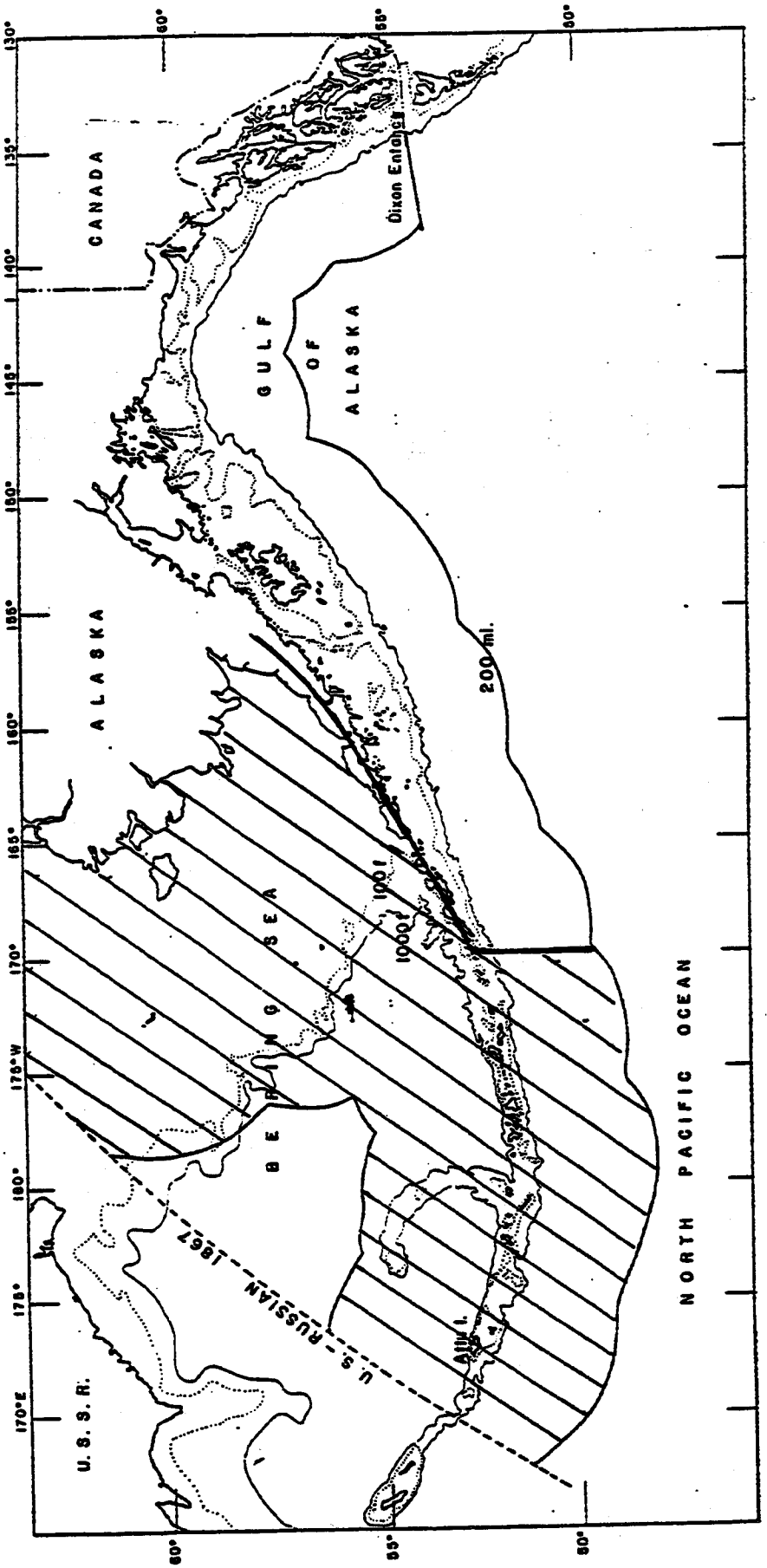


Figure 26.--Area (diagonal lines) over which this Fishery Management Plan applies.

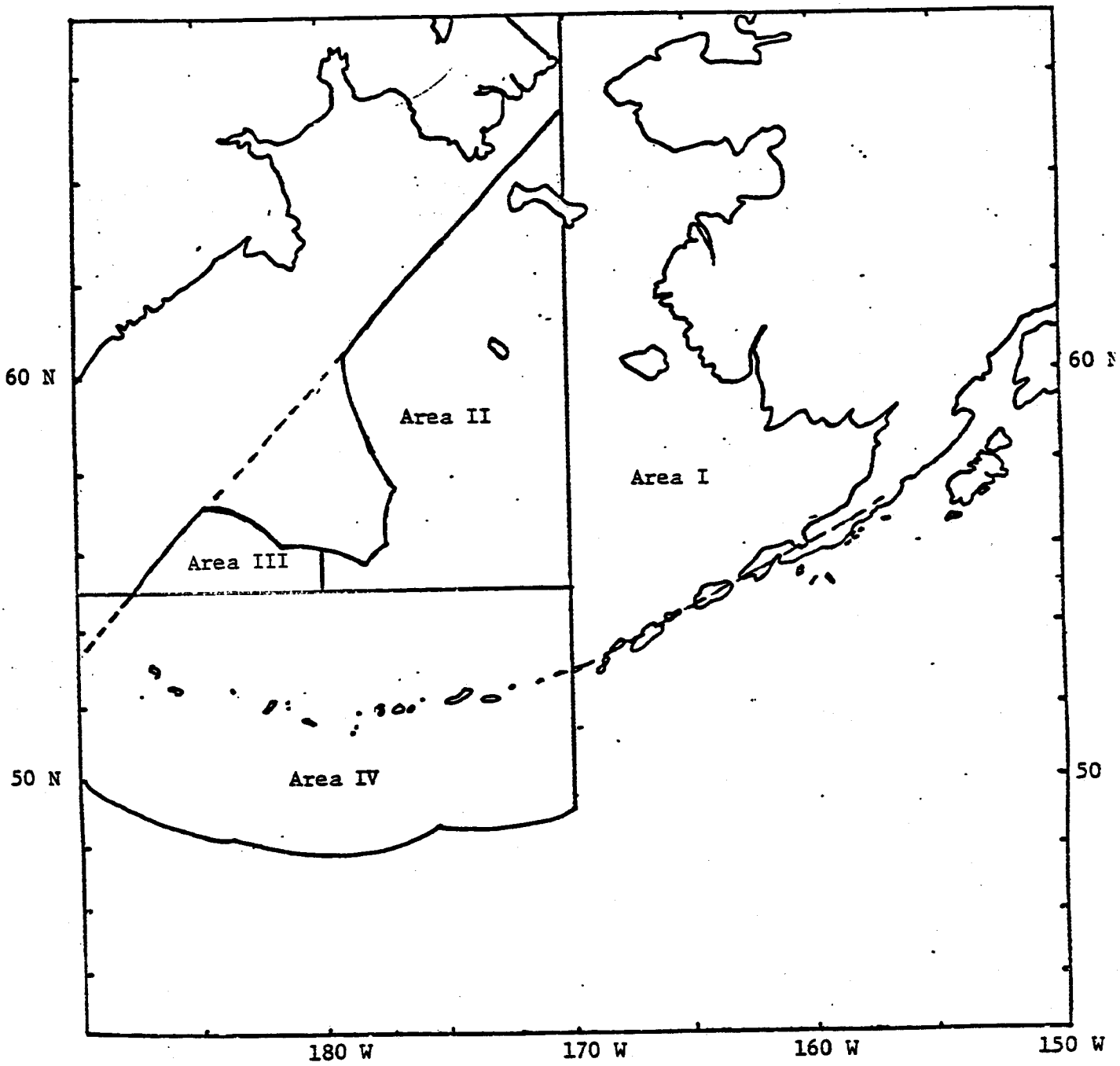


Fig. 26a Fishing areas in the Bering Sea and Aleutian Islands.
(See Appendix III for geographical coordinates.)

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 Annex V and are described as follows:

1. Prohibited Species--are those species and species groups the catch of 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 at 14.4.2.F). 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 which 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, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, "other flatfish," sablefish, Pacific ocean perch, "other rockfish," Atka mackerel, and squid.

3. Other Species -- species groups which 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 sufficient data are lacking to manage each separately. 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, eulachon, smelts, capelin, and octopus.

4. Forage fish species -- are those species not included in the target species category and 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. These species include those listed in Annex V. Virtually no data exist which would allow population assessments. No record of catch is necessary. The TAC for this category is the amount which is taken incidentally while fishing for target and other species, whether retained or discarded.

13.3 Fishing Year

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 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.
- Allocation: potential allocation effects among users and indirect effects on coastal communities.

13.4 Management Measures -- Domestic Fishery

13.4.1 Permit Requirements

Certain permits are required of participants in the BSAI Groundfish fisheries. Specific requirements are found in regulations implementing the FMP.

13.4.2 Prohibited Species

A. General

Pacific halibut, Pacific herring, Pacific salmon and steelhead, king crab, and Tanner crab are prohibited species and must be treated as described in Section 13.2.B.1. 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.

B. Objective

The objective of this section is to provide an environment which supports domestic harvesting of groundfish with an awareness of principles and techniques for keeping incidental catches of Pacific halibut, Pacific herring, Pacific salmon, steelhead, king crab, and Tanner crab to a minimum.

C. Guideline

Procedures chosen for controlling the incidental catch of prohibited species should provide incentives and opportunities for fishermen to modify their gear, fishing techniques, or whatever else is appropriate to result in long-term incidental catch reductions.

D. Policy

The North Pacific Fishery Management Council believes that domestic fishermen targeting on the groundfish fisheries of the Bering Sea and Aleutians share a responsibility to avoid to the fullest extent practicable the incidental taking of halibut, salmon, king crab, and Tanner crab. They also share with the North Pacific Fishery Management Council a responsibility to develop an accurate information base

concerning these species through maintenance of logbooks, accurate reporting of catch, and contributions to knowledge of fish distribution, behavior, etc.

The North Pacific Fishery Management Council advocates and strongly supports development of domestic harvesting and processing of the groundfish of the Bering Sea and Aleutian Islands. However, the Council also is fully committed to protection from needless waste of stocks of salmon, halibut, king crab, and Tanner crab which are fully utilized in other domestic fisheries. Furthermore, in accordance with MFCMA provisions, the Council has a continuing obligation to assure their management in accordance with optimum use objectives. Therefore, the Council charges domestic fishermen to develop their fishing strategies, techniques, and practices with full regard for and attention to the objectives of the Council for protection of species not properly a target of those groundfisheries, as demonstrated by the measures taken to assure protection by foreign fleets. The Council urges domestic fishermen to study the techniques used by foreign fleets to meet Council requirements for protection of non-target species, to adapt those techniques where appropriate for domestic use, and to experiment actively with gear modifications, selection of time and area fishing strategies designed to avoid concentrations of prohibited species, and other techniques designed to develop a clean fishery. The Council will work with domestic fishermen to facilitate transfer of useful information and technology from foreign sources, and to insure the collection of relevant fisheries data and information from all sources, foreign and domestic.

The Council will follow the development of Bering Sea and Aleutian Islands groundfish fisheries with much interest, and with particular attention to the success of those fisheries in avoiding unnecessary or excessive taking of prohibited species.

The Council hopes that through voluntary measures developed with the cooperation of domestic fishermen, stocks of salmon, halibut, king crab, and Tanner crab can be sufficiently sequestered from needless and wasteful bycatch to make unnecessary the imposition of special protective regulations upon the domestic groundfish fishery.

E. PSC Limits and Time/Area Closures for DAH Fisheries

The PSC limits and area closures for DAH fisheries will be reviewed each year to determine whether changes in prohibited species stock abundance or other factors justify consideration of alternative PSC limits or time/area closures.

F. Prohibited Species Donation Program.

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

(1) Pacific salmon
(2) Pacific halibut

13.4.2.1 Prohibited Species Bycatch Limitation Zones and Areas

A. Zone 1 is that area bounded by 165°W longitude and 58°N latitude extending east to the shore (Figure 27).

B. Zone 2 is that 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 (Figure 27).

C. Crab and Halibut Protection Zone. Domestic and foreign trawl fishing is not permitted in the Crab and Halibut Protection Zone, which 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 includes that portion of the EEZ north of the Alaska Peninsula, south 58°N latitude, west of 160°W longitude and east of 163°W longitude (Figure 27).

D. Herring Savings Areas (Figure 27a) means any of the three areas described as follows:

(1) Summer Herring Savings Area 1 means that part of the Bering Sea subarea that is south of 57° N. latitude and between 162° and 164° longitude from 12:00 noon Alaska Local Time (ALT) June 15 through 12:00 noon ALT July 1 of a fishing year.

(2) Summer Herring Savings Area 2 means that part of the Bering Sea subarea that is south of 56°30' N. latitude and between 164° and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year.

(3) Winter Herring Savings Area means that part of the Bering Sea subarea that is between 58° and 60° N. latitudes and between 172° and 175° W. longitudes from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year.

E. The C. Opilio Bycatch Limitation Zone (COBLZ) is an area defined as that portion of the Bering Sea Subarea north of 56°30' N. latitude that are west of a line connecting the following coordinates in the order listed:

56°30' N. lat.,	165°00' W. long.
58°00' N. lat.,	165°00' W. long.
59°30' N. lat.,	170°00' W. long.

and north along 170°00' 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.

13.4.2.2 Prohibited Species Catch Limits

A. Red king crab. A Zone 1 PSC limit for red king crab 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 effective spawning biomass is less than 14.5 million lb. the Zone 1 PSC limit will be 35,000 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 lb. the Zone 1 PSC limit will be 100,000 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 lb. the Zone 1 PSC limit will be 200,000 red king crab.

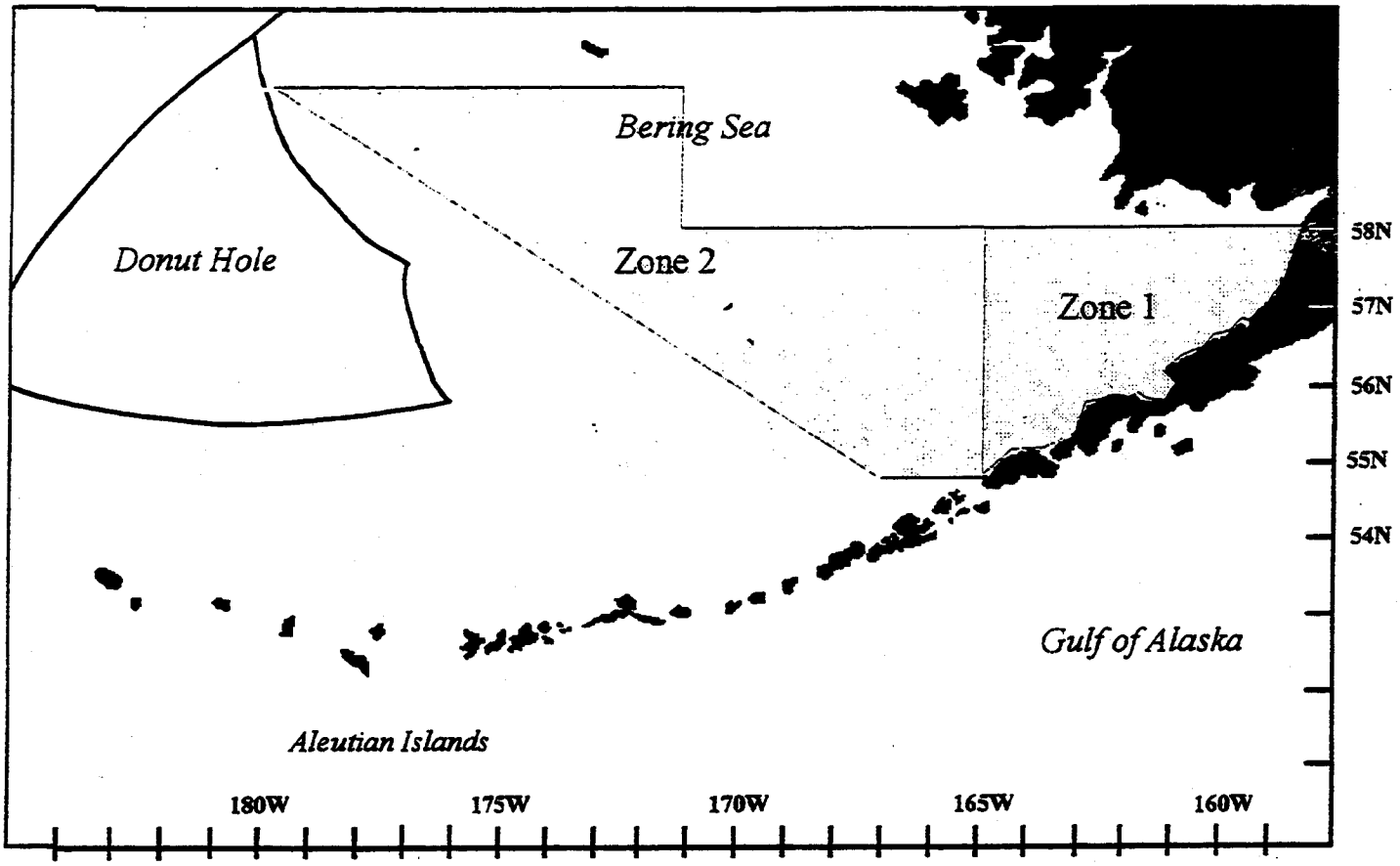
B. The PSC limit(s) for C. bairdi Tanner crab is established by regulation based on abundance of C. bairdi crab as indicated by the NMFS bottom trawl survey.

C. The PSC limit (s) for C. opilio crab is established by regulation based on total abundance of C. opilio crab as estimated by the NMFS bottom trawl survey. Minimum and maximum PSC limits also are established by regulation.

D. 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 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;
8. Other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives.

Figure 27 - PSC bycatch Limitation Zones



Prohibited Species Bycatch Limitation Zones

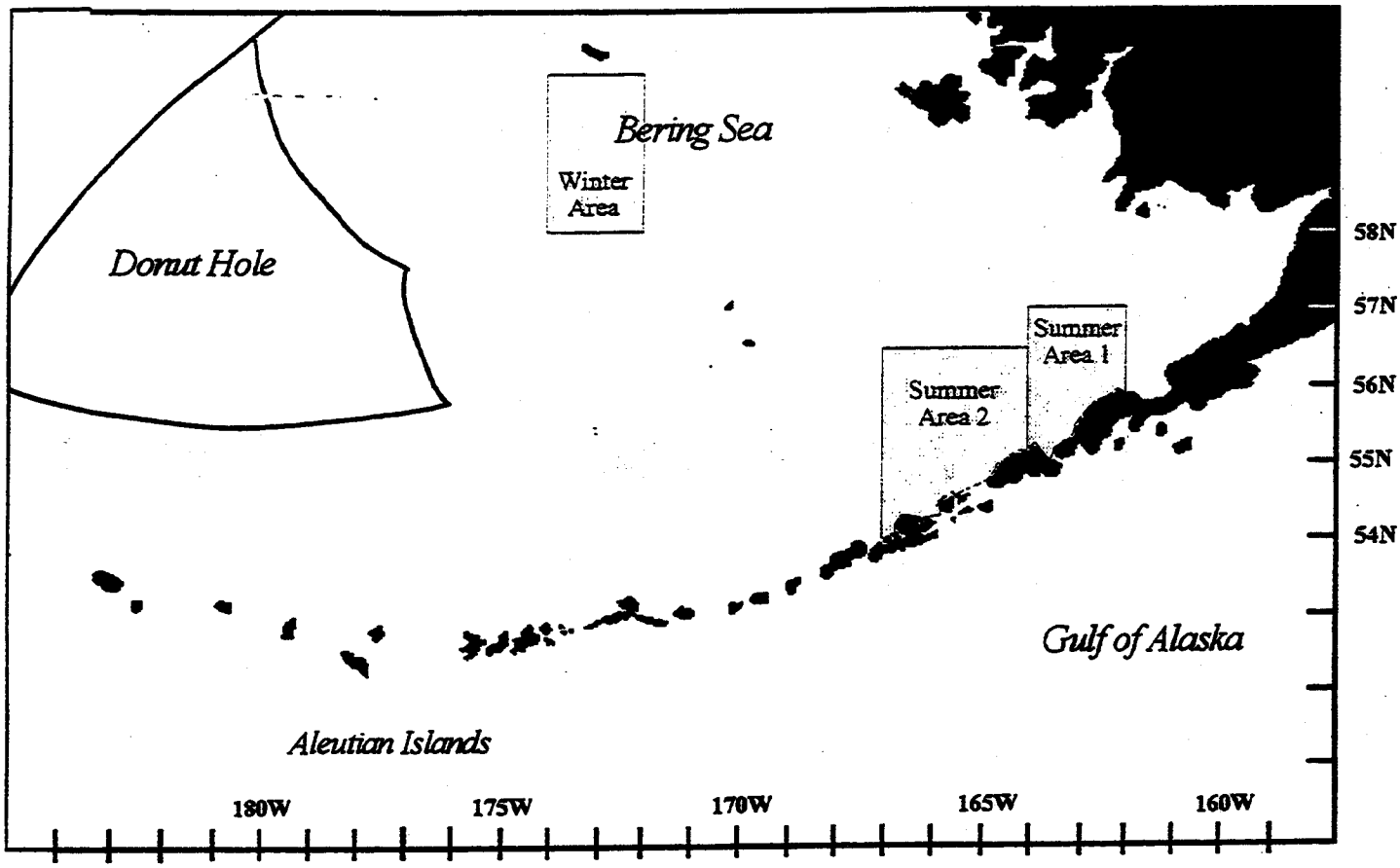
Rationale for Closure: To allow for control of red king crab and C. bairdi Tanner crab bycatch.

Origin: Implemented under Amendment 10 on March 16, 1987.

Description of Area: Areas close to directed fishing when crab bycatch caps are attained in specified fisheries. Bycatch Limitation Zone 1 means that part of the Bering Sea Subarea that is south of 58°00' N. latitude and east of 165°00' W. longitude. Bycatch Limitation Zone 2 means that part of the Bering Sea Subarea bounded by straight lines connecting the following coordinates in the order listed:

North latitude	West longitude
54° 30'	165° 00'
58° 00'	165° 00'
58° 00'	171° 00'
60° 00'	171° 00'
60° 00'	179° 20'
59° 25'	179° 20'
54° 30'	167° 00'
54° 30'	165° 00'

Figure 28 - Herring Savings Areas



Herring Savings Areas

Rationale for Closure: Established to control the bycatch of herring PSC in groundfish fisheries.

Origin: Implemented as part of Amendment 16a on July 12, 1991.

Description of Area: All trawling is prohibited in the herring savings areas when a herring PSC limit (set at 1% of biomass) is attained.

Summer Herring Savings Area 1 means that part of the Bering Sea subarea that is south of 57° N. latitude and between 162° and 164° W. longitude from June 15 through July 1.

Summer Herring Savings Area 2 means that part of the Bering Sea susbarea that is south of 56°30'N. latitude and between 164° and 167° W. longitude from July 1 through August 15.

Winter Herring Savings Area means that part of the Bering Sea subarea that is between 58° and 60° N. latitude and between 172° and 175° W. longitude from September 1 through March 1 of the succeeding fishing year.

E. The annual PSC limit of Pacific herring caught while conducting and DAH trawl fishery for groundfish in the Bering Sea and Aleutian Islands area management unit is 1 percent of the annual biomass of eastern Bering Sea herring.

13.4.2.3 Apportionment of PSC Limits to Target Fisheries

A. The Pacific halibut bycatch mortality limit for trawl gear and the PSC limits for C. bairdi Tanner crab, C. opilio crab, red king crab, and herring apply to trawl fisheries for groundfish that are categorized by target species or species groups. The Pacific halibut bycatch mortality limit for non-trawl gear applies to non-trawl gear fisheries for groundfish that may be categorized by target species or species groups, gear type, and area. Fishery categories will be implemented by regulations that accomplish the goals and objectives of the FMP, the Magnuson 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 13.4.2.2.

B. Apportionments of PSC limits to target fishery categories established under Part A of this section 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 September Council meeting. The Plan Team will prepare for the Council a preliminary Stock Assessment and Fishery Evaluation (SAFE) Report under Section 11.3 which provides 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. Based on the SAFE report, the Plan Team will provide recommendations for apportionments of PSC limits to DAP and JVP target fisheries, seasonal allocations, thereof, and an economic analysis of the effects of the PSC limit apportionments or allocations.

(2) September Council meeting. While recommending proposed groundfish harvest levels under Section 10.3, 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 13.4.2.2, Part D. 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, including that contained in the preliminary SAFE report prepared by the Plan Team. 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 September meeting, the Secretary will publish the Council's recommendations as a notice in the Federal Register. Information on which the recommendations are based also will 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 10.3 which provides the best available information on estimated halibut bycatch rates in the target groundfish fisheries. The Plan Team will provide final recommendations for apportionments of PSC limits among DAP and JVP target fisheries, seasonal allocations of fishery bycatch apportionments, and also an economic analysis of the effects of the PSC limit apportionments or seasonal allocations.

(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 same factors (a) through (g) set forth under Section 13.4.2.3, Part B (seasonal allocations of the PSC limits). The Council also makes final decisions on the exemption of any non-trawl fishery category from halibut bycatch mortality restrictions using the same factors (1) through (8) set forth under Section 13.4.2.2, Part D.

(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.

13.4.2.4 Incentive programs to reduce bycatch rates of prohibited species

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 13.4.2.2. The intended effect of such measures is to increase the opportunity to harvest groundfish TACs before established PSC limits are reached.

13.4.3 Fishing Area Restrictions

13.4.3.1 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 mammals species are reduced in abundance. For example, Steller sea lions are so reduced in abundance that they have been listed as threatened within the meaning of the Endangered Species Act. Even absent such a listing, 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.

13.4.3.2 Trawl Fishery

A. Pribilof Islands Habitat Conservation Area (As described in Appendix III and Figure 29)--Closed to all trawling from January 1 to December 31.

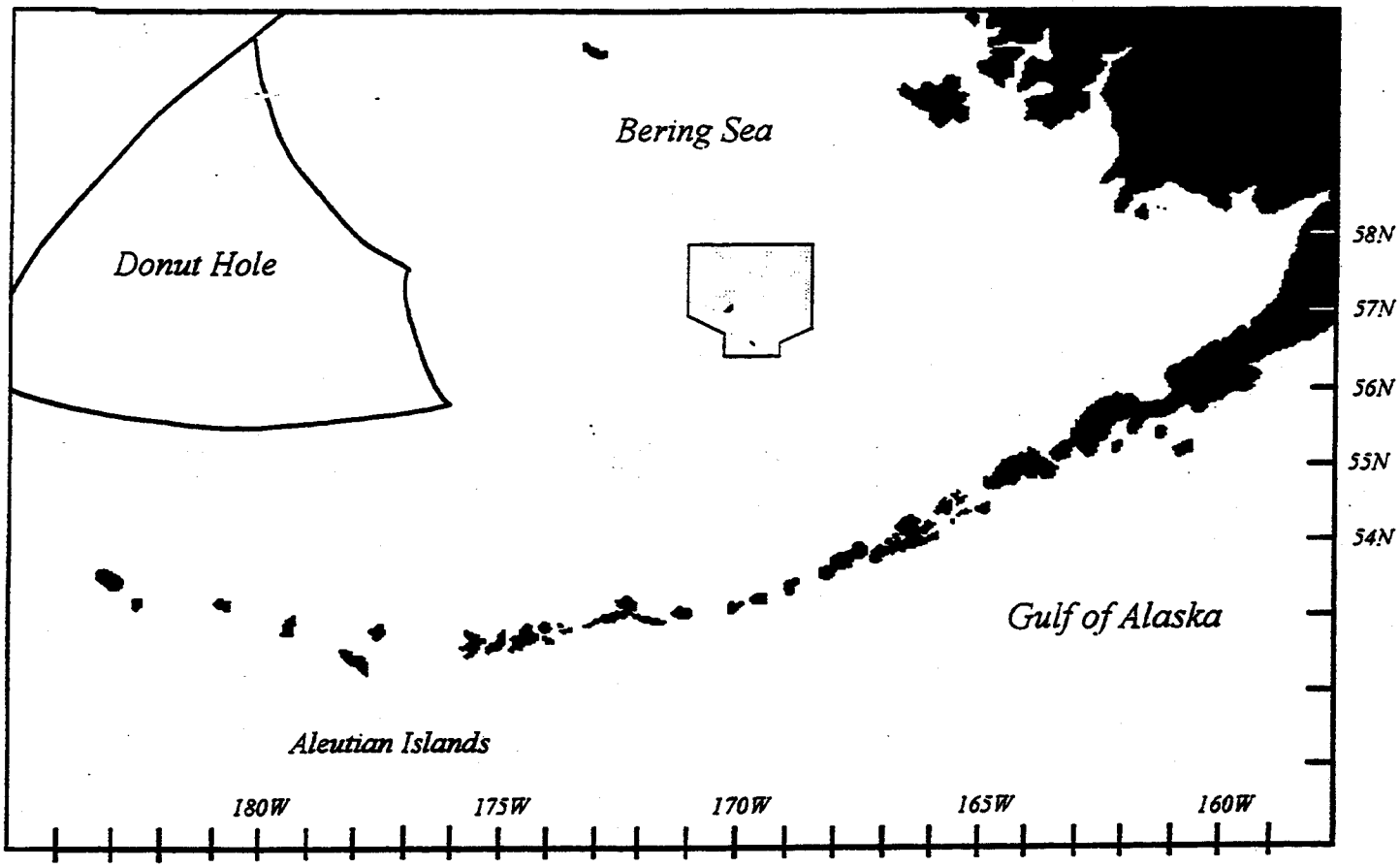
B. Chum Salmon Savings Area. (As described in Appendix III and Figure 30)--Closed to trawling from August 1 through August 31. In addition, when the Regional Director determines that 42,000 non-chinook salmon have been caught by vessels using trawl gear during the time period of August 15 through October 14 in the catcher vessel operational area, NMFS will prohibit fishing with trawl gear for the remainder of the period September 1 through October 14 in the chum salmon savings area. Accounting for the 42,000 fish bycatch limit will begin on August 15.

C. Chinook Salmon Savings Areas. (As described in Appendix III and Figure 31)-- When the Regional Director determines that 48,000 chinook salmon (Oncorhynchus tshawytscha) have been caught by vessels using trawl gear during the time period of January 1 through April 15 in the BSAI, NMFS will prohibit fishing with trawl gear for the remainder of the period January 1 through April 15 in the chinook salmon savings areas.

D. Red King Crab Savings Area (RKCSA). (As described in Appendix III and Figure 32)--Closed to non-pelagic trawling year round, except that when the Director, Alaska Region, 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 RKCSA between 56°00' and 56°10' N. lat. and 162°00 and 164°00 W. long. to non-pelagic trawling.

E. Nearshore Bristol Bay Trawl Closure. (As described in Appendix III and Figure 33)--Bristol Bay east of 162°W. Closed to all trawling on a year round basis, with the exception of a subarea bounded by 159°00 and 160°00 W. long. and 58°00 and 58°43' N. lat. that remains open to trawling during the period April 1 to June 15 each year.

Table 29 - Pribilof Island Habitat Conservation Area



Pribilof Islands Habitat Conservation Area

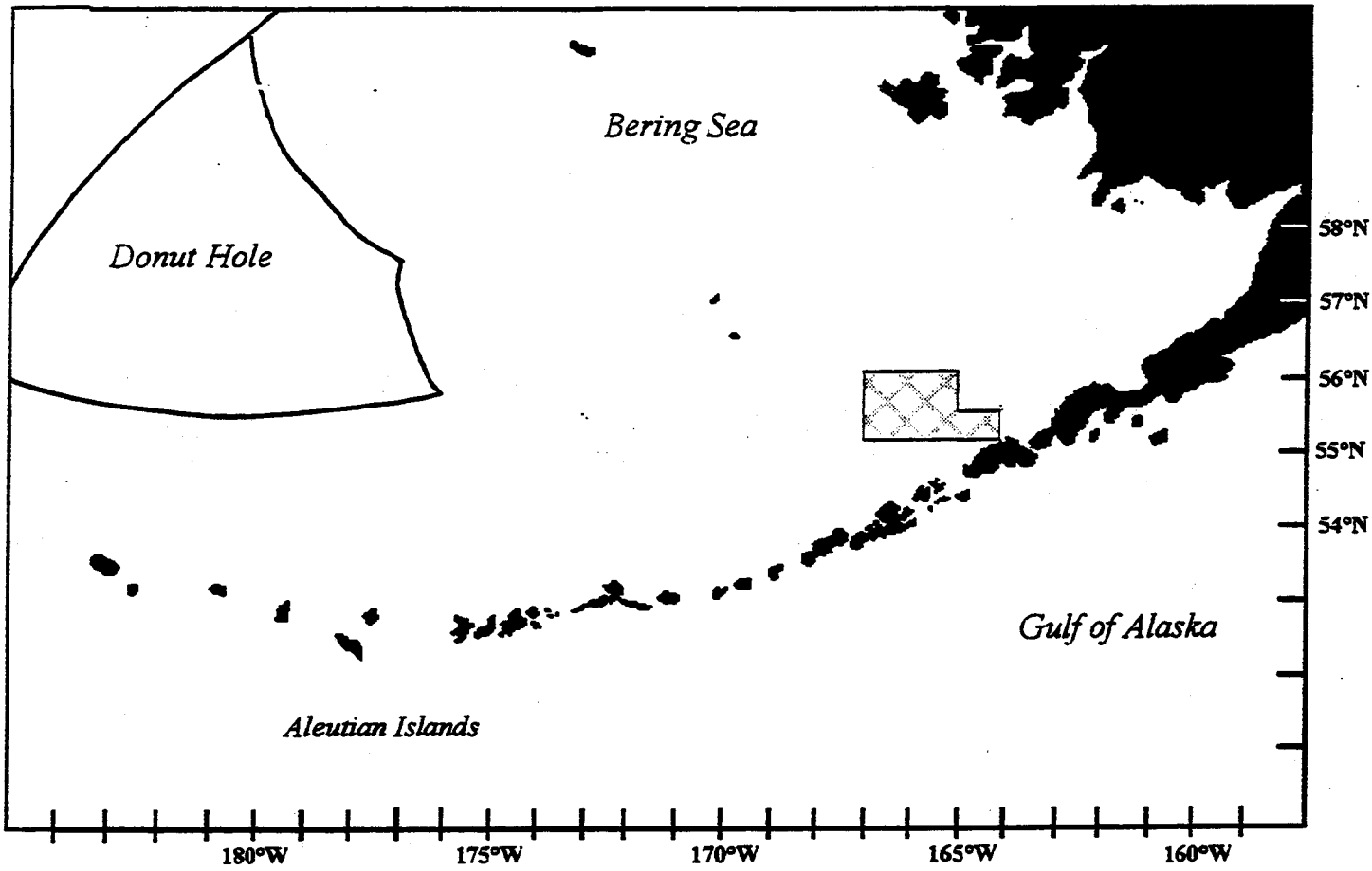
Rationale for closure: Closed to protect blue king crabs, marine mammals, seabirds and their prey species to allow rebuilding of these depressed stocks.

Origin: Adopted by the Council on April 23, 1994, and implemented as Amendment 21a on January 20, 1995.

Description of Area: All trawling is prohibited at all times in the EEZ within the area bounded by a straight line connecting the following parts of coordinates in the order listed:

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.

Table 30 - Chum Salmon Savings Area



Chum Salmon Savings Area

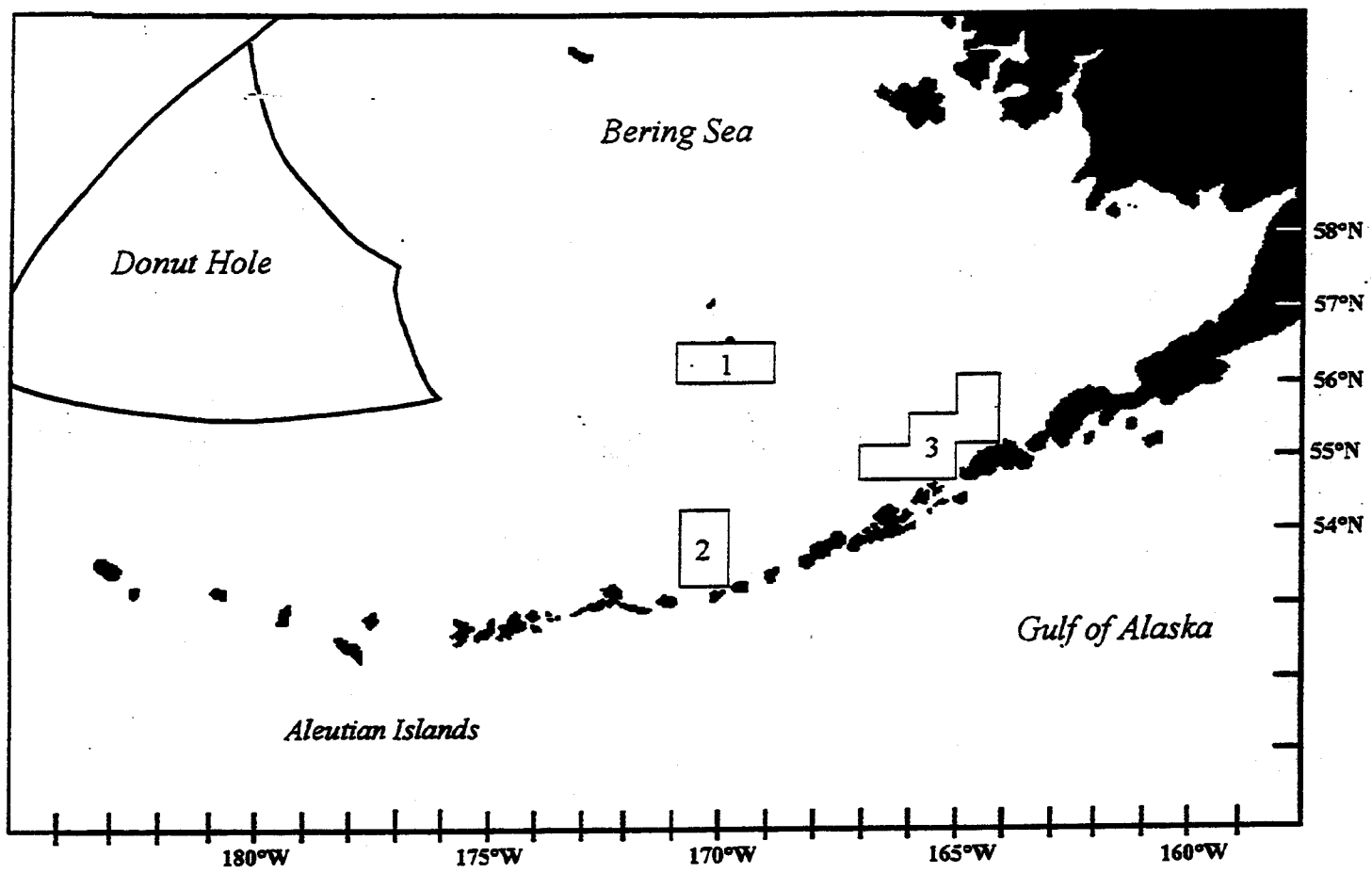
Rationale for Closure: To reduce excesive bycatch of "other" (chum) salmon in groundfish trawl fisheries.

Origin: Originally implemented by emergency rule effective August 15, 1994 through November 12, 1994. Adopted as Amendment 35 by the Council on January 14, 1995.

Description of Area: All trawling is prohibited from August 1 through August 31 and after September 1, upon attainment of a bycatch limit of 42,000 other salmon taken within the CVOA, 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°00'W.;
56°00'N., 165°00'W.;
55°30'N., 165°00'W.;
55°00'N., 164°00'W.;
55°00'N., 164°00'W.;
55°00'N., 167°00'W.;
56°00'N., 167°00'W.

Table 31 - Chinook Salmon Savings Area



Chinook Salmon Savings Area

Rationale for Closure: To reduce excesive bycatch of chinook salmon in groundfish trawl fisheries.

Origin: Adopted as Amendment 21b by the Council on April 24, 1995.

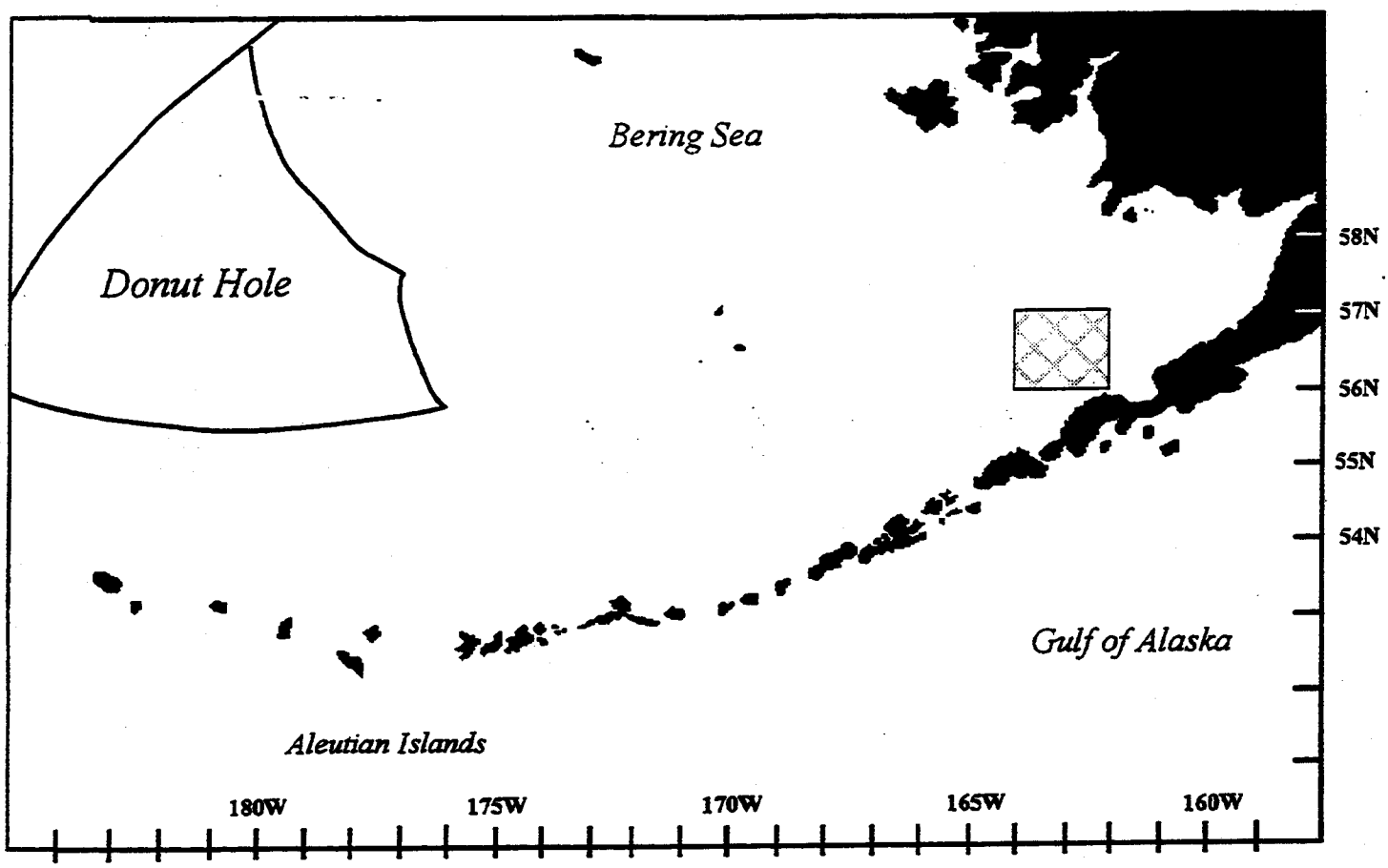
Description of Area: All trawling is prohibited in the Chinook Salmon Savings Area upon attainment of a bycatch limit of 48,000 chinook salmon taken in the BSAI. A closure would remain in effect through April 15, then reopen for the remainder of the year. The nine blocks consist of 3 district areas with the following coordinates:

Area 1: 56°30' N., 171° W.; 56°30' N., 169° W.; 56° N., 169° W.; 56° N., 171° W.; 56°30' N., 171° W.

Area 2: 54° N., 171° W.; 54° N., 170° W.; 53° N., 170° W.; 53° N., 171° W.; 54° N., 171° W.

Area 3: 56° N., 165° W.; 56° N., 164° W.; 55° N., 164° W.; 55° N., 165° W.; 54°30' N., 165° W.; 54°30' N., 167° W.; 55° N., 167° W.; 55° N., 166° W.; 55°30' N., 166° W.; 55°30' N., 165° W.; 56° N., 165° W.

Table 32 - Red King Crab Savings Area



Bristol Bay Red King Crab Savings Area

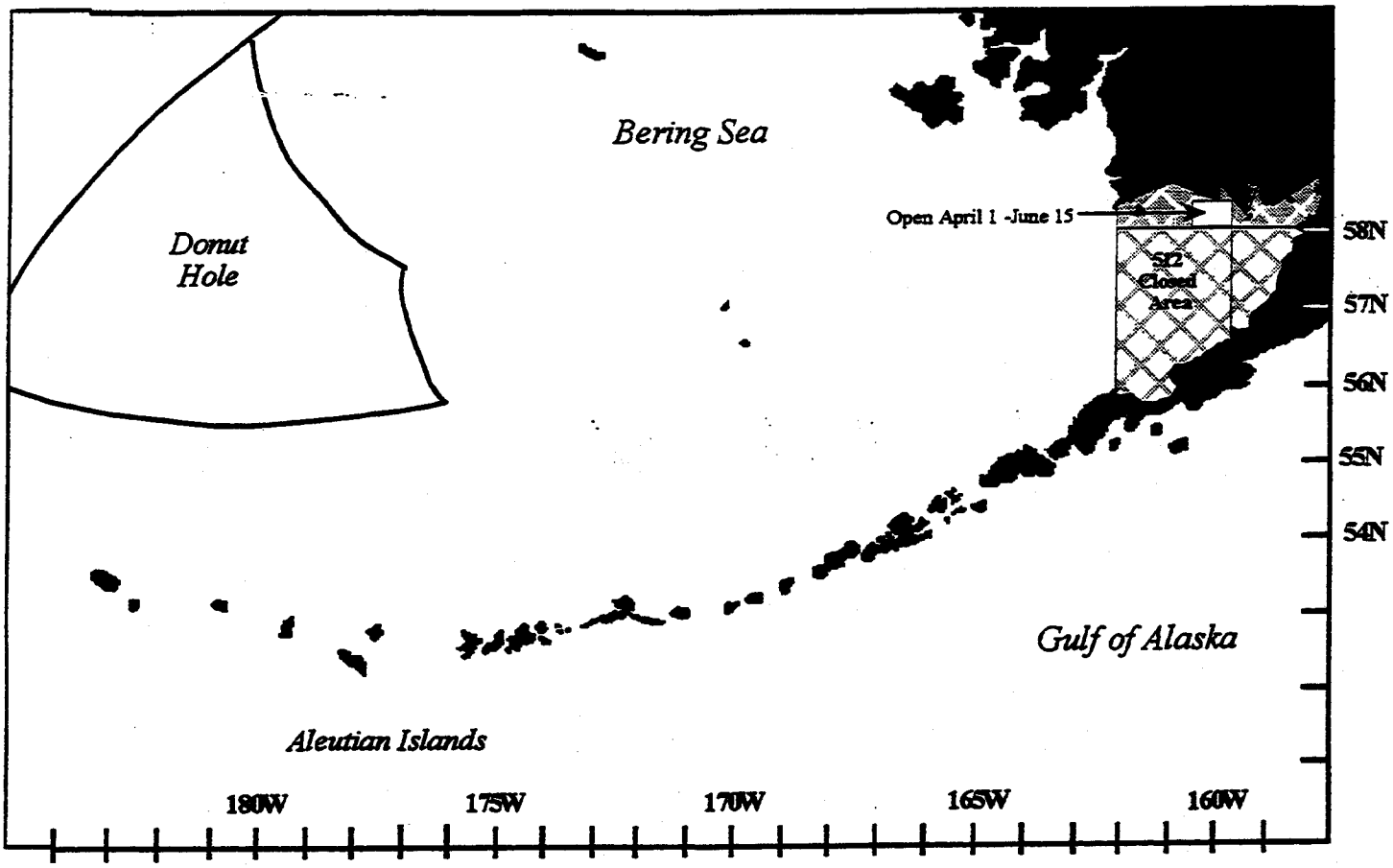
Rationale for Closure: Closed to protect red king crab population and habitat.

Origin: Implemented as an emergency rule January 20, 1995. Adopted as part of Amendment 37 in June 1996.

Description of Area: Non-pelagic 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:

56°00', 162°00'
56°00', 164°00'
57°00', 164°00'
57°00', 162°00'
56°00', 162°00'

Table 33 - Nearshore Bristol Bay Trawl Closure



Nearshore Bristol Bay Closure Area

Rationale for Closure: Closure established to protect juvenile red king crab habitat.

Origin: Council adopted as part of Amendment 37 in June 1996.

Description of Area: Prohibits all trawling at all times in the EEZ within the area east of 162°W longitude with the exception of an area bounded by 159° to 160°W and 58° to 58°43'N that would remain open April 1 - June 15.

13.4.3.3 Longline Fishery -- no closures

13.4.3.4 Implementation of Time and Area Limitations (Reserved)

When a DAP or JVP target fishery specified in regulations attains a PSC limit apportionment or seasonal allocation specified in regulations, the bycatch zone(s) or management area(s) to which the PSC limit apportionment or seasonal allocation applies will be closed to that target fishery (or components thereof) for the remainder of the year or season, whichever is applicable.

13.4.4 Gear Restrictions

Gear types authorized by the FMP are trawls, hook-and-line, pots, jigs, and other gear as defined in regulations. Further restrictions on gear that 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 675.

13.4.5 Reporting Requirements

A. Domestic

The Council and NOAA Fisheries 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 NOAA Fisheries 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 Act, Executive Order 12291, 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 NOAA Fisheries 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 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 would be required of operators of catcher vessels, catcher/processor vessels, mothership processor vessels, and by responsible officers of shoreside processor plants. Such requirements will be contained in regulations implementing this FMP.

Information on processing expectations. In consultation with the Council, the Secretary may require U.S. processors and persons delivering U.S.-caught fish to foreign processing vessels to submit information to the Regional Director that is necessary and appropriate to reassess the adequacy of DAP and JVP specifications. Such information may be collected by means of written or telephone surveys. Such requirements will be contained in regulations implementing this FMP.

Information on catching and/or processing activity. The Secretary may require catcher/processor vessels and mothership processor vessels to submit check-in and check-out reports for any Federal statistical area and the Territorial Sea adjacent to the Federal Statistical area. Such requirements will be contained in regulations implementing this FMP.

B. Processor Reports

All processors of groundfish shall report information necessary for the periodic reassessment of DAP. The regulation implementing this plan specify the information to be reported and the time schedule for reporting.

C. Joint Venture Reports

Persons delivering U.S. caught groundfish to foreign processing vessels shall report information required for periodic reassessment of that portion of the DAH to be delivered to foreign processors (JVP). The regulations implementing this plan specify the information to be reported and the time schedule for reporting.

D. At-Sea Processor Vessels

1. Reporting requirements. 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 Director, Alaska Region, 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 total allowable catch (TAC) is established within a time period prescribed by regulation. This report may be by radio through the U.S. Coast Guard to the Director, National Marine Fisheries Service. The NPFMC intends that this requirement will enhance the National Marine Fisheries Service's ability 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 Director within one week of the end of the reporting period through such means as the Regional Director 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 Bering Sea and Aleutian Islands 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.
(h) The product weight, rounded to the nearest one-tenth of a metric ton (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 must record, for each transfer or off-loading of any fishery product in the EEZ, and also quantities transferred or off-loaded outside the EEZ, within any states' territorial waters, or within the internal waters of any state, the following information within a time specified by regulations:

(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 vessel off-loading to or, if to a shoreside facility, the name of the commercial facility receiving the product.
(d) The intended port of destination of the receiving vessel if off-loaded to another vessel.

13.4.6 Domestic Observer Program

The Council and NOAA Fisheries 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 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.

13.4.7 Effort Limitation Programs

13.4.7.1 MANAGEMENT OF FIXED GEAR SABLEFISH FISHERIES

Beginning with the 1995 fishing season, the directed fixed gear sablefish fisheries will be managed under an Individual Fishing Quota (IFQ) program. This form of limited entry will replace the current open access fisheries for sablefish in the Bering Sea/Aleutian Islands and is described in this section.

13.4.7.1.1 DEFINITIONS

For purposes of Section 13.4.7.1, 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) which 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 QS in each management area. The QS 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 QS into the QS 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 which 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), that is 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 QS will be considered a bona fide crew member.

13.4.7.1.2 MANAGEMENT AREAS

Quota shares and IFQs shall be made available for each of the management areas identified in this FMP. These management areas are the Bering Sea and the Aleutian Islands management areas.

13.4.7.1.3 INITIAL ALLOCATION OF QUOTA SHARES

(A) INITIAL RECIPIENTS

(1) Initial assignments of Quota Shares shall be made to:

(i) a qualified person who is a vessel owner who meets the requirements in this section; or

(ii) 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 will be 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 shall be assigned initially for each management area to qualified persons based on recorded landings, as documented through fish tickets or other documentation for fixed gear landings. Historical catch of sablefish will be counted from 1985 through 1990. This historical period shall be known as the quota share base period. For each management area, 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 QS in any area shall be added together to form the "Quota Share Pool" for that area.

(B) VESSEL CATEGORIES Quota shares and IFQs shall be assigned by vessel category as follows:

(1) Freezer Longliner Shares:

(i) 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 Boat Shares:

(i) All landings made during the QS 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 boat quota shares.

(ii) There shall be two categories of catcher boat shares for the sablefish QS/IFQ fishery;

(a) vessels less than or equal to 60 feet in length overall, and

(b) vessels greater than 60 feet in length overall.

(iii) For initial allocation of catcher boat Quota Shares:

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

(b) if a QS recipient bought or sold vessels in succession during the qualifying period, and to the extent the QS recipient operations were in one vessel category during one year and the next vessel owned was in another vessel category, the QS will be combined and applied to the latest vessel category of ownership as of September 25, 1991.

(3) CDQ Compensation QS:

(I) All CDQ compensation QS initially issued to a person in and IFQ regulatory area in which that person does not hold QS is designated as uncategorized catcher vessel QS, except if the CDQ compensation QS initially issued to a person in an IFQ regulatory area in which that person does not hold QS is issued as compensation for QS foregone in the freezer vessel category, in which case it is designated as freezer vessel QS. The IFQ resulting from uncategorized catcher vessel QS can be fished on a vessel of any length. CDQ compensation QS will remain uncategorized until it is transferred; upon transfer the CDQ compensation QS must be designated in a specific catcher vessel category.

(C) Quota Share Blocks:

(1) All initial allocations of sablefish QS and all CDQ compensation QS initially issued to a person in an IFQ regulatory area in less than 20,000 pounds of IFQ based on the 1994 TAC for the fixed gear sablefish fishery in that area will be issued as a QS block.

(2) All initial allocations of sablefish QS that would result in at least 20,000 pound of IFQ based on the 1994 TAC for the fixed gear sablefish fishery in that area, and all CDQ compensation QS initially issued to a persons in an IFQ regulatory area in which that person does not hold QS, will be issues as unblocked QS.

13.4.7.1.4 <u>TRANSFER PROVISIONS</u>

(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 boat quota shares may sell those quota shares to any person meeting the provisions outlined in this section. Ten percent of an person's catcher boat quota shares may be leased during the first three years following implementation.

(3) In order to purchase or lease QS, the purchaser must be an individual who is a U.S. citizen and a bona fide fixed gear crew member. Additionally, persons which received an initial allocation of catcher boat QS may purchase catcher boat QS 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 boat and the freezer boat categories. Quota shares, or IFQs arising from those quota shares, initially issued to Category B vessels may be used on Category C vessels, except in the Southeast management area where only blocked Category B QS equivalent to less than 5,000 lb IFQ (based on 1996 quotas) 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 allows the transfer of catcher boat QS/IFQs for limited periods of time.

(6) Quota share (QS) designated as a "block" may only be traded in its entirely and may not be divided into smaller QS units. Blocks of QS representing IFQs of less than 5,000 pounds 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 pounds.

13.4.7.1.5 USE AND OWNERSHIP PROVISIONS

(1) Fish caught with freezer longliner IFQs may be delivered frozen or unfrozen.

(2) Fish caught with catcher boat 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 QS, 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 below, who receive initial catcher vessel QS may utilize a hired skipper to fish their quota providing the person owns the vessel upon which the QS will be used. These initial recipients may purchase up to the total share allowed for the area. There shall be no leasing of such catcher vessel QS other than provided for in Section 13.4.8.4 (1) above.

This provision will cease upon the sale or transfer of QS or upon any change in the identity of the corporation or partnership 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 members. 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 changes, 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 changes, nor is a partnership deemed to have changed if a partner leaves the partnership.

c) **Individual**: any individual as defined in Section 13.4.7.1.1.

(6) For sablefish each qualified person or individual may own, hold, or otherwise control, individually or collectively, but may not exceed, 1% of the combined QS for the Gulf of Alaska and Bering Sea/Aleutian Islands.

(7) Any person who receives an initial assignment of quota shares in excess of the limits set forth in (6) above 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% of the combined Gulf of Alaska and Bering Sea/Aleutian Island 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 IPHC.

(10) QS Block Provisions

(i) A person may own and use up to two Blocks in each management area.

(ii) Persons owning two Blocks in a given management area may not use normal QS in that area.

(iii) Persons who own less than two Blocks in an area may own and use normal QS up to the limits specified under this program, noting that the limit applies to both normal QS and QS embedded in Blocks.

13.4.7.1.6 ANNUAL ALLOCATION OF QS/IFQ

Individual fishing quotas are determined for each calendar year for each person by applying the ratio of a person's QS to the QS pool for an area to the annual fixed gear Total Allowable Catch for each management area, after adjusting for the Community Development Quota (CDQ) program. In mathematical terms, IFQs = (QS / QS pool) x fixed gear TAC.

13.4.7.1.7 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) QS owners wishing to transport their catch outside of the jurisdiction of the Council must first check in their catch at a NMFS specified site and have the load sealed.

(d) 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) QS 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 Community Development Quota (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 IPHC on an annual basis.

(7) Those persons that would otherwise have received a full complement of sablefish QS in the Bering Sea and Aleutian Islands 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 QS in each non-CDQ area to each disadvantaged person.

13.4.7.2 Moratorium on Vessels Entering the Fisheries *superceded by Amendment 39, implemented on October 1, 1998 but not implemented in regulations*

Beginning on January 1, 1996, a moratorium on new harvesting vessels (including harvester/processors) entering the BSAI groundfish fisheries, other than fixed gear sablefish, is in effect. Vessels fishing in State waters will be exempt. The vessel moratorium will last until the Council replaces or rescinds the action, but in any case will end on December 31, 1999. The Council may however extend the moratorium up to 2 additional years, if a permanent limited access program is imminent.

13.4.7.2.1 Elements of the Moratorium

1. Qualifying Period. In order to qualify, a harvesting vessel must have made a reported landing in one of the designated moratorium fisheries during the period beginning January 1, 1988, and ending February 9, 1992, including landings of moratorium species from State waters. Moratorium species are those managed under Council FMPs and include groundfish (other than fixed gear sablefish) in the BSAI and GOA and BSAI king and Tanner crab. A moratorium qualification for which a vessel moratorium permit has not been issued prior to December 31, 1998, or for which a vessel moratorium permit is not applied for applied for on or before December 31, 1998, will not be eligible for a vessel moratorium permit after that date.

2. Eligible Fisheries. If a vessel qualifies based on Item 1 above, the following provisions apply:

   a. A vessel that made a qualifying landing in the BSAI or GOA groundfish fisheries would be eligible to participate in the BSAI groundfish fisheries under the moratorium.

   b. A vessel that made a qualifying landing in the BSAI crab fisheries would be eligible to participate in the BSAI crab fisheries **AND** the BSAI groundfish fisheries under the moratorium providing:
      (1) it uses only the same fishing gear in the groundfish fisheries that it used in the BSAI crab fisheries to qualify for the moratorium, and
      (2) it does not use any fishing gear prohibited in the BSAI or GOA groundfish fisheries.

   c. A vessel that made a qualifying landing in the BSAI crab fisheries, and during the period February 9, 1992, through December 11, 1994, made a landing in the BSAI or GOA groundfish fisheries would be eligible to continue to participate in the BSAI groundfish fisheries under the moratorium using the gear with which the groundfish landing was made.

3. Length Increases During the Moratorium: The 20% Rule. Moratorium qualified vessels will be limited to a 20% increase in length overall (LOA) as long as the increase does not result in a vessel greater than 125 ft LOA. The 20% increase will be based on the LOA of the original qualified vessel, even in cases of multiple transfers/replacements. Vessels over 125 ft LOA may not be lengthened under any circumstance.

4. Reconstruction of Vessels During the Moratorium. An eligible vessel that is reconstructed during the moratorium retains its privilege to participate in all fisheries under the Council's jurisdiction subject to the following provisions: (1) If reconstruction is completed prior to June 24, 1992, the new size is unrestricted and length increases subject to the 20% Rule discussed above are allowed between June 24, 1992 and the end of the moratorium. (2) If reconstruction began prior to June 24, 1992 but was not completed until after that date, the new size would be unrestricted but no more length increases would be allowed. (3) If reconstruction commences on or after June 24, 1992, increases in length may not exceed the 20% Rule. (4) Other types of vessel reconstructions or upgrades may occur as long as they do not result in the lengthening of a vessel.

5. Replacement of Vessels During the Moratorium. During the moratorium, qualifying vessels can be replaced with non-qualifying vessels so long as the replaced vessel leaves the fishery. Though multiple or sequential replacements are allowed, vessel length can only be increased subject to the 20% Rule. In the case of existing qualified vessels over 125 ft LOA, the replacement vessel cannot exceed the length of the original vessel. In the event of a combined replacement/reconstruction, increases in LOA may not exceed the 20% Rule.

6. Replacement of Vessels Lost or Destroyed On or After January 1, 1989 But Before January 1, 1996. Vessels lost or destroyed on or after January 1, 1989 may be replaced provided the following conditions are met. (1) The LOA of the replacement vessel does not exceed the 20% rule. (2) The replacement vessel must make a landing in a moratorium fishery prior to January 1, 1998 to remain a qualified vessel. The replaced vessel would no longer be a moratorium qualified vessel.

7. Replacement of Vessels Lost or Destroyed After January 1, 1996. Vessels lost or destroyed after January 1, 1996 may be replaced subject to the 20% Rule and the replaced vessel would no longer be a moratorium qualified vessel.

8. Salvage of Vessels Lost or Destroyed On or After January 1, 1989. A moratorium qualified vessel lost or destroyed between January 1, 1989 and the end of the moratorium may be salvaged and will be considered a moratorium qualified vessel, as long as it has not already been replaced, as per item 5 above.

9. Salvage of Vessels Lost or Destroyed Before January 1, 1989. A moratorium qualified vessel lost or destroyed before January 1, 1989 may not be replaced. The lost or destroyed vessel may be salvaged and become moratorium qualified if it meets the following two conditions: (1) Salvage operations must have been ongoing as of June 24, 1992. (2) The salvaged vessel must make a landing in a moratorium fishery prior to January 1, 1998.

10. Small Vessel Exemptions. Vessels 32 ft or less LOA would be exempted from the moratorium in the Bering Sea and Aleutian Islands.

11. Disadvantaged Communities. New vessels constructed after implementation of Community Development Quota (CDQ) programs, pursuant to an approved CDQ project, will be exempt from the moratorium. In order to qualify for such exemption the vessel must: (1) be constructed solely for the purpose of furthering the goals of a community CDQ project, and (2) be a specialized vessel designed and equipped to meet the needs of a community or group of communities that have specific and unique operating requirements. Such exemptions would be limited to vessels 125 ft LOA and under. These vessels may fish in both CDQ and non-CDQ fisheries. Vessels built pursuant to a CDQ project under this exemption that are transferred to a non-CDQ entity during the life of the moratorium may not be considered eligible under the moratorium.

12. Halibut and Sablefish Fixed Gear Vessels. Halibut and sablefish fixed gear vessels operating under the provisions of the proposed IFQ Amendment will be exempted from the vessel moratorium as it affects directed halibut and sablefish operations. Such an exemption becomes effective at the time of implementation of the IFQ program. Non-qualifying vessels entering the halibut and sablefish fisheries under this exemption may not participate in any other directed fisheries under the Council's authority. If the total retained catch of species other than halibut and sablefish exceeds 20% of the total weight of all species of fish on board, then the vessel must be a moratorium-qualified vessel.

13. Transfer of Moratorium Rights. It shall be assumed that any transfer of vessel ownership includes a transfer of moratorium fishing rights. Moratorium rights may however be transferred without a transfer of ownership of the original qualifying vessel or any subsequently qualified vessel. The recipient of such transfers of rights will bear the burden of proof for moratorium qualification. Transfers of moratorium rights may not be used to circumvent the 20% Rule. Moratorium permits may be transferred only in their entirety; i.e., species or gear endorsements may not be separated and transferred independently.

13.4.7.2 Groundfish License Limitation Program *superceded 13.4.7.2* Moratorium on Vessels Entering the Fisheries *but not yet implemented in regulations.*

Beginning on (*pending*) a Federal groundfish license will be required for harvesting vessels (including harvester/processors) participating in all BSAI groundfish fisheries, other than fixed gear sablefish. However, the following vessel categories are exempt from the license program requirements:

1. Vessels fishing in State of Alaska waters (0-3 miles offshore);

2. Vessels less than 32' LOA;

3. Jig gear vessels less than 60' 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 license programs qualification requirements will be issued a license, regardless of whether they are exempt from the program or not. The vessel license program will last until the Council replaces or rescinds the action.

13.4.7.2.1 Elements of the License Limitation Program

1. Nature of Licenses. General licenses will be issued for the entire Bering Sea / Aleutian Island area based on historical landings defined in Federal regulations. Vessels that qualify for both a Bering Sea / Aleutian Island and a Gulf of Alaska general license will be issued both as a non-severable package. Area endorsements will be issued along with the general license for the Bering Sea and/or Aleutian Islands. 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 (<60', ≥60' but < 125', or ≥ 125' LOA).

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% 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.

6. Separability of General Licenses and Endorsements. General licenses may be issued for the Bering Sea /Aleutian Islands groundfish, Gulf of Alaska groundfish, and Bering Sea /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/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% rule". This rule was originally defined for the vessel moratorium program. The maximum length over all (MLOA) 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 § 676.4(d). The MLOA of a vessel with license qualification will be determined by the Regional Director as follows:

   (a) For a vessel with license qualification that is less than 125' LOA, the maximum LOA will be equal to 1.2 times the vessel's original qualifying length or 125', which ever is less; and
   (b) For a vessel with license qualification that is equal to or greater that 125', the maximum LOA will be equal to the vessel's original qualifying length.

   If a vessel upgrades under the "20% 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) which 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 which 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 < 125' 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. 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 which 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.

13.4.7.3 COMMUNITY DEVELOPMENT QUOTAS

(A) PURPOSE AND SCOPE. The Western Alaska Community Development Quota Program is established to provide fishermen who reside in western Alaska communities a fair and reasonable opportunity to participate in the Bering Sea/Aleutian Islands groundfish fisheries, to expand their participation in salmon, herring, and other nearshore fisheries, and to help alleviate the growing social 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 Western Alaska Community Development Quota 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 Bering Sea/Aleutian Islands fisheries which have been foreclosed to them because of the high capital investment needed to enter the fishery.

The NMFS Regional Director shall hold the designated percent of the annual total allowable catch (TAC) of groundfish for each management area in the Bering Sea and Aleutian Islands 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 its wise and appropriate use.

The Western Alaska Community Quota program will be 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 the 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 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.

13.4.7.3.2 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 western Alaska community quota program (hereinafter "the 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, that 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 Bering Sea/Aleutian Islands 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 North Pacific Fishery Management Council.

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

13.4.7.3.3 Fixed Gear Sablefish CDQ Allocation

The NMFS Regional Director shall hold 20 percent of the annual fixed-gear Total Allowable Catch of sablefish for each management area in the Bering Sea/Aleutian Islands Area for the western Alaska sablefish community quota. The portions of sablefish TACs for each management area not designated to CDQ fisheries will be allocated as QS and IFQs and shall be used pursuant to the program outlined in Section 13.4.7.1.

13.4.7.3.4 Pollock CDQ Allocation

For a Western Alaska Community Quota, 50% of the BSAI pollock reserve as prescribed in the FMP will be held annually. This held reserve 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 released reserve.

13.4.7.3.5 Multispecies Groundfish and Prohibited Species CDQ Allocations

CDQs will be issued for 7.5% of the TAC for all BSAI groundfish species not already covered by another CDQ program (pollock and longline sablefish). A pro-rata share of PSC species will also be issued. PSC will be allocated before the trawl/non-trawl splits. The program will be patterned after the pollock CDQ program, but will not contain a sunset provision.

13.4.8 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 Director and/or the Council during the course of a fishing year that warrants inseason adjustments in 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. Such 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 Director to protect the resource from biological harm by instituting gear modifications or adjustments through closures or restrictions. Other changes warrant action by the Regional Director to provide greater fishing opportunities for the industry by instituting time/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 Aleutian Islands management areas to reduce prohibited species bycatch rates and the probability of premature attainment of prohibited species catch (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 Director may have difficultly in 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 in the Bering Sea and Aleutian Islands area groundfish fisheries. 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 current 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. Likewise, current information relating to prohibited species, i.e., those species that must be returned to the sea, might become available that indicates their abundance has decreased. Conservation measures limited to establishing prohibited species catch (PSC) 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 demonstrate a harvest level to have been set too low, closing a fishery at the annually specified harvest level would result in underharvesting 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 was more abundant than was anticipated when (PSC) 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 which 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 delegation to the Regional Director, NMFS, to make inseason adjustments to conserve fishery resources on the basis of all relevant information. Using all available information, he may extend, open or close fisheries in any or part of a regulatory area, or restrict the use of any type of fishing gear as a means of conserving the resource. He 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.

(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 which on the basis of currently available information is found by the Secretary to be incorrectly specified.

The Regional Director 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 13.4.2 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 OY.

The types of information which the Regional Director will consider in determining whether conditions exist that require an inseason adjustment or action are described, as follows, although he 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 which are designated as a prohibited species or for which a PSC limit has been specified.

The Regional Director is constrained, however, in his 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 Director 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 which would still allow fisheries to continue for other species; (2) a time/area closure which 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 which 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 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 Director 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/area adjustments made by the Regional Director 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 Act. Any adjustments will be made by the Regional Director 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 Act.

13.4.9 Gear allocations

The following gear allocations are specified by this plan:

13.4.9.1 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 Island 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.

13.4.9.2 Pacific Cod

13.4.9.2.1 Gear allocations. The Bering Sea and Aleutian Islands area Pacific cod TAC shall be allocated among gear groups as follows: 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% to catcher vessels and 50% to catcher processors.

13.4.9.2.2 Seasonal apportionments. The amount of Pacific cod allocated to gear groups under section 13.4.9.2.1 may be seasonally apportioned. Criteria for seasonal apportionments and the seasons authorized to receive separate apportionments will be set forth in regulations.

13.4.9.3 Pollock

The Regional Director, 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 Director's determination, the Council will recommend to him a limit on the amount of pollock that may be taken with other than pelagic trawl gear. The Regional Director shall make the Council's recommendations available to the public for comment under the annual TAC specification process set forth under section 11.3.

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 13.4.2;

(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.

13.4.9.4 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 years' catch 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.

13.4.9.5 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.

13.4.10 Utilization and seasonal allowances of the pollock TAC

Roe-stripping of pollock is prohibited, and the Regional Director 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.

The pollock TAC shall be divided into two allowances: roe-bearing and non roe-bearing. 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.

13.4.11 Inshore/offshore allocations of Pollock *Allocations and duration have been superceded by the American Fisheries Act. Amendment 62 will revise the FMP according to the Act, pending Secretarial approval.*

In addition to the provisions of Section 13.4.10, the allowed harvest of Bering Sea and Aleutians pollock in non-CDQ fisheries is allocated between the inshore and offshore components of industry in specific shares in order to lessen or resolve resource use conflicts and preemption of one segment of the groundfish industry by another, to promote stability between and within industry sectors and affected communities, and to enhance conservation and management of groundfish and other fish resources.

13.4.11.1 Definitions

Inshore is defined to consist of three components of the industry:

1) All shoreside processors as defined in federal regulations.
2) All catcher/processors which meet length requirements defined in federal regulations and which have declared themselves to be "Inshore."
3) All motherships or floating processors which have declared themselves to be "Inshore."

Offshore is defined to consist of two components the of industry:

1) All catcher/processors not included in the inshore processing category, or which have declared themselves to be "Offshore."
2) All motherships and floating processing vessels not included in the inshore processing category, or which have declared themselves to be "Offshore."

The Secretary is authorized to suspend the definitions of inshore and offshore as prescribed by federal regulations implementing this FMP to allow for full implementation of section 13.4.11.5.

13.4.11.2 Declarations and operating restrictions

Annually before operations commence, each mothership, floating processing vessel mid catcher/processor vessel must declare on its Federal Permit application whether it will operate in the inshore or offshore component of industry. This declaration must be the same for both the BSAI and the GOA if applications for both are made. All shoreside processors will be in the inshore component. Once declared, a vessel cannot switch to the other component, mid will be subject to restrictions on processing amounts or locations for pollock for the rest of the fishing year. Harvesting vessels can choose to deliver their catch to either or both components.

Catcher Processors which have declared themselves to be inshore have the following restrictions:

1) The vessel must be less than 125' LOA.
2) The vessel may not catch or process more than 126 mt (round weight) of pollock or GOA Pacific cod in combination in a given week of operations.

Motherships and floating processors which have declared themselves to be inshore have the following restriction:

Processing from a directed pollock fishery or a directed GOA Pacific cod fishery must occur in a single location within the waters of the State of Alaska.

13.4.11.3 Allocations

The allowed harvest of BSAI pollock in non-CDQ fisheries shall be allocated: Thirty five percent (35%) of the pollock in each subarea for each season will be allocated to the inshore component, beginning in 1996 and continuing through 1998. By the same action, the offshore fleet will be allocated 65% of the pollock resource beginning in 1996 and continuing through 1998 in each subarea and in each season. The percentage allocations are made by subarea and period as provided in federal regulations implementing this FMP. All pollock caught as bycatch in other fisheries will be attributed to the sector which processes the remainder of the catch.

13.4.11.4 Reapportionment of unused allocations

If during the course of the fishing year it becomes apparent that a component will not process the entire amount of the allocation, the amount which will not be processed shall be released to the other component for that year. This shall have no impact upon the allocation formula.

13.4.11.5 Bering Sea Catcher Vessel Operational Area

A catcher vessel operational area shall be defined as the area of the BSAI east of 167 degrees 30 minutes West longitude, west of 163 degrees West longitude, south of 56 degrees North latitude, and north of the Aleutian Islands. The CVOA shall be in effect during the B season from September 1 until the date that NMFS closes

the inshore component B season allocation to directed fishing. Vessels in the offshore are prohibited from conducting directed fishing for pollock in the CVOA unless they are participating in a CDQ fishery.

13.4.11.6 Duration

Inshore-offshore allocations of pollock and the CVOA shall cease to be a part of this FMP either (1) at midnight on December 31, 1998; or (2) earlier if replaced with another management regime approved by the Secretary.

13.4.12 Experimental fishing permits

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

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

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

(i) 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.; or
(ii) Issuance of the experimental fishing permit would inequitably allocate fishing privileges among domestic fishermen or would have economic allocation as its sole purpose; or
(iii) Activities to be conducted under the experimental fishing permit would be inconsistent with the intent of the management objectives of the FMP; or
(iv) The applicant has failed to demonstrate a valid justification for the permit; or
(vi) The activity proposed under the experimental fishing permit could create a significant enforcement problem; or
(vii) The applicant failed to make available to the public information that had been obtained under a previously issued experimental fishing permit.

13.5 Management Measures -- Foreign Fisheries

13.5.1 Permit Requirements

All foreign vessels operating in this management unit shall have on board a permit issued by the Secretary of Commerce pursuant to the Magnuson Act.

13.5.2 Prohibited Species

A. General

Pacific halibut, Pacific herring, salmonids, king crab, and Tanner crab are prohibited species and must be treated as described in Section 13.2.B.1. Records of catches of these species must be kept. Any groundfish species not allocated to foreign fishermen must be treated as described in Section 13.2.B.1. Records of catches of these species must be kept. Catches of "nonspecified" species as described in Section 13.2.B.4 and Annex V must be treated as prohibited species, except that catch records are not required.

1. Purpose. The purpose of this section is to reduce the amount of prohibited species taken incidentally in the extensive foreign groundfish fisheries operating in the management area.

2. Objectives. The objective of this section is to effect incremental reductions in the catch of prohibited species by the foreign groundfish fisheries consistent with the need to provide opportunities to catch the TALFF of groundfish and consistent with the considerations in part "E" of this section.

3. Guideline. The procedures chosen for controlling the incidental catch of prohibited species should provide incentives and opportunities for fishermen to modify their gear, fishing techniques, or whatever is appropriate to reduce the incidental catch of prohibited species so that long-term solutions will result from their actions.

4. Restricted Gear. The management regime prescribed in this section applies to all foreign trawl fisheries in the FMP management area. The foreign longline fisheries are exempted from the management measures prescribed for salmon, Pacific halibut, king crab, and Tanner crab in this section. The foreign longline fishery will be monitored closely for its impact on these species.

   The Secretary, after consultation with the Council, shall include foreign longliners in regulations promulgated under this section if they are determined to have a detrimental impact on prohibited species.

B. C. Bairdi Tanner Crab PSC Limits

A limit of 64,000 C. bairdi Tanner crabs applicable to the foreign directed fisheries for yellowfin sole and other flatfish is established in the combined areas of Zones 1 and 2 as described in Appendix III.

C. Target Reduction Schedule of Prohibited Species Catch Rates for Pacific Halibut, King Crab, and Tanner Crab

This part establishes target prohibited species catch rates for Pacific halibut, king crab, and Tanner crab, and provides that elements of the foreign groundfish fishery may be closed if the resulting prohibited species catches (PSCs) are exceeded. Prohibited species catch rates will be gradually reduced over a fixed period, with the intent to reduce total PSCs.

PSCs will be determined each year based on target catch rates and the amount of TALFF available each year. They may be further adjusted according to the considerations listed in part "E" of this section.

Target catch rates have been established by following three steps:

(1) determination of base PSC rates for measurement;
(2) determination of target rate and period of reduction; and
(3) determination of the annual percentage rate of reduction.

1. Base PSC rates for measurement. The average incidental catch of prohibited species and the average trawl groundfish catch by foreign nations during 1977-80 were used to calculate the catch rate (prohibited species/total groundfish) as the base level rates for each prohibited species from which PSCs were determined.

2. Target rates and period of reduction. Target rate and period of reduction for each prohibited species vary and were determined as follows:

   Pacific halibut - 50% reduction in 5 years.

   Rationale: This reduction was chosen by the Council rather than a more stringent one because of the difficulty of avoiding halibut in the yellowfin sole fishery.

   King and Tanner Crabs - 25% reduction in 5 years.

   Rationale: This reduction was chosen by the Council to accurately reflect conditions in these fisheries, i.e. (1) the slight biological impact of the incidental catch on the crab populations, and (2) the lesser socioeconomic impact of the incidental catches on the domestic crab fishing industry. As reported in Reeves (1981, Council Document #13) most of the crab taken are golden king crabs (72%-91% of king crab by-catch) and Chionoecetes opilio (59%-76% of Tanner crab by-catches).

3. Annual percentage rate of reduction. A straight line schedule of reduction from the base catch rates was adopted to derive annual target rates (R) for incidental catch of each prohibited species, as shown in Table 25.

   Based on current information, Council Document #13 (1981), the established catch rates in Table 25 will fulfill the objective of Part "A" of this section. However, it is conceivable that changes to the stocks and the fishery could occur, in which case the established catch rates may no longer meet the objective and therefore shall be adjusted as described in part "E" of this section.

Table 25 -- Incidental catch rate reductions for Pacific halibut, king crab and Tanner crab, based on the average 1977-80 foreign trawl groundfish and prohibited species catches.

Year	Halibut[1]/	King Crab[2]/	Tanner Crab[2]/
Base Catch Rates			
1977-80	3,182	16,804	16,003,329
Average	1,301,250	1,301,250	1,301,250
	base R=0.00245	base R=0.70456	base R=12.29843
Rate Reduction Schedule, R			
(1981)	--	--	--
(1982)	R=.00220 90%	R=.66933 95%	R=11.6840 95%
(1983)	R=.00196 80%	R=.63410 90%	R=11.0686 90%
(1984)	R=.00171 70%	R=.59887 85%	R=10.4537 85%
(1985)	R=.00147 60%	R=.56365 80%	R= 9.8387 80%
(1986)	R=.00122 50%	R=.52842 75%	R= 9.2238 75%

1/ Metric tons per metric ton of groundfish.
2/ Number of individuals per metric ton of groundfish.

D. Annual Determination of PSC Levels for Pacific Halibut, King Crab, and Tanner Crab

The incidental catch rate reduction schedules for halibut and crabs are expressed as percentage reductions of the average 1977-80 incidental catch rates (weight or number of prohibited species per metric ton of groundfish caught). Since the amount of TALFF and reserves cannot yet be determined by year (year i), the absolute amount of PSC for halibut and crabs (species j) will be determined each year as follows:

$$PSCij = Rij \times TALFF$$

Using this formula, the PSC for halibut and crabs will increase throughout the year as TALFF is increased through the apportionment of groundfish reserves and surplus DAH to TALFF.

The calculated PSCs will be reviewed annually and may be adjusted by the Regional Director, in consultation with the Council, as provided for in the annual review process of part "E" of this section.

When the Regional Director projects that a nation's groundfish allocation may not be reached due to premature achievement of PSC he will caution the nation to avoid further interception of prohibited species. Once the final PSC for halibut, king crab or Tanner crab is reached, the entire management area shall be closed to trawling by vessels of the affected nation, except to the extent exempted by the Regional Director for selected elements of the fleet to continue fishing as provided for in part "G" of this section.

E. Reducing the PSC of Salmon

The salmon catch reduction schedules in Table 26 are for chinook salmon and for all species of salmon combined. The chinook salmon incidental catch equals 93% of the all salmon incidental catch. The reduction schedule approved by the Council for chinook salmon was negotiated between the principal domestic and foreign user groups, western Alaskan residents and Japanese trawl industry representatives.

Salmon PSCs are indicated for 1981, 1982, 1983, 1984 and 1985. The objective is to achieve a 75% reduction from the 1981 level within five years, i.e., 16,250 chinook salmon and 17,473 for all salmon combined for the 1986 fishing year.

The salmon PSCs will be reviewed annually in accordance with part "E" of this section and a full and complete review of the salmon PSC reduction program shall be conducted in 1983 to determine the PSCs to be established thereafter. The review will consider the status of the chinook salmon resource, the economic and technological possibility of further PSC reductions, the economic and technological reasonableness of the goal for 1986, and other relevant matters.

The PSC reduction schedule for salmon is subject to the following conditions:

Table 26 -- Target reduction schedule of salmon prohibited species catches based on the average 1977-80 foreign trawl salmon incidental catch.

Year	Salmon	
	Chinook	Total Salmon[1]/
Base Numbers		
1977-80	74,400	80,000
Reduced Catch Levels		
(1981)	65,000	69,893
(1982)	55,250	59,409
(1983)	45,500	48,925
(1984)	35,750	38,441
(1985)	26,000	27,957
(1986)	16,250	17,473

1/ Total salmon numbers are calculated on the assumption that 93% of incidentally-caught salmon are chinook.

Note: A full and complete review of the salmon incidental catch reduction program will be conducted in 1983 to determine what the salmon incidental catch limits should be thereafter. This review will consider the status of the salmon resource, the economic and technological possibility of further incidental catch reductions, and other relevant matters. The review would also consider the economic and technological reasonableness of the goal set out above.

1. A rolling PSC limit which fixes the by-catch levels over a period of three successive years, will be in effect. In any year, a nation's incidental salmon catch may exceed the specified limit by up to 10%.

   Provided that the total incidental catch by that nation in any consecutive three-year period does not exceed the sum of the PSC limits for those three years.

   Note: All calculations of the rolling PSC limit shall start with the 1982 fishing season, regardless of when this section is implemented by the Secretary.

2. Once the rolling PSC limit is reached for salmon, Fishing Area II, as well as that part of Fishing Area I lying between 55°N and 57°N latitude and between 165°W and 170°W longitude, as shown in Figure 28, will be closed to trawlers of the affected nation, for so much of the months of January, February, March, October, November, and December which remain in that fishing year.

3. If any more salmon are caught in the areas which remain open, those catches will be deducted from the next year's salmon PSC of the affected nation consistent with the rolling PSC limit.

F. Annual Review and Adjustment of PSCs

Since fisheries resources and socioeconomic conditions of the fishing community are expected to change, the PSC management system will be reviewed annually by the Council and the calculated PSCs and may be adjusted by the Regional Director, as a result of the Council's review. The annual review of calculated PSCs, target rates and period of reduction, and the percentage reduction in target rates from the previous year which are used to calculate PSCs is intended to respond to such changes to the stocks and the fishery as:

- changes in the stock condition and abundance of prohibited species;

- changes in stock condition and abundance of target groundfish species, except that in the annual reviews this will not be applied to salmon. However, it will be included in the three-year review which is referenced in part "D", and the note to Table 26;

- changes in the degree of socioeconomic impact of prohibited species' catches on domestic fisheries dependent on them; and

- changes in the impact on the ability of foreign fisheries to take their groundfish TALFF.

In the annual adjustments of PSCs, the Regional Director, in consultation with the Council, shall consider all of the following, in order of priority:

(1) the need to protect prohibited species for biological and other conservation reasons;
(2) the impact of PSCs on the domestic fisheries dependent on prohibited species;
(3) the impact of the PSC regulations on development and operation of domestic groundfish fisheries; and
(4) the impact of PSCs on the foreign groundfish fisheries.

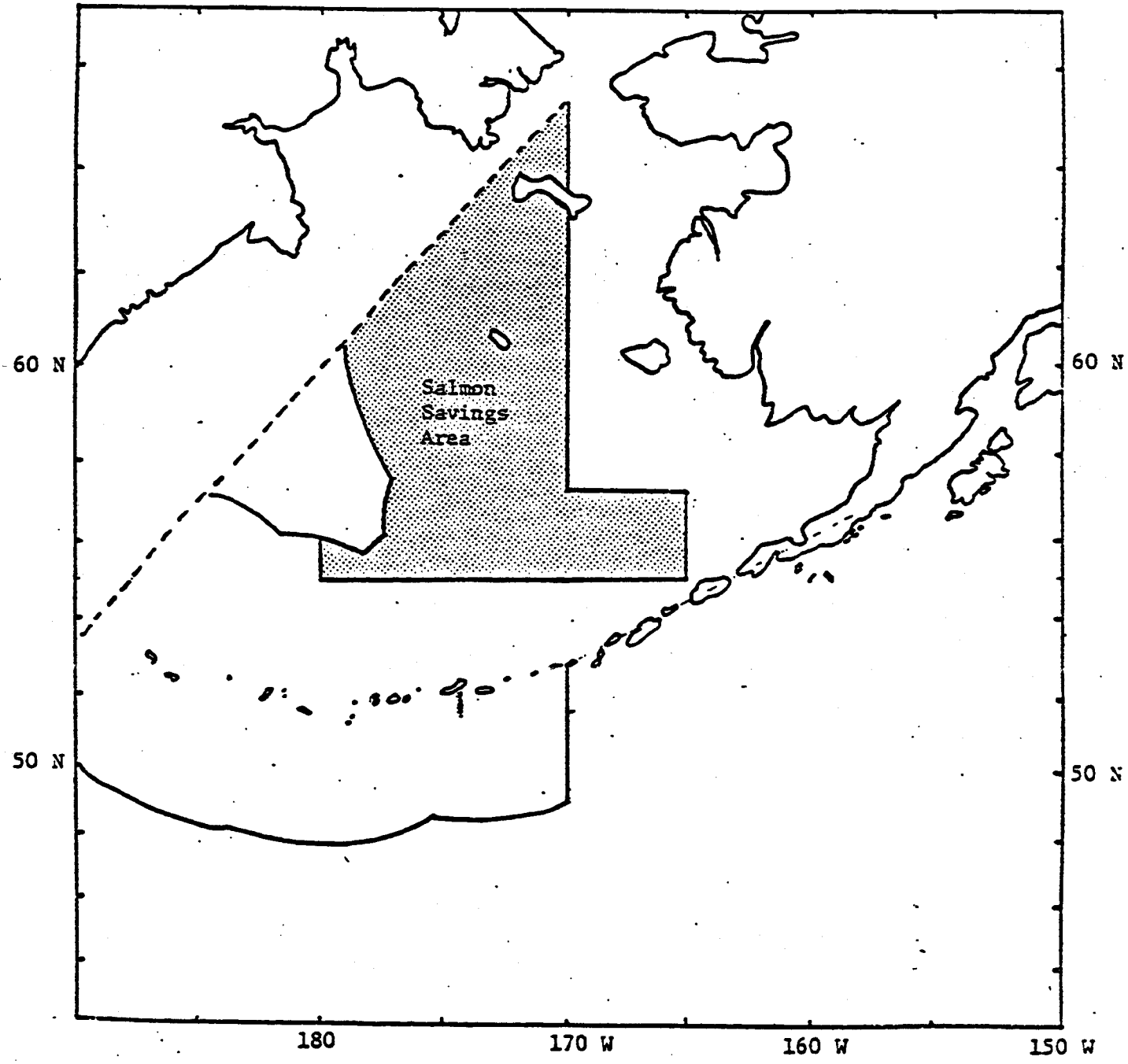


Fig. 28 Salmon Savings Area of the Bering Sea and Aleutian Islands Groundfish FMP (See Appendix III for geographical coordinates.)

Prior to the beginning of each fishing year, the latest technical information bearing on changes to the stocks and the fishery will be provided to the Regional Director and the Council so that decisions for adjusting PSCs can be made by the beginning of the fishing year. When the final PSCs are determined, the Regional Director will notify nations of such adjustments.

G. Distribution of PSCs to Foreign Nations

1. Pacific halibut, king crab and Tanner crab. The PSCs for Pacific halibut, king crab and Tanner crab (species j) in any year (year i) shall be distributed to each nation in direct proportion to a nation's groundfish allocation by the following equation:

Nation's PSCij equals Rij multiplied by Nation's Groundfish Allocation

Since the total PSCij for Pacific halibut, king crab and Tanner crab is based on an incidental catch rate and will increase throughout the fishing year as TALFF is increased, a nation's PSCij may also increase accordingly.

2. Salmon. A nation's share of the salmon PSC at the beginning of a fishing year is in the same proportion to the total salmon PSC as its initial groundfish allocation is to the total groundfish TALFF plus reserves, and is automatically established by the following equation:

Nation's Initial Salmon PSC equals Total Salmon PSC multiplied by the Nation's Initial Groundfish Allocation divided by Total Initial Groundfish TALFF plus Reserves.

At the beginning of the fishing year, a portion of the salmon PSC will not be distributed to nations because groundfish reserves will not yet be apportioned and some of the initial TALFF may not yet be allocated. This remaining portion of the salmon PSC shall be subsequently distributed to nations in proportion to increases in their groundfish allocations which result from the apportionment of the initial unallocated TALFF and groundfish reserves.

H. Exceptions to Prohibited Species Management Regime for Pacific Halibut, King Crab, and Tanner Crab

Although a nation's PSC may have been reached, the Regional Director may notify the nation that selected fishing elements of the nations's trawl fleet will be allowed to continue fishing under specified conditions until the nation's groundfish allocation is reached. The Regional Director will take into account the following considerations when making such allowances: (1) the risk of biological harm to prohibited species stocks and of socioeconomic harm to authorized prohibited species users posed by continued trawling by the selected elements; (2) the extent to which the selected elements have avoided incidental prohibited species catches up to that point in the fishing year; (3) the confidence of the Regional Director in the accuracy of the estimates of prohibited species catches by the selected elements up to that point in the fishing year; (4) whether observer coverage of the selected elements is sufficient to assure adherence to the prescribed conditions, and to alert the Regional Director to increases in the elements' prohibited species catch; and (5) the enforcement record of owners and operators of vessels included in the selected elements, and the confidence of the Regional Director that adherence to prescribed conditions can be assured in light of available enforcement resources. Any additional incidental catches of prohibited species by

vessels which have been allowed to continue fishing will be considered when establishing future PSC limits.

I. Incentives for PSC Reduction

In making supplemental foreign groundfish allocations during a fishing year, the Council recommends that the Secretary of State, in consultation with the Secretary of Commerce, consider the effort of each nation to fulfill the objective of this section. It is inconsistent with the management objective of this section for any nation to conduct its fishing operations without: (1) an earnest attempt to reduce its catch of prohibited species; and (2) remaining within its PSC limitations. Supplemental allocations should serve to reward a nation for its past performance and should serve as an incentive to continue its operating methods that avoid prohibited species. A nation's effort to comply with PSC regulations is therefore a legitimate and important consideration in making foreign allocations.

In order to arrive at long-term solutions for controlling incidental catch of prohibited species, the foreign groundfish fisheries are encouraged to:

(1) conduct NMFS approved gear experiments which are intended to reduce the incidental catch of prohibited species;
(2) collect detailed information on the characteristics of incidental catches; and
(3) transfer the information and gear technology conducive to reduction of the incidental catch of prohibited species to the U.S. for use by government and industry.

As an incentive for gear research, catches of prohibited species during any research aimed at long-term solutions for controlling incidental catches of prohibited species that are approved by the National Marine Fisheries Service will be exempted from the PSC limits for that nation, for that year. Groundfish catches during the research where the catch is retained for commercial purposes will continue to be counted towards a nation's allocations.

J. Estimation of Prohibited Species Catch

Catches of prohibited species will be estimated from data by U.S. observers and other reported statistics that are considered reliable.

13.5.3 Fishing Area Restrictions

A. General

1. No harvesting year-round within 12 miles of the baseline used to measure the territorial sea, except as specified below.

Rationale -- To prevent conflicts with U.S. fixed gear and small inshore fishing vessels and to prevent catch of localized inshore species important to U.S. commercial and subsistence fishermen. If joint venture operations are permitted, foreign ships receiving fish from American fishermen may operate to within three miles of the baseline used to measure the territorial sea. However, when operating within the area between 3 and 12 miles of the baseline used to measure the territorial sea, such foreign processors may not receive fish from foreign vessels.

2. The area covered by this FMP (or an individual sub-area where a specific catch limit applies) will be closed to all fishermen of a nation for the remainder of the calendar year when that nation's allocation of any species or species group is exceeded, except that such closures will affect longline fishing only if the national allocation of any of the following species is exceeded: sablefish; Pacific cod; and Greenland turbot.

   Rationale -- To discourage foreign fleets from covertly targeting on a species after the allowed catch for it has been taken.

B. Trawl Fishery

1. Area A -- No trawling year-round in the Bristol Bay Pot Sanctuary (as described in Appendix III and Figure 27b).

   Rationale -- To prevent conflicts between foreign mobile gear and concentrations of U.S. crab pots; to prevent incidental catch of juvenile halibut which are known to concentrate in this area.

2. Crab and Halibut Protection Zone -- No trawling year-round in the Crab and Halibut Protection Zone (as described in Appendix III and Figure 27).

3. Area B -- No trawling from December 1 to May 31 in the Winter Halibut Savings Area (as described in Appendix III and Figure 27b).

   Rationale -- To protect winter concentrations of juvenile halibut, and to protect spawning concentrations of pollock and flounders.

4. Area C -- No trawling year-round in the Longline Sanctuary Area (as described in Appendix III and Figure 27b).

   Rationale -- To provide a sanctuary for foreign and domestic longline fishing in recognition of the situation in which highly developed trawl fisheries in both the Bering Sea/Aleutians area and the Gulf of Alaska have tended to preempt grounds from the traditional longline fishing method.

   (Prior to 1977, no Danish seiners, side trawlers, or pair trawlers operated in this area, and less than one percent of the foreign stern trawl effort occurred in this area. Because of the displacement of the Japanese land-based dragnet fleet from the Soviet 200-mile zone, that fleet has, since 1977, increased its utilization of the trawl grounds surrounding the Aleutian archipelago. As a result, during the first seven months of 1978, of the total foreign stern trawl effort in the Bering Sea/Aleutians region, about 3% occurred in this longline sanctuary area.)

5. Area D -- No trawling January 1 through June 30 in the area known as Petrel Bank (as described in Appendix III and Figure 27b). Trawling is permitted seaward of three nautical miles at other times of the fishing year.

   Rationale -- To avoid gear conflicts during the conduct of the domestic king crab fishery and to avoid the incidental catch of king crab by trawling. Data available from the fishery in the Petrel Bank area indicate a substantial incidental trawl catch of red, blue and golden

king crab. The crab savings effected by the trawl closure is a direct benefit to the domestic fleet by preserving harvestable crabs from the rigors of a trawl effort during the soft-shell or molting period.

6. Area E -- No trawling within 12 nautical miles of the baseline used to measure the U.S. territorial sea January 1 - April 30 in Area E (as described in Appendix III and Figure 27b) EXCEPT trawling is permitted seaward of three nautical miles from May 1 - December 31.

   Rationale -- To avoid gear conflicts during the conduct of the domestic king crab fishery and the development of the domestic bottomfish effort and to avoid the adverse effects of the incidental catch of king crabs by trawl.

7. Area F -- Trawling permitted seaward of three nautical miles from the baseline used to measure the U.S. territorial sea in Area F (as described in Appendix III and Figure 27b).

C. Longline Fishery

1. Area B -- Winter Halibut Savings Area (as described in Appendix III and Figure 27b).

   (a) December 1 through May 31 -- When the incidental catch of Pacific halibut by all foreign longline vessels in the Bering Sea/Aleutian Islands area reaches 105 mt during the 12-month period from June 1 through May 31, all foreign longline vessels shall be prohibited from fishing landward of the 500 meter isobath for the remainder of the 6-month period December 1 through May 31.
   (b) June 1 through November 30 -- no closures.

   Rationale -- To allow foreign longline fleets to catch their groundfish allocation and still adequately protect juvenile Pacific halibut which concentrate in the area during winter months.

2. Other Areas -- no closures.

3. Throughout the area west of 170°W, longlining is permitted seaward of three nautical miles from the baseline used to measure the U.S. territorial sea.

D. In-Season Adjustments (Reserved)

1. Inseason adjustments issued by the Secretary under this paragraph include:

   (a) The closure, extension, or opening of a season in all or part of a management area.
   (b) Modification of the allowable gear to be used in all part of a management area.
   (c) The adjustment of TACs or PSC limits.

2. Any inseason adjustment under this paragraph must be based on a determination that such adjustments are necessary to prevent:

   (a) The overfishing of any species or stock of fish or shellfish.

(b) The harvest of a TAC for any groundfish species, the taking of a PSC limit for any prohibited species, or the closure of any fishing for groundfish based on a TAC or PSC limit which on the basis of the best available scientific information is found by the Secretary to be incorrectly specified.

3. The selection of the appropriate inseason management adjustments under (1)(a) or (b) of this paragraph must be from the following authorized management measures and be based on a determination by the Regional Director that the management adjustment selected is the least restrictive necessary to achieve the purpose for the adjustment:

(a) Any gear modification that would protect the species in need of conservation protection, but which would allow fisheries to continue.
(b) A time/area closure which would allow fisheries to continue in non-critical areas and time periods.
(c) Closure [or opening] of a management area to all groundfish fishing for the remainder of the fishing year.

4. The adjustment of a TAC or PSC limit for any species under (1)(c) of this paragraph must be based on the best available scientific information concerning the biological stock status of the species in question and on the Regional Director's determination that the currently specified TAC or PSC limit is incorrect. Any adjustment to a TAC or PSC limit must be reasonably related to the change in biological stock status.

13.6 Operational Needs and Costs (1000's dollars)

114 man-months of foreign fishery observer coverage	370
NWAFC allocation compliance analyses	10
NMFS computerized foreign fishery information system	36
NMFS Alaska Regional Office Management Division	435
NOAA/Justice administration of penalties	12
800 Coast Guard ship patrol days	2,800
2500 Coast Guard aerial patrol hours	1,900
State of Alaska fishery data collection	11
Total	5,574

13.7 Management Measures to Address Identified Habitat Problems

An FMP may contain only those conservation and management measures which 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.

- Propose regulations establishing gear, timing, or area restrictions for purposes of protecting particular habitats of species in the Bering Sea/Aleutian Island groundfish fishery.

- Propose regulations establishing area or timing restrictions to prevent the harvest of fish in contaminated areas.

- Propose regulations restricting disposal of fishing gear by domestic vessels.

13.8 Other Measures

13.8.1 Gear Testing

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.

(5) Must not be within a designated Steller sea lion protection area at any time of the year.

13.9 Improved Retention/Improved Utilization (IR/IU) Program.

13.9.1 Minimum retention requirements

All vessels participating in the groundfish fisheries of the BSAI are required to retain all catch of all IR/IU species (pollock and Pacific cod beginning January 1, 1998 and rock sole and yellowfin sole beginning January 1, 2003) when directed fishing for those species are 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 bycatch 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. At-sea discarding of my processed product from any IR/IU species is also prohibited, unless required by other regulations.

13.9.2 Minimum utilization requirements

Beginning January 1, 1998, 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 this amendment, or (2) delivered in their entirety to onshore processing plants for which similar processing requirements are implemented by State regulations.

14.0 RELATIONSHIP OF RECOMMENDED MANAGEMENT MEASURES TO FCMA NATIONAL STANDARDS AND OTHER APPLICABLE LAWS

This management plan can be considered an extension of the Preliminary Fishery Management Plan (PFMP) for the Bering Sea and Aleutians Trawl Fishery and portions of the PFMP for the Sablefish Setline/Trap Fishery, both prepared and implemented by the Secretary of Commerce, and which are superceded by this plan.

The management regime described in Section 14.0 is considered to be in conformance with the seven national standards set forth in Section 301 of the FCMA.

The U.S. is party to the following international conventions which directly or indirectly address conservation and management needs of groundfish in the Bering Sea/Aleutians region: the International Convention for the High Seas Fisheries of the North Pacific Ocean (INPFC), and the Convention Between the United States of America and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea (IPHC).

This plan has a most significant relationship to the management of the Pacific halibut fishery which continues to be vested in the International Pacific Halibut Commission. Many of the management measures contained herein are for the expressed purpose of mitigating a severe crisis in the domestic halibut fishery by recognizing a situation in which the trawl fishery (and possibly the sablefish setline fishery) could be a major contributor to declining halibut abundance.

There are no Indian treaty fishing rights for groundfish in the fishery conservation zone in the Bering Sea/Aleutians region.

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 its 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".

15.0 RESEARCH NEEDS

In deciding which of these research needs are to be addressed, it is important that they be reviewed regularly and ranked in order of importance and likelihood of success.

Research will be required to: (1) find means of improving the accuracy of commercial catch statistics; (2) refine estimates of abundance and biological characteristics of stocks through research resource surveys; (3) improve the capability for predicting changes in resource abundance, composition, and availability; (4) develop means of reducing the incidental catch of non-target species; (5) identify subpopulations; and (6) examine the direct affects of man's activities on fish habitats and ecosystems.

Catches reported by the foreign fishing fleets provide a means of monitoring the progress of the fisheries towards catch quotas. Later these catch statistics are examined with associated fishing effort to compute CPUE, an index of stock abundance. Discrepancies have been found between reported catches by foreign vessel skippers and those estimated by U.S. observers aboard these vessels. Observer's estimates have been generally greater than those reported by the vessel's master, suggesting under-reporting of catches by the foreign fleets. This problem needs to be examined and steps taken to improve the accuracy of reported catch statistics.

Estimates of biomass of specific groundfish resources have been obtained through resource surveys using bottom trawls. For such semi-demersal species as pollock and cod, biomass estimates through research vessel trawl surveys have so far been underestimated because of the lack of knowledge of the portion of the stocks in the water column that lie above the stratum sampled by the trawl. Studies are required to determine the efficiency at which research trawls capture pollock, cod, and other semi-demersal forms in order to improve the accuracy of biomass estimates of these species.
Long-term fisheries management requires reliable forecasting of stock conditions. Until now forecasts have been based mainly on past events, such as trends in abundance indices (CPUEs) and size and age composition of specific resources without any consideration of the interactions of these resources with each other and the environment. Studies need to be continued to determine for predictive purposes those factors that have major influences on the abundance, composition, and distribution of resources, and there is a critical need for annual prerecruit surveys (i.e., of young fish before they enter the fisheries) so that a measure of their abundance can be used to forecast later contributions to the exploitable stock.

For purposes of conservation and harvesting efficiency, fishing gear should be modified or developed which will reduce the bycatch of halibut, crabs, and other important species in the trawl fisheries. Although these species are immediately returned to the sea after capture, they still suffer an added source of mortality from their capture and handling.

Within the eastern Bering Sea/Aleutians region there undoubtedly exist subpopulations of species that, because of their unique biological features (e.g. growth and mortality) should be managed as separate stocks. Research, therefore, is required to provide a firm basis for the identification and delineation of specific stock units.

The paucity of specific information concerning sablefish, Pacific ocean perch, Atka mackerel, arrowtooth flounder, and Greenland turbot has required an empirical approach to management. Although some information on these species has recently been gathered by U.S. observers aboard foreign fishing vessels and from foreign fisheries statistics, direct assessment of abundance and stock condition has not been accomplished. In the past, surveys have essentially been restricted to the Continental Shelf of the eastern Bering Sea with very little effort directed to the Continental Slope where these and other species are know to concentrate. No assessment surveys have been conducted in the Aleutians region where important stocks of Pacific ocean perch,

sablefish, and Atka mackerel occur. Geographic and bathymetric extensions of research surveys to these areas should be considered.

The several squids which are present in the region form another resource for which very little information is available. The squid fishery is presently of small magnitude but, because of intuitive indications of very large abundances, exploitation is expected to increase substantially. If the sustainable potential of this resource is to be realized, basic taxonomic, distributional, biological, and abundance studies will soon have to be initiated.

Research needs related to maintaining the productive capacity of fish habitat can be broadly classified as those which (a) examine the direct affects of man's activities (such as fishing, oil exploration, or coastal development), and (b) apply fisheries oceanography in an ecosystem context (such as migration and transport patterns, predator/prey relationships, life histories). Both categories of research serve to increase the understanding of natural systems and the ability to detect and measure change caused by natural or man-made forces. The following represents areas that are potential cause for concern, and where precaution is warranted.

Under category (a), further research should be conducted on the short and long-term effects of habitat alteration caused by fishing and oil exploration in the Bering Sea/Aleutian Island groundfish management area. These include the effects of derelict fishing gear, pollution products, the recovery rate of oil-polluted environments, and long-term cumulative effects of discharged and spilled oil.

Under category (b), expanded research is needed on factors affecting the ecosystem such as currents, temperatures, ocean productivity and food chains, and the influence of climatic variation on biological and physical events. More information about life histories, habitat requirements, and predator/prey relationships is needed for a clearer understanding of an organism's response to perturbations in the habitat.

Finally, but in the long run most importantly, the complex ecosystem will have to be accurately modelled so that bio-environmental processes can be understood and inter-species--including birds and marine mammals--relationships can be quantified and relied upon in determining optimum yields.

15.1 Essential Fish Habitat Research and Information Needs

Alaska leads the Nation in fish habitat area and in the value of fish harvested, yet the most basic information on distribution and habitat utilization for most early life stages of commercially valuable groundfish and shellfish is lacking. Systematic sampling exists only for targeted adults. A program is required to generate distributional data on which to determine EFH for the juvenile and larval stages of most of our marine fish. Additionally, Alaska fisheries are affected by anthropogenic impacts, including anthropogenic development that impacts watersheds, wetlands, estuaries, and nearshore benthic environment. Mapping and assessing impacted wetlands and eelgrass beds in an established GIS database with all salmonid producing streams (including riparian and upland land cover and use determinations) and escapements in the system is required to make necessary resource management decisions. Priority needs to be given to identifying, assessing and mapping habitat types such as offshore larval concentration areas (i.e. gyres), near shore nursery areas such as eel grass beds, rocky outcroppings, fine/mixed sediments, and productive bottom types for juveniles and adults. Functional value of high-priority habitats need to be established, and the linkages between fishery productivity and habitats need to be understood. Fishing impact studies are in their infancy in Alaska. Increased emphasis needs to be placed of fish ecology, and marine benthic habitat typing in conjunction with impact assessments of trawls, dredges, longlines, pot gear, and other fishing gear used in Alaska fisheries. Development of a standardized marine benthic habitat typing technology is a required precursor.

Specific Research Needs for the Bering Sea and Aleutian Islands are:

1. Surveys and studies of nearshore pelagic and benthic areas are needed to determine their use by a variety of species, including Atka mackerel, Pacific cod, pollock, rockfish. sablefish, octopus and flatfishes and juveniles and larvae of all species and forage species considered in NPFMC FMPs.

2. Information on habitat distribution, in conjunction with fish distribution, is needed to determine species' habitat requirements and utilization. Information on the extent and distribution of complex habitat types susceptible to bottom fishing will greatly improve the ability to evaluate the potential of a fishery to physically alter bottom habitat and evaluate proposed measures to minimize impacts on EFH. To attain this information, increased use of remote bottom typing technology is necessary, as well as, increased application of currently available technology such as multi-beam sonar, that can provide detailed topographic maps of the continental shelf and slope.

3. Research necessary to raise the level of information known on a species life stage from Level 0 or 1 to Level 2 or higher. To increase EFH tier levels and obtain valid measures of habitat utilization, systematic surveys must be conducted throughout the full-depth habitat range of each species.

16.0 STATEMENT OF COUNCIL INTENTIONS TO REVIEW THE PLAN AFTER APPROVAL BY THE SECRETARY OF COMMERCE

The North Pacific Fishery Management Council will, after approval and implementation of this plan by the Secretary, maintain a continuing review of the fisheries managed under this plan through the following methods:

1. Maintain close liaison with the management agencies involved, usually the Alaska Department of Fish and Game and the National Marine Fisheries Service, 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, usually at the close of a fishing season and in those areas where a fishery is concentrated, to hear testimony on the effectiveness of the management plans and requests for changes.

4. Consideration of all information gained from the above activities and development if necessary, of amendments to the management plan. The Council will also hold public hearings on proposed amendments prior to forwarding them to the Secretary for possible adoption.

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18.0 APPENDICES

Appendix I	--	Sample Community Profile
Appendix II	--	Pollock Cohort Analyses
Appendix III	--	Description of Closed Areas
Appendix IV	--	Programs Addressing Habitat of Bering Sea/Aleutian Islands Groundfish Stocks

"Faces of the Fisheries"

A publication of Community Profiles by the
North Pacific Fishery Management Council

1994 Printing

These profiles are intended to provide a snapshot of various coastal communities, highlighting their involvement in fisheries off Alaska. Data through 1992 are included with the following regional packages available:

- Western Alaska
- Pribilof Islands
- Alaska Peninsula/Aleutian Islands
- South Central Alaska
- Prince William Sound
- Kodiak Island
- Southeast Alaska
- Washington (Puget Sound)
- Oregon

The information in this publication was compiled and edited by Krys Holmes of Winterholm Press, drawing on a variety of data sources including: Alaska Department of Fish & Game's Community Profile Database; Commercial Fisheries Entry Commission's Fish Ticket Databases; International Pacific Halibut Commission; National Marine Fisheries Service; U.S. Department of Labor; Alaska Department of Labor; Minerals Management Service Social Indicators Studies; Alaska Regional Development Organizations; and various local and regional Chambers of Commerce. For more information, or copies of specific regional profiles, contact the North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, Alaska, 99501, or call (907) 271-2809.

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FACES OF THE FISHERIES:

THE

PRIBILOF ISLANDS

Saint Paul **Saint George**

THE PRIBILOF ISLANDS, 500 MILES WEST OF THE ALASKA MAINLAND IN THE central Bering Sea, were discovered in June 1786 by Gavrill Pribilof of the Russian Lebedov Lastochkin Company on his search for the famed northern fur seal breeding grounds. He first landed on the southernmost island, which he named after his vessel, the *Sveti Georgiy* — Saint George.

Pribilof left a small group of hunters on St. George Island and, along with provisions for the winter, left them with instructions to scope out the area for potential fur seal hunts. On one unusually clear June day a year later, the hunters could see the outline of another big island about 30 miles northward, and they named that island St. Peter and St. Paul Island, because it was the dedication day of those two apostles.

In 1788, groups of Aleut hunters from Unalaska and Atka were captured as slaves and taken to St. George and St. Paul islands to hunt fur seals for the Russian company. Their descendents live on the two islands to this day, the progeny of hunters and slaves, and themselves the wards of a federal government that has outlawed residents' historic livelihood, fur seal hunting, but has been slow to provide aid to develop a commercial fisheries infrastructure.

The Aleuts who first came to the Pribilof Islands, under the Russian plan to centralize and control the Native communities of Western Alaska for their own commercial purposes, were prohibited from traveling back to the mainland, were cut off from their kinship ties, and in many cases were prevented from hunting for their own food in an effort to keep families dependent upon the income from seal harvesting. The hunters and their families suffered nutritional deficiencies, isolation and other hardships at the hands of their Russian masters.

When the U.S. bought Alaska from the Russians in 1867, control of the Pribilofs shifted to the Alaska Commercial Company, and later to the North American Commercial Company, and under their control the fur seal populations declined and the industry fell into a depression that left Pribilovians poverty stricken and far from home, mainland and other opportunities. The U.S. government took over control of the island activities after 1910 and regulated seal hunting and other activities there with no more understanding of the Aleut ways of life than the previous landlords had had.

Pribilovians were evacuated from their homes on one June day in 1942 — with no warning from the federal government — along with the residents of other Aleutian Island communities important to the military's agenda in World War II. Most Pribilovians were returned in 1942, but continued to live under federal control — virtually as wards of the federal government, which controlled management and administration of all community facilities and activities — until fur seal harvests were outlawed in 1983. At that time, control of the villages was turned over to local entities, along with $20 million in grants ($12 to St. Paul, $8 million to St. George) to develop an alternative economy for the Pribilof Islands.

Whether or not that local economy is possible, the Pribilov Islanders have set their hopes on the groundfish fisheries of the Bering Sea. Though their participation in groundfish has been minimal to date, they have identified this industry as the only opportunity they have for economic survival, other than continuing to seek federal grants.

ST. PAUL

Zip code:	99660
County:	16
FIPS:	66470
Census area code:	586 - Aleutians West

General profile --

The community of St. Paul, the only settlement on St. Paul Island, is located on a narrow thumb of land on the southern tip of the 44-square-mile island, 47 miles from St. George. Here, fur seal rookeries and thousands of sea bird rookeries explode with life in summertime, and windswept, icy shorelines hug and pummel the island through the winter. More than 210 species of sea birds nest here, some from as far away as Argentina. Tourists fly here too, to view the largest single herd of sea mammals in the world — 1.3 million or so fur seals distributed among 14 rookeries and haul-outs. There is also a reindeer herd on St. Paul Island, a holdover from a previous commercial venture.

St. Paul is trying with all its might to become a commercial fishing town. The city has built dock and breakwater, and is completing a 700-foot dock expansion, cold storage, surimi plant and warehouse facility. There is a state-maintained airport with a 5,075-ft. gravel runway that accommodates regular air service. St. Paul is the major port for ships operating in the Central Bering Sea area, but the full potential for developing portside business has not yet been developed because the infrastructure has been so slow in coming.

The community --

St. Paul is the largest community of Aleut people in the world. With a population of 763 and 66.1% Alaska Native, St. Paul's 504 Aleut residents represent the largest remaining concentration of a community of seafaring Natives that once spread throughout the Aleutian Islands and the Alaska Peninsula. The proportion of men to women is uncommonly high (62.6% to 37.4%, respectively). Young people often leave the island for work or schooling, and women are more likely than men to marry or settle into other areas; male residents are more likely to return to their home town, according to a 1988 study (Kevin Waring Associates).

This is a struggling community, with alcohol and drug problems rising in direct proportion to the uncertainty of the economic and political climate. Yet the strong sense of direction and self-determination that the community demonstrates in the face of its sorrowful past and uncertain future is also evident. St. Paul has a 10.8% unemployment rate and a per capita income of $15,115, and 7.1% of the population is below poverty level. Though per capita income is nearly as high as the statewide average, the cost of living is far higher here, 500 miles offshore, than it is in most villages.

Of the 433 residents over 25 years old, 61.7% have high school diplomas, and only 3.2 have college degrees or higher. Some 88 residents speak their Native language, with 58 of them unable to speak English well, and 25 residents speak an Asian or Pacific Island language and do not speak English very well.

Schoolchildren up to 10th grade attend school in St. Paul, but high school juniors and seniors have to leave the island for the school year. The Russian Orthodox church is strong here; St. Paul is one of the few communities with a resident Russian Orthodox priest. There is also an Assembly of God church, attended primarily by non-Natives.

Population data:

Community	Saint Paul
1990 Population	763
Non-Native Population	259
Native Population	504
Percent Native	66.1

Housing Units	177
Vacant Units	23
Owner-Occup Housing Units	105
Median Value of Housing Units	$84,100
Renter-Occup Housing Units	49
Median Rent Paid	$508
Number of Households	161
# Family Households	132
# Non Related Households	29
Median Family Income	$48,000
Persons in Poverty	50
Percent in Poverty	7.11

(Source: ADCRA)

The city of St. Paul, 1990

Males	478
Females	285
White	21.5%
Black	1.5%
Pacific Islanders	5.8%
American Indian, Eskimo or Aleut	66.1%
Other races	5.1%
Median age	28.0
Median household income (1989)	$39,922
Median family income	$48,000
Median per capita income	$15,115
# people with nonfarm self emp. income	9
Mean non-farm self employment income	$12,400
# people on public assistance	20
Mean public assistance income	$4,089
Under poverty level	7.1%
High school graduates (of pop. 25+)	61.7%
College graduates (of pop 25+)	3.2%
Total households	161
Single women raising families	13

(Source: US Census)

The city --

Form of government: The City of St. Paul is a second-class city (incorporated in 1971) and, as primary beneficiary of the St. Paul Trust set up by the federal government in 1983 to facilitate the transition from federal to local control, is also the city's largest employer. The city is run by a city manager and a seven-member city council, and levies a 3% sales tax.

The local Native corporation organized under ANCSA is Tanadgusix (or TDX) Corp., and while not a political force in itself, the corporation is the major land owner and is the major economic development force in the community.

The Aleut Community of St. Paul was organized under the Indian Reorganization Act, and it also is instrumental in fisheries development and other economic activities here. The IRA Council does act as a political institution on the island, and is also a force in helping preserve the Aleut culture in the face of increasing intrusion by Anglo-Americans.

Housing costs: Housing was constructed by the federal government and was extremely limited until the early 1980s. Since then some higher-quality homes have been built, the average household size has decreased, and housing for families and local workers is a lot closer to adequate.

Of the 93 owner-occupied homes in St. Paul, 73 are valued between $50,000 and $99,000, with a median value of $84,100. There are 32 mortgaged homes in St. Paul, with a

median mortgage payment of $414, and the average non-mortgage house payment is $394. Median rent is $688

Municipal facilities: St. Paul has a 300-foot city dock, a 300-foot private dock, a boat harbor, water, electrical, sewer, refuse removal and telephone services. The city has also started a solid waste reduction and recycling program, and is planning a new landfill area.

Community care: The City of St. Paul provides public safety, fire, police, search and rescue and airport fire, crash and rescue services. There is a three-bed Indian Health Service clinic, with three physician's assistants and a paraprofessional social worker. A dentist visits periodically, and an EMT team provides stabilization care in emergencies. The nearest hospital is Anchorage, 800 miles away; emergency patients are evacuated by air.

The economy --

Today, St. Paul is a supply and processing port for a portion of the Bering Sea groundfish and crab fleets. The city and the TDX Corp. have put forth major efforts to increase processing capacity, to build docks and breakwaters to accommodate the Bering Sea fleet, and to find ways to help local fishermen participate more in the region's fisheries. Those efforts themselves, fueled by federal grants and state funding, have generated a certain amount of economic activity.

Also, the magnificent local habitat for Arctic birds, marine mammals and other rare sights have attracted an increasing number of tourists to St. Paul Island. But the primary focus is increasing participation in the Bering Sea fisheries, the industry the U.S. government hoped would provide an economic future for St. Paul after their previous economic structure, and way of life, was shut down in 1983.

The 1990 census showed St. Paul had a 10.8% unemployment rate, and that the economic community supported 330 jobs, as outlined below:

St. Paul jobs, 1990	
Manufacturing non-durable goods	71 jobs
Ag/forestry/fisheries	44
Public administration	41
Educational services	34
Construction	32
Other professional services	28
Health services	19
Communications/utilities	15
Transportation	12
Personal services	12
Retail trade	12
Wholesale trade	6
Business/repair services	2
Entertainment/recreation	2
Total jobs	**330**

The median wage/salary income was $42,026 in 1990. Median self-employment income, among the nine people who reported it, was $12,400.

In 1980, when there were only 244 jobs in St. Paul, 18 people worked in reindeer antler processing, a business not highlighted but which is probably included in the "manufacturing non-durable goods" category, above. Back then, 180 of the 244 jobs — 73.7% — were only part-time jobs. There is no current information on now many of the 330 jobs in 1990 were full-time or part-time.

Subsistence activities --

Subsistence hunting, fishing and gathering has always been an important part of life on the Pribilof Islands. The ADF&G estimated in 1981 that St. Paul residents consumed approximately 307 lbs. of subsistence resources per capita annually (Schroeder, et al). Halibut, cod and sculpin are the primary marine fishes harvested for subsistence purposes. Salmon and

Dolly Varden are absent in the Pribilofs, and clams and marine invertebrates are less abundant than on the mainland or in the Aleutians.

Fur seals are by far the most important marine mammal taken for subsistence use. Though it is illegal under the Fur Seal Act, to commercially harvest these animals, Natives are allowed to take them for subsistence purposes only. Sea lions are also taken frequently, and harbor seals once in a while. The abundance of sea birds, ducks, geese, murre, kittiwakes, cormorants, and least auklets that nest on the island have led to the enthusiastic use of those birds and their eggs by the local Natives. The only land mammal harvested in any number is reindeer.

Following a house-by-house survey in 1981, ADF&G estimated the per-household use of seals, sea lions, halibut and reindeer as follows:

Estimated consumption per household for subsistence purposes, 1981	
Total fur seal	1,020 lbs.
Summer harvest	320
Winter harvest	700
Sea lion	105
Halibut	513
Reindeer	54
Total weight:	**1,692**

Fisheries activities --

Though fisheries activities are the prime mover in the economy and the hopes of St. Paul, their participation has been relatively small so far. The local fleet fishes primarily for halibut; local processors produce crab and several species of groundfish. Several obstacles currently hold back fisheries activities: Though $75 million in federal, state and private funds have been spent building ocean breakwaters, docks and other marine improvements, those improvements have come slowly and the fact that they're not finished yet means the community is missing out on a lot of fisheries activity. So while the fisheries remain St. Paul's primary focus, actual participation is still pretty minimal until the city's fisheries development program can get on line.

St. Paul is the only member of the Central Bering Sea Fishermen's Association (CBSFA), a CDQ corporation, and so has received some pollock quota. CBSFA is using its new groundfish quotas to further develop the port's seafood processing capacities.

Fishing: The St. Paul fleet does not have the vessels or equipment to participate in the cod, pollock or crab fisheries, nor do they have the capital or the expertise to jump into those fisheries right now. All the local boats are under 50' in length. Most fishermen harvest only halibut, in the pulse fisheries in the Bering Sea areas. They began halibut fishing in about 1982 because, though there were no docks or harbor facilities to support a large fleet, the small locally-owned boats could fish off resources close to the island in small boats, which could be hauled out of the water.

The most halibut the St. Paul fleet has ever taken was 75% of the Halibut Area 4C quota in 1990, a year when most longliners preferred to fish elsewhere for regulatory reasons. Most years, the local fleet averages about 35% of the Area 4C harvest, primarily because the size of their boats means they have to sit out bad weather or rough seas while larger boats from outside the area continue fishing. St. Paul has applied some of its partnership funds gained from CDQ arrangements to helping fishermen invest in larger, more competitive vessels. Under the proposed IFQ program, St. Paul and St. George fishermen will be allocated quota shares that, assuming 1992 quotas, would bring in 400,000 to 550,000 lbs. of halibut quota according to CBSFA.

There are no salmon or herring fisheries in the Pribilofs, and the fleet is made up of boats too small to cross the Bering Sea to participate in other small-boat fisheries nearer the mainland. The St. Paul fleet hopes to expand its flexibility to participate in Pacific cod, pollock, flounder, crab, sea urchin and other fisheries.

Table 1: Number of permit holders in St. Paul, by species

YEAR	POUNDS	VALUE	PERMITS	SPECIES	
81	19,213	17,976.00	21	HALIBUT	

83	58,476	47,297.00	44	HALIBUT	
84	142,145	100,960.00	31	HALIBUT	
85	143,350	100,342.00	17	HALIBUT	
86	77,693	114,440.00	11	HALIBUT	
87	98,716	118,459.00	8	HALIBUT	
88	353,545	330,210.00	13	HALIBUT	
89	214,922	203,531.00	15	HALIBUT	
90	144,638	255,720.00	17	HALIBUT	
91	189,036	257,597.00	18	HALIBUT	
92	**	**	2	CRAB	
92	**	**	2	SALMON	

Table 2: Vessels home-ported in St. Paul, by species fished

YEAR	POUNDS	VALUE	VESSELS	SPECIES	
81	19,263	18,021.00	22	HALIBUT	
83	39,163	33,561.00	29	HALIBUT	
83	**	**	1	SALMON	
84	137,739	97,506.00	30	HALIBUT	
85	131,378	91,962.00	14	HALIBUT	
85	**	**	2	SALMON	
86	78,025	114,929.00	12	HALIBUT	
86	**	**	1	SALMON	
87	98,716	118,459.00	8	HALIBUT	
87	**	**	1	HERRIN	
88	353,545	330,210.00	13	HALIBUT	
89	216,362	204,895.00	16	HALIBUT	
89	**	**	1	SALMON	
90	145,152	256,629.00	18	HALIBUT	
91	189,036	257,597.00	18	HALIBUT	
92	**	**	1	OTHER	
92	**	**	1	SALMON	

Table 3: St. Paul permit holders by gear type

YEAR	GEAR	POUNDS	VALUE	PERMITS	SPECIES
81	LGL	11,048	10,425.00	5	HALIBUT
81	JIG	8,165	7,551.00	16	HALIBUT
83	TRL	**	**	1	HALIBUT
83	LGL	19,914	20,209.00	13	HALIBUT
83	JIG	38,220	26,817.00	30	HALIBUT
84	TRL	**	**	1	HALIBUT
84	JIG	9,018	7,663.00	14	HALIBUT
84	LGL	132,353	92,635.00	16	HALIBUT
85	JIG	6,213	4,347.00	6	HALIBUT
85	LGL	137,137	95,995.00	14	HALIBUT
86	JIG	3,495	5,148.00	6	HALIBUT
86	LGL	74,198	109,292.00	7	HALIBUT
87	JIG	7,483	8,980.00	5	HALIBUT
87	LGL	91,233	109,479.00	5	HALIBUT
88	JIG	27,812	25,976.00	6	HALIBUT
88	LGL	325,733	304,234.00	7	HALIBUT

89	JIG	**	**	3	HALIBUT
89	TRL	**	**	3	HALIBUT
89	LGL	208,039	197,013.00	9	HALIBUT
90	JIG	**	**	2	HALIBUT
90	TRL	**	**	2	HALIBUT
90	LGL	140,062	247,629.00	13	HALIBUT
91	TRL	**	**	1	HALIBUT
91	JIG	**	**	3	HALIBUT
91	LGL	185,504	252,794.00	14	HALIBUT
92	NET	**	**	2	SALMON
92	POT	**	**	2	CRAB

Processing: The only processing plant on St. Paul is Pribilof Island Processors (PIP), which underwent Chapter 11 bankruptcy in 1990 and was facing reorganization. However, it geared up for the 1991 season and, according to a 1991 report by Impact Assessment, Inc., took delivery from 18 or 19 crab boats and hired between 55 and 180 people, depending on how busy the plant is. The plant also processes halibut and Pacific cod.

In 1991, reports showed that the PIP plant paid $7/hour to locals, and $5.50/hour to non-locals (the lower wage to compensate for travel, room and board costs). However, many locals are unwilling or unable to work for $7/hour, especially the primary breadwinners of a household. Cost of living studies here show that it requires at least $9.59/hour to barely survive on the most meager budget in St. Paul — and that budget would not provide off-island travel, a motorized vehicle on the island, or any other such "amenities."

In addition, a Japanese-financed group called St. Paul Seafood has been developing a shore-based processing facility and already has invested $28 million, but in 1991 needed additional financing to construct a waste outflow system. This plant was originally designed to process surimi.

The CBSFA is working to attract a major shore-based processor to St. Paul to produce the groundfish made available through the CDQ program. The corporation is also considering chartering a 98' crab boat to tender halibut for the 1993 season.

Economic development plans --

In a study conducted at the end of the federal control of the Pribilofs, four areas were identified as potential economic development opportunities for St. Paul: fisheries, tourism, fur sealing and offshore oil and gas development. Tourism is a small, seasonal activity that contributes some, but not much, to the local economy, and probably is limited because of the expense of flying out to the Pribilofs from the mainland. Fur sealing had already become uneconomical even before it was politically incorrect — and subsequently was outlawed. Offshore oil and gas development was attempted for a while, but regulatory uncertainties concerning oil and gas leases in the Bering Sea killed that idea. Fisheries development is the area's only remaining realistic hope.

The City of St. Paul and the TDX Corp. are struggling through a long-term plan to build a 700-foot dock, surimi plant, a floating processor, cold storage and warehouse facilities along with a bulk fuel terminal, airport terminal, container storage and transfer, a new hotel, restaurant and recreation building. These plans are enhanced by the CBSFA's program to repair the old East Landing dock, develop temporary floating moorage for the local fishing fleet, and boost the harbor development project, which is the most pressing need right now in St. Paul's fisheries development progress.

At the same time that the St. Paul community hopes to develop new opportunities in the Bering Sea fisheries, residents are also concerned that the sea surrounding their island may be overfished. Many residents struggle with their resentment against the gigantic, efficient factory trawl fleet that is designed to potentially degrade the marine environment for lucrative short-term gains, while at the same time hoping that their own fleet can develop enough to participate in the groundfish fisheries as well. There is also discomfort at the idea of developing new fisheries from underutilized resources, after a bad experience in the hair crab fishery when, after local fishermen

opened up the fishery, large Outside boats came in and exploited most of the resource before the locals could catch up to them.

ST. GEORGE

Zip code:	99660
County:	16
FIPS:	65800
Census area code:	586 - Aleutians West

General profile --

St. George is a smaller island and a smaller town than St. Paul and has lived in its larger brother's shadow for most of its 20th Century life. It is the second largest of the five Pribilof Islands, and is 11 miles long and 5 miles wide. A 6,000-ft. gravel runway accommodates regular commercial air traffic from Anchorage and the Aleutians, and most freight and supplies come by barge from Anchorage every month. Like St. Paul, St. George is strategically located in the middle of the groundfish and crab fisheries of the Bering Sea, and is a major breeding ground for fur seals, sea lions and arctic birds.

The climate here is typical of northern maritime regions, with cool, cloudy weather the year round and temperatures ranging from 24°F to 52°F. Average precipitation is 23" annually, and average snowfall is 57".

The community --

With only 143 residents, St. George is tied economically, socially and culturally to St. Paul. The community here is 94.9% Aleut; only seven residents (at the time of the 1990 census) were white. Median age is 28.4, some 64.6% of adults over 25 have finished high school, and 5.1% have a bachelor's degree or higher. St. George residents are considerably poorer than St. Paul residents; here, 42% of the people — ten families out of 36 — are under the poverty line (compared to 7.1% in St. Paul.)

Most residents in this tightly knit community are Russian Orthodox. There are quite a few organized recreational activities for the community, as well as a few continuing education programs for adults, including on-the-job training and academic programs in hatchery management, sponsored by the St. George Aquaculture Association. The local school educates children through the 8th grade; high school students have to leave the island for schooling.

Population data:

Community	Saint George
1990 Population	138
Non-Native Population	7
Native Population	131
Percent Native	94.9
Housing Units	67
Vacant Units	22
Owner-Occup Housing Units	31
Median Value of Housing Units	$55,600
Renter-Occup Housing Units	14
Median Rent Paid	$133
Number of Households	43
# Family Households	36
# Non Related Households	7
Median Family Income	$26,000
Persons in Poverty	60
Percent in Poverty	41.96

(Source: ADCRA)

The city of St. George, 1990	
Males	66
Females	77
Median age	28.4
Median household income (1989)	$25,250
Median family income	$26,000
Median per capita income	$9,332
Under poverty level	42%
# people on public assistance	5
Mean public assistance income	$13,152
High school graduates (of pop. 25+)	64.6%
College graduates (of pop 25+)	5.1%
Total households	43
Single women raising families	2

(Source: US Census)

The city --

Form of government: St. George is a second-class city, (incorporated in 1983) with a seven-member city council and a mayor elected from that council. The seven-member St. George Traditional Council is the tribal government, owns and operates the clinic, publishes a local newspaper, administers recreational programs and also oversees other community development projects and job training for the community. The St. George Tanaq Corp., the local Native corporation, owns the store, hotel, the port and most of the land on the island.

Housing costs: There are 28 owner-occupied homes in St. George, with a median value of $55,600. None of them is mortgaged; the median non-mortgage house payment is $325 per month, and median rent is $475 per month.

Municipal facilities: St. George's new 6,000-foot runway is the only one in the Pribilofs that can accommodate jet traffic. The 8-acre Zapadni Bay Harbor is still under construction, but has been open for use. The City harbor provides 60-ft. and 75-ft. docks, with 250 feet of additional moorage.

The City of St. George also provides electric services, water, sewer, solid waste disposal at the local landfill, public safety and fire protection, and distributes fuel to the community.

Community care: A Village Public Safety Officer acts as the city policeman. A volunteer fire department takes care of fire protection, and there is a four-bed clinic staffed by a physician's assistant and two community health aides. The state public health nurse, a dentist, a doctor and an optometrist visit the community a few times a year.

The economy --

Most of the employment in St. George is government-related. Together government, education and Native corporation jobs make up 60% of the jobs available to St. George residents. The St. George Aquaculture Assoc. has begun developing salmon and shellfish aquaculture programs, with the first salmon returns expected in 1993. In addition, there are several private concerns here, including a day care, gas station, grocery and hardware stores, lumber yard and marine supply, movie rental, restaurant, taxi and underwater construction company.

At the time of the 1990 Census, St. George residents reported 40 jobs among a labor force of 47 people, leaving 7 people unemployed. Census data does not differentiate between full- and part-time jobs. The jobs were distributed as follows:

St. George jobs, 1990 (Source: U.S. Census)	
Educational services	10
Construction	10
Public administration	5
Health services	5
Retail trade	4
Transportation	2
Personal services	2
Professional/related services	2
Total jobs	**40**

Subsistence activities --

Subsistence is as crucial to the cultural and nutritional life of St. George as it is to any rural Alaskan village, though St. George residents usually take less per capita in subsistence resources than St. Paul residents do. The ADF&G estimated in 1981 that St. George residents consumed approximately 270 lbs. of subsistence resources per capita annually (Schroeder, et al). Halibut, cod and sculpin are the primary marine fishes harvested for subsistence purposes. Salmon and Dolly Varden are absent in the Pribilofs, and clams and marine invertebrates are less abundant than on the mainland or in the Aleutians.

Fur seals are by far the most important marine mammal taken for subsistence use. Though it is illegal under the Fur Seal Act, to commercially harvest these animals, Natives are allowed to take them for subsistence purposes only. Sea lions are also taken frequently, and harbor seals once in a while. The abundance of sea birds, ducks, geese, murre, kittiwakes, cormorants, and least auklets that nest on the island have led to the enthusiastic use of those birds and their eggs by the local Natives.

Following a house-by-house survey in 1981, ADF&G estimated the per-household use of seals, sea lions, halibut and reindeer as follows:

Estimated consumption per household for subsistence purposes, 1981	
Total fur seal	561 lbs.
Local harvest	331
From St. Paul	230
Sea lion	324
Halibut	270
Total lbs. per household:	**1,155 lbs.**

Fisheries activities --

Like St. Paul, St. George is struggling to develop a groundfish and crab fishery, and to build up its harbor facilities enough to attract business from the Bering Sea commercial fishing fleets. The City of St. George hopes to develop a shoreside seafood processing facility in Zapadni Bay Harbor, though there are some reservations about how a large processing plant might affect the social structure of this small, isolated and close-knit community.

St. George is a member of the Aleutian Pribilof Island Community Development Association (APICDA), a CDQ organization that also includes Aleutian villages from Adak east to Nelson Lagoon.

Fishing: There are 28 fishermen and 12 fishing vessels in St. George, and the vessels range in size from 16' to 30' in length, according to the Aleutian Pribilof Island Community Development Association. They primarily longline for halibut and cod, though their participation is sometimes limited by bad weather and high seas. Fishing the Bering Sea with vessels of this size is quite a challenge, and the fishing community will have to upgrade the size and safety of its fleet before fishermen can expand their participation in Bering Sea fisheries.

Table 1: Number of permit holders in St. George, by species					
YEAR	POUNDS	VALUE	PERMITS	SPECIES	
83	95,484	68,169.00	41	HALIBUT	
84	5,913	849.00	33	GRNDFISH	
84	104,729	73,080.00	46	HALIBUT	
85	126,999	88,897.00	40	HALIBUT	
86	5,858	1,781.00	8	GRNDFISH	
86	43,189	63,619.00	13	HALIBUT	
87	36,834	44,200.00	9	HALIBUT	
88	138,345	129,214.00	9	HALIBUT	
89	47,016	44,523.00	15	HALIBUT	
90	43,587	77,061.00	17	HALIBUT	

Table 2: Vessels home-ported in St. George, by species fished					
YEAR	POUNDS	VALUE	VESSELS	SPECIES	
83	82,731	57,976.00	34	HALIBUT	
83	**	**	1	SALMON	
84	4,958	712.00	29	GRNDFISH	
84	99,697	69,568.00	44	HALIBUT	
84	**	**	2	SALMON	
85	114,143	79,898.00	37	HALIBUT	
86	5,858	1,781.00	8	GRNDFISH	
86	43,189	63,619.00	13	HALIBUT	
87	36,834	44,200.00	9	HALIBUT	
88	138,345	129,214.00	9	HALIBUT	
89	47,016	44,523.00	15	HALIBUT	
90	43,587	77,061.00	17	HALIBUT	
90	**	**	2	SALMON	

Table 3: St. George permit holders by gear type					
YEAR	GEAR	POUNDS	VALUE	PERMITS	SPECIES
83	TRL	**	**	3	HALIBUT
83	LGL	6,149	6,581.00	12	HALIBUT
83	JIG	87,960	60,577.00	26	HALIBUT
84	LGL	3,712	536.00	16	GRNDFISH
84	JIG	2,201	313.00	17	GRNDFISH
84	LGL	18,878	13,159.00	18	HALIBUT
84	JIG	85,851	59,921.00	28	HALIBUT
85	LGL	36,470	25,528.00	15	HALIBUT
85	JIG	90,529	63,369.00	26	HALIBUT
86	JIG	**	**	2	HALIBUT
86	LGL	5,858	1,781.00	8	GRNDFISH
86	LGL	42,130	62,059.00	11	HALIBUT
87	JIG	**	**	2	HALIBUT
87	LGL	34,944	41,932.00	7	HALIBUT
88	TRL	**	**	1	HALIBUT
88	JIG	**	**	2	HALIBUT
88	LGL	111,775	104,398.00	6	HALIBUT
89	JIG	**	**	3	HALIBUT

89	LGL	22,816	21,606.00	6	HALIBUT
89	TRL	9,862	9,340.00	6	HALIBUT
90	JIG	**	**	3	HALIBUT
90	TRL	**	**	4	HALIBUT
90	LGL	30,200	53,394.00	10	HALIBUT

Processing: Two floating processors operated within the Zapadni Bay Harbor in recent years, but because the harbor itself is incomplete there is no shoreside processing facility operating here. As soon as the harbor is complete, establishing shoreside processing capabilities will become the top priority at St. George Tanaq Corp. The community is looking for a small processor that could operate on a year-round basis, rather than a large plant that would bring in a large influx of new people.

Economic development plans --

Finishing the harbor and finding a shoreside processor are the two economic development priorities for this community. In the past ten years, $30 million has been invested in literally carving the harbor out of the island, but more dredging and construction work is required before the port is usable. The APIDCA has set aside approximately $2.27 million of its CDQ-generated funds to to construct docks and complete upland construction at the harbor. They are seeking $3.3 million from the state legislature to complete the project.

APICDA has entered an agreement with Snopac Products, Inc. to develop a shoreside processing facility on Zapadni Bay after the harbor project is complete. In addition, some CDQ-generated Fishery Investment Funds will be used to help local fishermen upgrade their vessels, gain training with operating larger vessels, and to purchase halibut and sablefish quota shares after the new IFQ program is implemented.

APPENDIX II. Pollock Cohort Analyses (Ref. Section 9.4)

Cohort analyses which show growth and decay of a pollock biomass under different instantaneous rates of natural mortality (Tables A-G).

Table A. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .350 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	344	15	5.6	.0	344	15	5.7	.0	344	15	5.7	.0
2	1047	47	9.3	.2	1051	46	9.3	.2	1049	46	9.3	.2
3	1711	77	12.4	.5	1731	76	12.5	.5	1721	76	12.4	.5
4	2114	95	15.0	.9	2154	94	15.1	.9	2134	94	15.1	.9
5	2231	100	17.2	1.3	2286	100	17.3	1.3	2258	100	17.3	1.3
6	2129	95	19.1	1.7	2193	96	19.2	1.8	2161	96	19.2	1.8
7	1897	85	20.7	2.2	1962	86	20.9	2.3	1930	85	20.8	2.2
8	1609	72	22.1	2.6	1670	73	22.2	2.7	1639	73	22.2	2.7
9	1315	59	23.3	3.1	1369	60	23.4	3.2	1342	59	23.3	3.1
10	1045	47	24.2	3.5	1091	48	24.4	3.6	1068	47	24.3	3.5
11	812	36	25.1	3.8	850	37	25.2	4.0	831	37	25.2	3.9
12	620	28	25.8	4.1	651	28	26.0	4.3	636	28	25.9	4.2
13	467	21	26.4	4.4	491	21	26.6	4.6	479	21	26.5	4.5
14	348	16	26.9	4.7	366	16	27.1	4.9	357	16	27.0	4.8
15	257	12	27.3	4.9	271	12	27.5	5.2	264	12	27.4	5.0
16	188	8	27.7	5.1	199	9	27.9	5.4	193	9	27.8	5.2

Table B. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .375 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	336	17	5.6	.0	336	17	5.7	.0	336	17	5.7	.0
2	996	51	9.3	.2	1000	50	9.3	.2	998	50	9.3	.2
3	1587	81	12.4	.5	1606	80	12.5	.5	1596	80	12.4	.5
4	1913	97	15.0	.9	1949	97	15.1	.9	1931	97	15.1	.9
5	1969	100	17.2	1.3	2017	100	17.3	1.3	1993	100	17.3	1.3
6	1833	93	19.1	1.7	1887	94	19.2	1.8	1860	93	19.2	1.8
7	1593	81	20.7	2.2	1647	82	20.9	2.3	1620	81	20.8	2.2
8	1317	67	22.1	2.6	1367	68	22.2	2.7	1342	67	22.2	2.7
9	1050	53	23.3	3.1	1093	54	23.4	3.2	1072	54	23.3	3.1
10	814	41	24.2	3.5	850	42	24.4	3.6	832	42	24.3	3.5
11	617	31	25.1	3.8	646	32	25.2	4.0	631	32	25.2	3.9
12	460	23	25.8	4.1	482	24	26.0	4.3	471	24	25.9	4.2
13	338	17	26.4	4.4	355	18	26.6	4.6	346	17	26.5	4.5
14	245	12	26.9	4.7	258	13	27.1	4.9	252	13	27.0	4.8
15	177	9	27.3	4.9	186	9	27.5	5.2	181	9	27.4	5.0
16	126	6	27.7	5.1	133	7	27.9	5.4	130	7	27.8	5.2

Table C. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .400 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	328	19	5.6	.0	327	18	5.7	.0	327	19	5.7	.0
2	947	55	9.3	.2	951	53	9.3	.2	949	54	9.3	.2
3	1472	85	12.4	.5	1490	84	12.5	.5	1481	84	12.4	.5
4	1731	100	15.0	.9	1763	99	15.1	.9	1747	99	15.1	.9
5	1737	100	17.2	1.3	1780	100	17.3	1.3	1759	100	17.3	1.3
6	1577	91	19.1	1.7	1624	91	19.2	1.8	1601	91	19.2	1.8
7	1337	77	20.7	2.2	1383	78	20.9	2.3	1360	77	20.8	2.2
8	1079	62	22.1	2.6	1119	63	22.2	2.7	1099	62	22.2	2.7
9	839	48	23.3	3.1	873	49	23.4	3.2	856	49	23.3	3.1
10	634	36	24.2	3.5	662	37	24.4	3.6	648	37	24.3	3.5
11	469	27	25.1	3.8	490	28	25.2	4.0	480	27	25.2	3.9
12	341	20	25.8	4.1	357	20	26.0	4.3	349	20	25.9	4.2
13	244	14	26.4	4.4	256	14	26.6	4.6	250	14	26.5	4.5
14	173	10	26.9	4.7	182	10	27.1	4.9	177	10	27.0	4.8
15	121	7	27.3	4.9	128	7	27.5	5.2	125	7	27.4	5.0
16	85	5	27.7	5.1	89	5	27.9	5.4	87	5	27.8	5.2

Table D. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .430 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	318	21	5.6	.0	318	20	5.7	.0	318	21	5.7	.0
2	892	58	9.3	.2	896	57	9.3	.2	894	58	9.3	.2
3	1346	88	12.4	.5	1362	87	12.5	.5	1354	87	12.4	.5
4	1535	100	15.0	.9	1564	100	15.1	.9	1549	100	15.1	.9
5	1495	97	17.2	1.3	1532	98	17.3	1.3	1514	98	17.3	1.3
6	1318	86	19.1	1.7	1357	87	19.2	1.8	1337	86	19.2	1.8
7	1084	71	20.7	2.2	1121	72	20.9	2.3	1102	71	20.8	2.2
8	848	55	22.1	2.6	881	56	22.2	2.7	864	56	22.2	2.7
9	640	42	23.3	3.1	666	43	23.4	3.2	653	42	23.3	3.1
10	470	31	24.2	3.5	490	31	24.4	3.6	480	31	24.3	3.5
11	337	22	25.1	3.8	353	23	25.2	4.0	345	22	25.2	3.9
12	238	15	25.8	4.1	249	16	26.0	4.3	243	16	25.9	4.2
13	165	11	26.4	4.4	174	11	26.6	4.6	169	11	26.5	4.5
14	114	7	26.9	4.7	120	8	27.1	4.9	117	8	27.0	4.8
15	77	5	27.3	4.9	82	5	27.5	5.2	79	5	27.4	5.0
16	52	3	27.7	5.1	55	4	27.9	5.4	54	3	27.8	5.2

Table E. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .450 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	312	22	5.6	.0	311	22	5.7	.0	311	22	5.7	.0
2	857	60	9.3	.2	861	60	9.3	.2	859	60	9.3	.2
3	1267	89	12.4	.5	1282	89	12.5	.5	1275	89	12.4	.5
4	1417	100	15.0	.9	1444	100	15.1	.9	1430	100	15.1	.9
5	1353	95	17.2	1.3	1386	96	17.3	1.3	1370	96	17.3	1.3
6	1169	82	19.1	1.7	1203	83	19.2	1.8	1186	83	19.2	1.8
7	942	66	20.7	2.2	974	67	20.9	2.3	958	67	20.8	2.2
8	723	51	22.1	2.6	750	52	22.2	2.7	737	52	22.2	2.7
9	535	38	23.3	3.1	557	39	23.4	3.2	546	38	23.3	3.1
10	384	27	24.2	3.5	401	28	24.4	3.6	393	27	24.3	3.5
11	270	19	25.1	3.8	283	20	25.2	4.0	277	19	25.2	3.9
12	187	13	25.8	4.1	196	14	26.0	4.3	191	13	25.9	4.2
13	127	9	26.4	4.4	134	9	26.6	4.6	131	9	26.5	4.5
14	86	6	26.9	4.7	90	6	27.1	4.9	88	6	27.0	4.8
15	57	4	27.3	4.9	60	4	27.5	5.2	59	4	27.4	5.0
16	38	3	27.7	5.1	40	3	27.9	5.4	39	3	27.8	5.2

Table F. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .500 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	297	26	5.6	.0	296	25	5.7	.0	296	25	5.7	.0
2	776	67	9.3	.2	779	66	9.3	.2	777	66	9.3	.2
3	1091	94	12.4	.5	1104	93	12.5	.5	1097	94	12.4	.5
4	1160	100	15.0	.9	1182	100	15.1	.9	1171	100	15.1	.9
5	1054	91	17.2	1.3	1080	91	17.3	1.3	1067	91	17.3	1.3
6	866	75	19.1	1.7	891	75	19.2	1.8	879	75	19.2	1.8
7	664	57	20.7	2.2	687	58	20.9	2.3	675	58	20.8	2.2
8	485	42	22.1	2.6	503	43	22.2	2.7	494	42	22.2	2.7
9	341	29	23.3	3.1	355	30	23.4	3.2	348	30	23.3	3.1
10	233	20	24.2	3.5	243	21	24.4	3.6	238	20	24.3	3.5
11	156	13	25.1	3.8	163	14	25.2	4.0	160	14	25.2	3.9
12	103	9	25.8	4.1	108	9	26.0	4.3	105	9	25.9	4.2
13	66	6	26.4	4.4	70	6	26.6	4.6	68	6	26.5	4.5
14	43	4	26.9	4.7	45	4	27.1	4.9	44	4	27.0	4.8
15	27	2	27.3	4.9	29	2	27.5	5.2	28	2	27.4	5.0
16	17	1	27.7	5.1	18	2	27.9	5.4	18	1	27.8	5.2

Table G. Cohort analysis to determine the growth and decay of a pollock cohort starting with 10,000 individuals and assuming .600 natural mortality rate.

Age	Female Population				Male Population				Combined Sexes			
	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of max Biomass	Length (in)	Weight (lb)	Biomass (lb)	Percent of Max Biomass	Length (in)	Weight (lb)
1	268	33	5.6	.0	268	33	5.7	.0	268	33	5.7	.0
2	635	79	9.3	.2	638	78	9.3	.2	636	78	9.3	.2
3	808	100	12.4	.5	818	100	12.5	.5	813	100	12.4	.5
4	778	96	15.0	.9	792	97	15.1	.9	785	97	15.1	.9
5	639	79	17.2	1.3	655	80	17.3	1.3	647	80	17.3	1.3
6	475	59	19.1	1.7	489	60	19.2	1.8	482	59	19.2	1.8
7	330	41	20.7	2.2	341	42	20.9	2.3	350	41	20.8	2.2
8	218	27	22.1	2.6	226	28	22.2	2.7	222	27	22.2	2.7
9	139	17	23.3	3.1	144	18	23.4	3.2	141	17	23.3	3.1
10	86	11	24.2	3.5	90	11	24.4	3.6	88	11	24.3	3.5
11	52	6	25.1	3.8	54	7	25.2	4.0	53	7	25.2	3.9
12	31	4	25.8	4.1	32	4	26.0	4.3	32	4	25.9	4.2
13	18	2	26.4	4.4	19	2	26.6	4.6	19	2	26.5	4.5
14	11	1	26.9	4.7	11	1	27.1	4.9	11	1	27.0	4.8
15	6	1	27.3	4.9	6	1	27.5	5.2	6	1	27.4	5.0
16	3	0	27.7	5.1	4	0	27.9	5.4	4	0	27.8	5.2

APPENDIX III. Descriptions of Closed Areas

1. Specific regulation areas opened or closed to fishing during certain times of the year for some fishing vessels are shown in Figure 27b and defined as follows:

Area A -- Bristol Bay Pot Sanctuary

The portion of the Fishery Conservation Zone encompassed by straight lines connecting the following points, in the order listed:

Cape Sarichef Light (54°36'N - 164°55'42"W)
55°16'N - 166°10'W
56°20'N - 163°00'W
57°10'N - 163°00'W
58°10'N - 160°00'W
Intersection of 160°00'W with the Alaska Peninsula

Area B -- Winter Halibut-savings Area

That portion of the Fishery Conservation Zone encompassed by straight lines connecting the following points, in the order listed:

Cape Sarichef Light (54°36'N - 164°55'42"W)
52°48'N - 170°00'W
55°30'N - 170°00'W
55°30'N - 166°47'W
56°00'N - 167°45'W
56°00'N - 166°00'W
56°30'N - 166°00'W
56°30'N - 163°00'W
56°20'N - 163°00'W
55°16'N - 166°10'W
Cape Sarichef Light (54°36'N - 164°55'42"W)

Area C -- The area between 172-00'W and 178-30'W within the FCZ south of a line drawn to connect the following coordinates:

53°14'N - 172°00'W
52°13'N - 176°00'W
52°00'N - 178°00'W
52°00'N - 178°30'W

Area D -- The area known as Petrel Bank is bordered by straight lines connecting the following coordinates in the order listed:

52°51'N - 178°30'W
52°51'N - 179°00'E
51°15'N - 179°00'E
51°15'N - 178°30'W
52°51'N - 178°30'W

Area E -- The area west of 178°30'W but excluding Area D, known as Petrel Bank that is defined above.

Area F -- The area between three and twelve nautical miles from the baseline used to measure the U.S. territorial sea bounded by 170°30'W and 172°00'W on the north side of the Aleutian Islands and by 170°00'W and 172°00'W on the south side of the Aleutians.

2. Fishing areas governed by this Fishery Management Plan and shown in Figure 26a are defined as follows:

Area I -- The area of the Fishery Conservation Zone (FCZ) north of the Aleutian Islands and east of 170°W longitude.

Area II -- The area of the FCZ north of 55°N latitude and between 170°W longitude and 180° longitude.

Area III -- The area of the FCZ north of 55°N latitude and west of 180° longitude.

Area IV -- The area of the FCZ west of 170°W longitude and south of 55°N latitude.

For the purpose of spatially allocating TAC's, Area IV, the Aleutian Islands Management Area, is divided into three districts, defined as follows:

Eastern District -- That part of the Aleutian Islands Management Area between 170° W longitude and 177° W longitude.

Central District -- That part of the Aleutian Islands Management Area between 177° W longitude and 177° E longitude.

Western District -- That part of the Aleutian Islands Management Area west of 177° E longitude.

3. The Salmon Savings Area shown in Figure 28 is defined as follows:

Fishing Area II and that portion of Fishing Area I lying between 55°N and 57°N latitude and 165°W and 170°W longitude.

4. Bycatch Limitation Zones 1 and 2 (Zones 1 and 2) shown in Figure 27a are defined as follows:

Zone 1 is that area bounded by 165°W longitude and 58°N latitude extending east to the shore.

Zone 2 is that 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.

5. 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 58°N latitude, west of 160°W longitude and east of 163°W longitude (Figure 27a).

6. Herring Savings Areas shown in Figure 27c are defined as follows:

(1) Summer Herring Savings Area 1 means that part of the Bering Sea subarea that is south of 57° latitude and between 162° 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.

(2) Summer Herring Savings Area 2 means that part of the Bering Sea subarea that is south of 56°30' N. latitude and between 164° and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year.

(3) Winter Herring Savings Area means that part of the Bering Sea subarea that is between 58° and 60° N. latitudes and between 172° and 175° W. longitudes from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year.

7. 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', 168° 30.0');
(56° 55.2', 168° 30.0');
(56° 48.0', 169° 2.4');
(56° 34.2', 169° 2.4');
(56° 30.0', 169° 25.2');
(56° 30.0', 169° 44.1');
(56° 55.8', 170° 21.6');
(57° 13.8', 171° 0.0');
(57° 57.0', 171° 0.0');
(57° 57.0', 168° 30.0')

8. Chum Salmon Savings Area Trawling is prohibited from August 1 through August 31 and after September 1, upon the attainment of a bycatch limit of 42,000 "other" salmon taken within the CVOA, 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°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.

9. Chinook Salmon Savings Areas shown in Figure 27e are defined as follows: Trawling is prohibited, upon the attainment of a bycatch limit of 48,000 chinook salmon taken within the BSAI, through April 15, within the following three areas of the BSAI:

(1) The area defined by straight lines connecting the following coordinates in the order listed:

56°30'N., 171°00'W.;
56°30'N., 169°00'W.;
56°00'N., 169°00'W.;
56°00'N., 171°00'W.;
56°30'N., 171°00'W.

(2) The area defined by straight lines connecting the following coordinates in the order listed:

54°00'N., 171°00'W.;
54°00'N., 170°00'W.;
53°00'N., 170°00'W.;
53°00'N., 171°00'W.;
54°00'N., 171°00'W.

(3) The area defined by straight lines connecting the following coordinates in the order listed:

56°00'N., 165°00'W.;
56°00'N., 164°00'W.;
55°00'N., 164°00'W.;
55°00'N., 165°00'W.;
54°30'N., 165°00'W.;
54°30'N., 167°00'W.;
55°00'N., 167°00'W.;
55°00'N., 166°00'W.;
55°30'N., 166°00'W.;
55°30'N., 165°00'W.;
56°00'N., 165°00'W.

10. 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, with the exception that a subarea of the Red King Crab Savings Area may be opened as outlined in Section 14.4.3.2.(G):

56°00'N., 162°00'W.;
56°00'N., 164°00'W.;
57°00'N., 164°00'W.;
57°00'N., 162°00'W.;
56°00'N., 162°00'W.

11. Nearshore Bristol Bay Trawl Closure. All trawling is prohibited year round in Bristol Bay, as described in the current edition of NOAA chart 16006, east of 162° W. long., with the exception that the area bounded by a straight line connecting the following pairs of coordinates in the order listed below would be open to trawling during the period April 1 to June 15 each year:

58°00'N., 160°00'W.;
58°43'N., 160°00'W.;
58°43'N., 159°00'W.;
58°00'N., 159°00'W.;
58°00'N., 160°00'W.

APPENDIX IV. Programs Addressing Habitat of Bering Sea/Aleutian Islands Groundfish Stocks

A. Habitat Protection: Existing Programs

This section describes (a) general legislative programs, portions of which are particularly directed or related to the protection, maintenance, or restoration of the habitat of living marine resources; and (b) specific actions taken by the Council and NMFS within the Bering Sea/Aleutian Island area for the same purpose.

1. Federal legislative programs and responsibilities related to habitat. The Department of Commerce, through NOAA, is responsible for, or involved in, protecting living marine resources and their habitats under a number of Congressional authorities that call for varying degrees of inter-agency participation, consultation, or review. Those having direct effect on Council responsibilities are identified with an asterisk. A potential for further Council participation exists wherever Federal review is required or encouraged. In some cases, State agencies may share the Federal responsibility.

* (a) Magnuson Fishery Conservation and Management Act (Magnuson Act). This Act provides for the conservation and management of U.S. fishery resources within the 200-mile fishery conservation zone, and is the primary authority for Council action. Conservation and management is defined as referring to "all of the rules, regulations, conditions, methods, and other measures which are required to rebuild, restore, or maintain, and which are useful in rebuilding, restoring, or maintaining, any fishery resource and the marine environment, and which are designed to assure that...irreversible or long-term adverse effects on fishery resources and the marine environment are avoided." Fishery resource is defined to include habitat of fish. The North Pacific Council is charged with developing FMPs, FMP amendments, and regulations for the fisheries needing conservation and management within its geographical area of authority. FMPs are developed in consideration of habitat-related problems and other factors relating to resource productivity. After approval of FMPs or FMP amendments. NMFS is charged with their implementation.

(b) Fish and Wildlife Coordination Act of 1958 (FWCA). The FWCA provides the primary expression of Federal policy for fish and wildlife habitat. It requires interagency consultation to assure that fish and wildlife are given equal consideration when a Federal or Federally-authorized project is proposed which controls, modifies, or develops the Nation's waters. For example, NMFS is a consulting resource agency in processing Department of the Army permits for dredge and fill and construction projects in navigable waters, Environmental Protection Agency (EPA) ocean dumping permits, Federal Energy Regulatory Commission hydroelectric power project proposals, and Department of the Interior (DOI) Outer Continental Shelf (OCS) mineral leasing activities, among others.

* (c) National Environmental Policy Act of 1969 (NEPA). NEPA requires that the effects of Federal activities on the environment be assessed. Its purpose is to insure that Federal officials weigh and give appropriate consideration to environmental values in policy formulation, decision-making and administrative actions, and that the public is provided adequate opportunity to review and comment on the major Federal actions. NEPA requires preparation of an Environmental Impact Statement (EIS) for major Federal actions that significantly affect the quality of the human environment, and consultation with the agencies having legal jurisdiction or expertise for the affected resources. NMFS reviews EISs and provides recommendations to mitigate any expected impacts to living marine resources and habitats. An EIS or environmental assessment for a finding of no significant impact is prepared for FMPs and their amendments.

(d) Clean Water Act (CWA). The purpose of the CWA, which amends the Federal Water Pollution Control Act, is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters; to eliminate the discharge of pollutants into navigable waters; and to prohibit the discharge of toxic pollutants in toxic amounts. Discharge of oil or hazardous substances into or upon navigable waters,

contiguous zone and ocean is prohibited. NMFS reviews and comments on Section 404 permits for deposition of fill or dredged materials into U.S. waters, and on EPA National Pollutant Discharge Elimination System permits for point source discharges.

(e) River and Harbor Act of 1899. Section 10 of this Act prohibits the unauthorized obstruction or alteration of any navigable water of the United States, the excavation from or deposition of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such water. Authority was later extended to artificial islands and fixed structures located on the Outer Continental Shelf. The Act authorizes the Department of the Army to regulate all construction and dredge and fill activities in navigable waters to mean high water shoreline. NMFS reviews and comments on Public Notices the Corps of Engineers circulates for proposed projects.

* (f) Endangered Species Act of 1973 (ESA). The ESA provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by DOI (terrestrial, freshwater, and some marine species such as walrus) and DOC (marine fish, and some marine mammals including the great whales). Federal actions that may affect an endangered or threatened species are resolved by a consultation process between the project agency and DOC or DOI, as appropriate. For actions related to FMPs, NMFS provides biological assessments and Section 7 consultations if the Federal action may affect endangered or threatened species or cause destruction or adverse modification of any designated critical habitat.

* (g) Coastal Zone Management Act of 1972 (CZMA). The principal objective of the CZMA is to encourage and assist States in developing coastal zone management programs, to coordinate State activities, and to safeguard the regional and national interests in the coastal zone. Section 307(c) requires that any Federal activity directly affecting the coastal zone of a State be consistent with that State's approved coastal zone management program to the maximum extent practicable. Under present policy, FMPs undergo consistency review. Alaska's coastal zone program contains a section on Resources and Habitats. Following a January 1984 U.S. Supreme Court ruling, the sale of OCS oil and gas leases no longer requires a consistency review; such a review is triggered at the exploratory drilling stage.

* (h) Marine Protection, Research and Sanctuaries Act (MPRSA). Title I of the MPRSA establishes a system to regulate dumping of all types of materials into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect "human health, welfare or amenities or the marine environment, ecological systems, or economic potentialities." NMFS may provide comments to EPA on proposed sites of ocean dumping if the marine environment or ecological systems may be adversely affected. Title III of the MPRSA authorizes the Secretary of Commerce (NOAA) to designate as marine sanctuaries areas of the marine environment that have been identified as having special national significance due to their resource or human-use values. The Marine Sanctuaries Amendments of 1984 amend this Title to include, as consultative agencies in determining whether the proposal meets the sanctuary designation standards, the Councils affected by the proposed designation. The Amendments also provide the Council affected with the opportunity to prepare draft regulations, consistent with the Magnuson Act national standards, for fishing within the FCZ as it may deem necessary to implement a proposed designation.

(i) Outer Continental Shelf Lands Act of 1953, as amended (OCSLA). The OCSLA authorizes the Department of Interior's Minerals Management Service (MMS) to lease lands seaward of state marine boundaries, design and oversee environmental studies, prepare environmental impact statements, enforce special lease stipulations, and issue pipeline rights-of-way. It specifies that no exploratory drilling permit can be issued unless MMS determines that "such exploration will not be unduly harmful to aquatic life in the area, result in pollution, create hazardous or unsafe conditions, unreasonably interfere with other uses of the area, or disturb any site, structure or object of historical or archaeological significance." Drilling and production discharges

related to OCS exploration and development are subject to EPA NPDES permit regulations under the CWA. Sharing responsibility for the protection of fish and wildlife resources and their habitats, NOAA/NMFS, FWS, EPA and the States act in an advisory capacity in the formulation of OCS leasing stipulations that MMS develops for conditions or resources that are believed to warrant special regulation or protection. Some of these stipulations address protection of biological resources and their habitats. Interagency Regional Biological Task Forces and Technical Working Groups have been established by MMS to offer advice on various aspects of leasing, transport, and environmental studies. NMFS is represented on both groups in Alaska.

The Secretary of the Interior is required to maintain an oil and gas leasing program that "consists of a schedule of proposed lease sales indicating, as precisely as possible, the size, timing, and location of leasing activity" that will best meet national energy needs for a 5-year period following its approval or reapproval. In developing the schedule of proposed lease sales, the Secretary is required to take into account the potential impacts of oil and gas exploration on other offshore resources, including the marine, coastal, and human environments.

Once a lease is awarded, before exploratory drilling can begin in any location, the lessee must submit an exploration plan to the Minerals Management Service for approval. An oilspill contingency plan must be contained within the exploration plan. If approved by MMS and having obtained other necessary permits, the lessee may conduct exploratory drilling and testing in keeping with lease sale stipulations and MMS Operating Orders. If discoveries are made, before development and production can begin in a frontier lease area, a development plan must be submitted and a second EIS process begun. At this time, a better understanding of the location, magnitude, and nature of activity can be expected, and resource concerns may once again be addressed before development can be permitted to proceed.

* (j) National Fishing Enhancement Act of 1984. Title II of this Act authorizes the Secretary of Commerce (NOAA) to develop and publish a National Artificial Reef Plan in consultation with specified public agencies, including the Councils, for the purpose of enhancing fishery resources. Permits for the siting, construction, and monitoring of such reefs are to be issued by the Department of the Army under Section 10 of the River and Harbor Act, Section 404 of the Clean Water Act, or Section 4(e) of the Outer Continental Shelf Lands Act, in consultation with appropriate Federal agencies, States, local governments and other interested parties. NMFS will be included in this consultation process.

(k) Northwest Power Act of 1980 (NPA). The NPA includes extensive and unprecedented fish and wildlife provisions designed to assure equitable treatment of fish and wildlife, particularly anadromous fish, in making decisions about hydroelectric projects. Under the NPA, a detailed Fish and Wildlife Program has been established to protect, mitigate, and enhance fish and wildlife in the Columbia River Basin. In addition, general fish and wildlife criteria for hydroelectric development throughout the region have been established in the Regional Energy Plan developed under the Act. NMFS has a statutory role in the development of the Program and the Plan and encourages their implementation by Federal agencies such as the Federal Energy Regulatory Commmission, the Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration.

(l) Alaska National Interest Lands Conservation Act of 1980 (ANILCA). The purpose of this Act is to provide for the designation and conservation of certain public lands in Alaska. The Department of Agriculture Forest Service has authority to manage surface resources on National Forest Lands in Alaska. Under Title V of this Act, any regulations for this purpose must take into consideration existing laws and regulations to maintain the habitats, to the maximum extent feasible, of anadromous fish and other foodfish, and to maintain the present and continued productivity of such habitat when they are affected by mining activities. For example, mining operations in the vicinity of the Quartz Hill area in the Tongass National Forest must be conducted in accordance with an approved operations plan developed in consultation with NMFS;

consultation continues through the monitoring and altering of operations through an annual review of the operations plan. Title XII of the Act establishes an Alaska Land Use Council to advise Federal agencies, the State, local governments and Native Corporations with respect to land and resource uses in Alaska. NOAA is named as a member of this Council.

* (m) Marine Mammal Protection Act (MMPA). The Marine Mammal Protection Act establishes a moratorium on the taking of marine mammals and a ban on the importation of marine mammal products with certain exceptions. Responsibility is divided between DOC (whales, porpoises, seals, and sea lions) and DOI (other marine mammals) to issue permits and to waive the moratorium for specified purposes, including incidental takings during commercial fishing operations. The Magnuson Act amended the MMPA to extend its jurisdiction to the FCZ. If the FMP has effect on marine mammal populations, certain information must be included in the EIS, and the FMP should indicate whether permits are available for any incidental takings.

2. Specific actions taken by the Council and NMFS related to habitat for the for the Bering Sea/Aleutian Islands Groundfish fishery.

(a) Gear limitations that act to protect habitat or critical life stages. Section 611.16 of the foreign fishing regulations prohibit discard of fishing gear and other debris by foreign fishing vessels.

(b) Other management measures that act to allow for contingencies in the condition of the stock. Sections 675.20(a)(3) and 611.93 of the Bering Sea/Aleutian Islands Groundfish regulations establish a Reserve at 15 percent of the TAC; on specified dates, that portion of this reserve which the NMFS Regional Director finds will be harvested by U.S. vessels during the remainder of the year will be allocated to DAH, with the rest allocated to TALFF. However, the Regional Director is also permitted to withhold reserves for conservation purposes.

(c) Recommendations to permitting agencies regarding lease sales. Recommendations have been made to permitting agencies on all past proposed lease sales on the Alaska OCS, in the interests of protecting or maintaining the marine environment. These recommendations have ranged from calling for delay or postponement of certain scheduled sales such as in Bristol Bay and Kodiak, requesting deletions of certain areas from sales, identifying need for additional environmental studies and for protective measures such as burial of pipelines, seasonal drilling limitations, and oilspill counter-measure planning. For example, in 1979, the Council unanimously requested an indefinite postponement of the St. George Basin lease sale, citing incomplete research results and a concern for the possibility of oil spills in an area of great economic and biologic importance. The comment was transmitted to the NMFS Central Office for transmittal to the Department of the Interior.

B. Non-regulatory techniques to address identified habitat problems.

The following is a list of "real time" possible non-regulatory actions or strategies the Council may wish to take in the future, based on concerns expressed and data presented or referenced in this FMP. Actions taken must also be consistent with the goals and objectives of the FMP. Authorities for Council participation are described in Appendix IV-A, above. Possible regulatory actions may be found in section 13.7.

- Hold hearings to gather information or opinions about specific proposed projects having a potentially adverse affect on habitats of species in the Bering Sea/Aleutian Island groundfish fishery.

- Write comments to regulatory agencies during project review periods to express concerns or make recommendations about issuance or denial of particular permits.

- Respond to "Calls for Information" from MMS regarding upcoming oil and gas lease areas affecting the Bering Sea/Aleutian Islands.

- Identify research needs and recommend funding for studies related to habitat issues of new or continuing concern and for which the data base is limited.

- Establish review panels or an ad hoc task force to coordinate or screen habitat issues.

- Propose to other regulatory agencies additional restrictions on industries operating in the fisheries management area, for purposes of protecting the habitat against loss or degradation.

- Join as amicus in litigation brought in furtherance of critical habitat conservation, consistent with FMP goals and objectives.

ANNEX I -- Content of Stock Assessment and Fishery Evaluation Report

Stock Assessment and Fishery Evaluations (SAFEs) will be prepared annually by the Council's plan team (PT) with the assistance of the NMFS Northwest and Alaska Fisheries Center, other agencies, or other scientists noted for their expertise in groundfish biology. The SAFE will provide the biological information base necessary to manage groundfish stocks under a multi-species ecosystem management regime.

The SAFE will provide information on the historical catch trend, estimates of the MSY 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.

Current estimates of individual species' and species groups' ABC and MSY can be found in Bakkala, et al., 1989. These estimates are updated annually as part of the stock assessments prepared by the National Marine Fisheries Service for the annual meeting of the International North Pacific Fisheries Commission.

The SAFE will annually update the biological information base necessary for multispecies management. It will also provide readers and reviewers with knowledge of the factual basis for TAC decisions, and illustrate the manner in which new data and analyses are used to obtain individual species groups' estimates of ABC and MSY.

Copies of the most recent SAFE are available from the North Pacific Fishery Management Council, 605 W 4th Avenue, Suite 306, Anchorage, Alaska, 99501.

ANNEX II -- Derivation of Total Allowable Level of Foreign Fishing (TALFF)

The initial TALFF for each target species and for the "other species" category will be determined annually by the following equation:

$$TALFF = TAC - (DAH + Reserves)$$

The final TALFF for each target species and the "other species" category will equal the initial TALFF plus any Reserves or Unneeded DAH which are reallocated to TALFF during the fishing year as explained in Section 11.4

ANNEX III -- Catch Statistics of the Bering Sea/Aleutian Groundfish Fishery

Table A All nation catches in the Bering Sea/Aleutian Region, by major species groups for the last 10 years of record.

Table B Detailed statistics of the foreign fisheries in the Aleutians area, 1962-77.

Table C Detailed statistics of the foreign fisheries in the eastern Bering Sea, 1954-77.

ANNEX IIIA--All-nation catches in the Bering Sea/Aleutian Region, by major species groups, for the last 10 years of record (1000's mt)1/.

Species/	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978 2/
Pollock	702	863	1,257	1,744	1,875	1,759	1,588	1,357	1,238	888.2	921.3
Pacific cod	63.7	53.3	74.6	50.5	47.0	58.6	67.0	55.1	57.8	36.5	37.3
Pacific ocean perch	76.4	53.3	76.8	31.6	38.9	15.5	36.5	25.2	32.6	10.8	7.4
Sablefish	20.5	20.4	13.8	18.0	19.0	10.6	7.7	5.0	8.2	4.6	1.6
Halibut	7.1	6.3	7.7	8.6	5.9	4.3	2.2	1.6	1.2	0.6	4/
Flounders	149.9	236.2	234.9	323.4	237.7	207.1	196.3	200.4	187.2	121.9	208.3
Atka mackerel	3/	3/	1.0	3/	4.7	1.7	1.4	13.3	20.7	21.0	22.4
Others	31.5	14.4	25.9	41.5	134.7	62.3	79.9	61.9	45.6	57.3	73.9
All species	1,051.1	1,247.1	1,691.7	2,216.6	2,362.9	2,119.1	1,979.0	1,719.5	1,591.3	1,140.9	1,272.2

1/ Values in this table may differ slightly from those used elsewhere in this document because of differences in apportioning between species not clearly listed in foreign statistical reports or differences in treating estimates based on U.S. surveillance when catches were not reported.
2/ Preliminary.
3/ Catch, if any, included under "Others".
4/ Unknown at this time

ANNEX IIIB

--Foreign catches of groundfish in the Aleutian Island region (170°W to 170°E) by calendar year, 1962-76.[1/2/] (mt)

Species	Nation	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Pollock	Japan	6	1,359	543	633	1,102	1,359	2,680	512	178	624	571	848	1,318	1,519	55
	USSR	—	—	—	—	—	—	—	726	9,490	2,535	866	9,628	21,346	12,262	3,67
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	34
	TOTAL	6	1,359	543	633	1,102	1,359	2,680	1,238	9,668	3,159	1,437	10,476	22,664	13,781	4,56
Pacific cod	Japan	26	601	241	451	154	274	289	220	283	425	435	566	1,334	2,581	3,4
	USSR	—	—	—	—	—	—	—	—	—	1,653	—	411	45	257	3
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	26	601	241	451	154	274	289	220	283	2,078	435	977	1,379	2,838	3,8
Pacific ocean perch and other rockfish	Japan	214	7,636	29,377	38,204	28,733	10,285	23,889	15,641	14,173	14,809	8,789	9,793	22,317	9,528	9,8
	USSR	—	20,000	61,000	71,000	57,700	45,720	26,584	23,172	53,274	7,190	24,595	3,017	824	8,147	6,9
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	214	27,636	90,377	109,204	86,433	56,005	50,473	38,813	64,447	21,999	33,384	12,810	23,141	17,675	16,7
Blackcod	Japan	—	639	1,496	1,224	1,321	1,608	1,676	1,667	1,246	2,700	3,308	2,690	2,451	1,624	1,4
	USSR	—	—	—	—	—	—	—	—	—	170	269	162	14	79	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	—	639	1,496	1,224	1,321	1,608	1,676	1,667	1,246	2,870	3,577	2,852	2,465	1,703	1,5
Atka mackerel	Japan	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	USSR	—	—	—	—	—	—	—	—	—	—	4,515	1,604	1,377	12,078	20,0
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	—	—	—	—	—	—	—	—	—	—	4,515	1,604	1,377	12,078	20,0
Yellowfin sole	Japan	—	2	61	92	98	18	6	20	9	1	—	—	—	—	
	USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	—
	TOTAL	—	2	61	92	98	18	6	20	9	1	—	—	—	—	
Rock sole	Japan	—	27	152	147	82	25	17	2	2	1	5	2	36	3	
	USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	—
	TOTAL	—	27	152	147	82	25	17	2	2	1	5	2	36	3	
Flathead sole	Japan	—	14	43	128	25	32	186	2	11	16	4	24	41	1	
	USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	—
	TOTAL	—	14	43	128	25	32	186	2	11	16	4	24	41	1	
Alaska plaice	Japan	—	—	45	41	—	—	—	—	—	—	—	—	—	—	
	USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	—
	TOTAL	—	—	45	41	—	—	—	—	—	—	—	—	—	—	
Halibut	Japan	1	67	681	1,268	163	215	333	331	350	387	357	245	363	145	
	USSR	—	—	—	—	—	—	—	—	—	—	1	4	4	3	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	—
	TOTAL	1	67	681	1,268	163	215	333	331	350	387	358	249	367	148	
Arrowtooth flounder	Japan	CATCHES OF ARROWTOOTH FLOUNDER AND GREENLAND TURBOT COMBINED UNTIL 1970								274	581	1,323	3,705	3,195	784	
	USSR									—	—	—	—	—	—	1
	ROK									—	—	—	—	—	—	
	TOTAL									274	581	1,323	3,705	3,195	784	1
Greenland turbot	Japan	—	7	504	300	63	394	213	228	285	1,750	12,874	8,666	8,788	2,970	1
	USSR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	—	7	504	300	63	394	213	228	285	1,750	12,874	8,666	8,788	2,970	1
Other groundfish	Japan	—	513	66	768	131	563	318	2,361	1,181	2,753	3,028	2,630	7,998	8,110	
	USSR	—	—	—	—	—	7,979	8,630	727	9,490	220	19,419	1,614	1,726	178	
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
	TOTAL	—	513	66	768	131	8,542	8,948	3,088	10,671	2,973	22,447	4,244	9,724	8,288	
All groundfish total	Japan	247	10,865	33,209	43,286	31,872	14,773	29,607	20,984	17,992	24,047	30,694	29,189	47,841	27,265	2
	USSR	—	20,000	61,000	71,000	57,700	53,699	35,214	24,625	72,254	11,768	49,665	16,440	25,336	33,004	3
	ROK	0	0	0	0	0	—	—	—	—	—	—	—	—	—	
All nations total		247	30,865	94,209	114,286	89,572	68,472	64,821	45,609	90,246	35,815	80,359	45,609	73,177	60,269	5

1/ Catch statistics up to 1963 from Forrester et al. 1974 and for 1964-76 from data on file, Northwest and Alaska Fisheries Center, with the following exceptions: Pacific ocean perch and other rockfish - USSR catches for 1963-66 from Chikuni 1975; all flounders except halibut - all national catches, 1963-75 from Wakabayashi and Bakkala 1977.

2/ 0 indicates no fishing, — indicates fishing, but no catch reported.

3/ Japanese catches for November and December 1976 not included; 1976 catches of flounders (except halibut) by USSR and ROK prorated to species based on species composition in Japanese catch.

ANNEX IIIB (cont'd)

Foreign catches of groundfish in the Aleutian Island region (170°W to 170°E by calendar year, 1976-77. 1/ 2/

Species	Nation	1976	1977 3/
Pollock	Japan	1,015	5,870
	USSR	3,673	1,619
	ROK	344	325
	ROC	0	15
	Total	5,032	7,829
Pacific cod	Japan	3,862	3,162
	USSR	312	100
	ROK	16	-
	ROC	0	-
	Total	4,190	3,262
Pacific ocean perch and other rockfish	Japan	11,204	12,708
	USSR	6,951	786
	ROK	33	87
	ROC	0	2
	Total	18,188	13,583
Blackcod	Japan	1,569	1,768
	USSR	61	-
	ROK	71	86
	ROC	0	-
	Total	1,701	1,854
Atka mackerel	Japan	5	585
	USSR	20,092	20,971
	ROK	-	-
	ROC	0	-
	Total	20,097	21,556
Yellowfin sole	Japan	14	100
	USSR	110	-
	ROK	-	-
	ROC	0	-
	Total	124	100
Rock sole	Japan	23	75
	USSR	71	3
	ROK	-	-
	ROC	0	-
	Total	94	78

ANNEX IIIB (cont'd)

Flathead sole	Japan	7	37
	USSR	55	1
	ROK	-	-
	ROC	0	-
	Total	62	38
Alaska plaice	Japan	-	-
	USSR	-	-
	ROK	-	-
	ROC	0	-
	Total	-	-
Pacific halibut	Japan	15	1
	USSR	2	-
	ROK	-	-
	ROC	0	-
	Total	17	1
Arrowtooth flounder	Japan	1,375	2,297
	USSR	-	9
	ROK	5	-
	ROC	0	1
	Total	1,380	2,307
Greenland turbot	Japan	1,953	2,981
	USSR	112	57
	ROK	6	-
	ROC	0	3
	Total	2,071	3,041
Other groundfish	Japan	5,410	10,723
	USSR	326	4,661
	ROK	241	-
	ROC	0	-
	Total	5,977	15,384
All groundfish total	Japan	26,452	40,307
	USSR	31,765	28,207
	ROK	716	498
	ROC	0	21
All nation total		58,933	69,033

ANNEX IIIC--Foreign catches of groundfish in the eastern Bering Sea (east of 180°) by calendar year, 1954-76 1/ 2/ (mt)

Species	Nation	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	196
Pollock	Japan	—	—	—	—	6,924	32,793	26,097	24,216	58,765	103,353	171,957	229,275
	USSR	0	0	0	0	—	—	—	—	—	—	—	—
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	6,924	32,793	26,097	24,216	58,765	103,353	171,957	229,275
Pacific cod	Japan	—	—	—	—	171	2,864	5,679	2,448	6,054	3,879	13,408	14,722
	USSR	0	0	0	0	—	—	—	—	—	—	—	—
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	171	2,864	5,679	2,448	6,054	3,879	13,408	14,722
Pac. ocean perch and other rockfish	Japan	—	—	—	—	—	—	1,100	13,000	12,900	17,500	13,588	8,723
	USSR	0	0	0	0	—	—	5,000	34,000	7,000	7,000	7,000	9,000
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	—	—	6,100	47,000	19,900	24,500	20,588	17,723
Blackcod	Japan	—	—	—	—	32	393	1,861	26,183	28,521	18,404	6,165	5,001
	USSR	0	0	0	0	—	—	—	—	—	—	—	—
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	32	393	1,861	26,183	28,521	18,404	6,165	5,001
Yellowfin sole	Japan	12,562	14,690	24,697	24,145	39,153	123,121	360,103	399,542	281,103	20,504	48,880	26,039
	USSR	0	0	0	0	5,000	62,200	96,000	154,200	139,600	65,306	62,297	27,771
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	12,562	14,690	24,697	24,145	44,153	185,321	456,103	553,742	420,703	85,810	111,177	53,810
Rock sole	Japan	—	—	—	—	—	—	—	—	—	1,196	1,432	1,780
	USSR	0	0	0	0	—	—	—	—	—	3,806	1,806	1,898
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	—	—	—	—	—	5,002	3,238	3,678
Flathead sole	Japan	—	—	—	—	—	—	—	—	—	7,079	11,121	3,28
	USSR	0	0	0	0	—	—	—	—	—	22,546	14,167	3,42
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	—	—	—	—	—	29,625	25,288	6,713
Alaska plaice	Japan	—	—	—	—	—	—	—	—	—	233	808	474
	USSR	0	0	0	0	—	—	—	—	—	742	1,030	505
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	—	—	—	—	—	975	1,838	979
Pacific halibut	Japan	—	—	—	—	196	674	6,931	3,480	7,863	7,452	1,271	1,369
	USSR	0	0	0	0	—	—	—	—	—	—	—	—
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	196	674	6,931	3,480	7,865	7,452	1,271	1,369
Arrowtooth flounder	Japan	---Catches of arrowtooth flounder and Greenland turbot combined until 1970---											
	USSR												
	ROK												
	TOTAL												
Greenland turbot	Japan	—	—	—	—	—	—	36,843	57,348	58,226	31,565	33,729	7,947
	USSR	0	0	0	0	—	—	—	—	—	—	—	1,800
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	—	—	36,843	57,348	58,226	31,565	33,729	9,747
Other ground-fish	Japan	—	—	—	—	147	380	10,260	554	5,931	1,102	736	2,218
	USSR	0	0	0	0	—	—	—	—	—	—	—	—
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	—	—	—	—	147	380	10,260	554	5,931	1,102	736	2,218
All ground-fish total	Japan	12,562	14,690	24,697	24,145	46,623	160,225	448,874	526,771	459,365	212,267	303,095	300,835
	USSR	0	0	0	0	5,000	62,200	101,000	188,200	146,600	99,400	86,300	44,400
	ROK	0	0	0	0	0	0	0	0	0	0	0	0
All nation total		12,562	14,690	24,697	24,145	51,623	222,425	549,874	714,971	605,965	311,667	389,395	345,23

ANNEX IIIC (cont'd)

Species	Nation	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976 3/
Pollock	Japan	261,694	550,152	701,124	830,525	1,231,347	1,514,030	1,616,532	1,471,189	1,250,654	1,065,078	912,728
	USSR	—	—	—	33,571	35,590	233,511	213,895	280,005	309,613	216,567	175,539
	ROK	0	0	1,200	5,000	5,000	10,000	9,200	3,100	26,000	3,438	84,987
	TOTAL	261,694	550,152	702,324	869,096	1,271,937	1,757,541	1,839,627	1,754,294	1,586,267	1,285,083	1,173,254
Pacific cod	Japan	18,200	31,982	57,915	50,487	70,078	40,555	35,877	40,817	45,915	33,322	29,086
	USSR	—	—	—	—	—	2,486	7,028	12,569	16,547	18,229	17,756
	ROK	0	0	—	—	—	—	—	—	—	—	716
	TOTAL	18,200	31,982	57,915	50,487	70,078	43,041	42,095	53,386	62,462	51,551	47,558
Pac. ocean perch and other rockfish	Japan	16,786	20,598	26,214	16,150	10,392	10,369	5,837	3,147	6,811	3,716	3,163
	USSR	9,000	—	3,087	—	—	—	150	475	31,877	16,465	12,124
	ROK	0	0	—	—	—	—	—	—	—	—	578
	TOTAL	25,786	20,598	29,301	16,150	10,392	10,369	5,987	3,622	38,688	20,181	15,865
Blackcod	Japan	9,502	10,330	10,143	14,454	8,897	12,304	10,643	4,769	4,189	2,776	2,569
	USSR	—	1,237	4,256	1,579	2,874	2,830	2,137	1,192	77	38	29
	ROK	0	0	—	—	—	—	—	—	—	—	115
	TOTAL	9,502	11,567	14,399	16,033	11,771	15,134	12,780	5,961	4,266	2,814	2,713
Yellowfin sole	Japan	45,423	60,429	40,834	81,449	59,851	82,179	34,846	75,724	37,947	59,715	33,328
	USSR	56,930	101,799	43,355	85,685	73,228	78,220	13,010	2,516	4,288	6,060	3,343
	ROK	0	0	—	—	—	—	—	—	—	—	635
	TOTAL	102,353	162,228	84,189	167,134	133,079	160,399	47,856	78,240	42,235	65,775	37,306
Rock sole	Japan	4,037	1,890	2,633	4,285	9,616	20,159	43,055	22,840	17,311	9,682	7,828
	USSR	5,067	2,872	2,617	4,955	10,507	20,260	17,769	995	2,664	1,463	785
	ROK	0	0	—	—	—	—	—	—	—	—	150
	TOTAL	9,104	4,762	5,250	9,240	20,123	40,419	60,824	23,835	19,975	11,145	8,763
Flathead sole	Japan	4,996	10,621	11,851	9,168	20,088	25,538	9,850	17,190	12,889	4,873	6,911
	USSR	6,024	12,816	9,724	9,395	21,064	25,486	5,840	951	2,028	672	692
	ROK	0	0	—	—	—	—	—	—	—	—	132
	TOTAL	11,020	23,437	21,575	18,563	41,152	51,024	15,690	18,141	14,917	5,545	7,735
Alaska plaice	Japan	2,054	1,340	1,223	3,127	1,326	517	171	1,082	2,168	2,407	2,064
	USSR	2,579	2,513	1,396	3,815	2,076	475	119	35	220	207	207
	ROK	0	0	—	—	—	—	—	—	—	—	40
	TOTAL	4,633	3,853	2,619	6,942	3,402	992	290	1,117	2,388	2,614	2,311
Pacific halibut	Japan	2,199	3,756	2,775	2,764	1,735	4,861	955	644	81	137	87
	USSR	—	—	—	—	—	—	490	296	123	137	58
	ROK	0	0	—	—	—	—	—	—	—	—	—
	TOTAL	2,199	3,756	2,775	2,764	1,735	4,861	1,445	940	204	274	145
Arrowtooth flounder	Japan					9,354	11,603	3,823	4,929	2,823	1,241	1,652
	USSR					3,244	7,189	9,301	4,288	18,650	19,591	16,132
	ROK					—	—	—	—	—	—	32
	TOTAL					12,598	18,792	13,124	9,217	21,473	20,832	17,816
Greenland turbot	Japan	10,842	21,230	19,980	19,231	14,715	30,193	49,813	43,354	58,834	52,625	17,583
	USSR	2,200	2,639	15,252	16,798	4,976	10,271	14,697	11,926	10,820	12,194	8,867
	ROK	0	0	—	—	—	—	—	—	—	—	335
	TOTAL	13,042	23,869	35,232	36,029	19,691	40,464	64,510	55,280	69,654	64,819	26,785
Other groundfish	Japan	2,239	4,378	2,984	4,182	9,227	29,617	32,370	39,911	47,491	42,531	44,504
	USSR	—	—	19,074	6,277	6,068	3,879	78,523	15,915	12,770	12,314	12,294
	ROK	0	0	—	—	—	—	—	—	—	—	322
	TOTAL	2,239	4,378	22,058	10,459	15,295	33,496	110,893	55,826	60,261	54,845	57,120
All groundfish total	Japan	377,972	716,706	877,676	1,035,822	1,446,626	1,781,925	1,843,772	1,725,596	1,487,113	1,278,103	1,061,503
	USSR	81,800	123,876	98,761	162,075	159,627	384,607	362,959	331,163	409,677	303,937	247,826
	ROK	0	0	1,200	5,000	5,000	10,000	9,200	3,100	26,000	3,438	88,042
All nation total		459,772	840,582	977,637	1,202,897	1,611,253	2,176,532	2,215,931	2,059,859	1,922,790	1,585,478	1,397,371

1/ Catch statistics up to 1963 from Forrester et al., 1974, and for 1964-76 from data on file, Northwest Alaska Fisheries Center, Seattle, with the following exceptions: Pacific ocean perch and other rockfish—Jap catches 1960-63 and USSR catches 1960-66 from Chikuni 1975; blackcod—Japanese catches 1958-63 from Sasaki 19 and all flounders except halibut—all nation catches, 1954-75 from Wakabayashi and Bakkala 1977.

2/ 0 means no fishing. — means fishing, but no reported catch.

3/ Japanese catches for November and December 1976 not included; USSR and ROK catches of flounders (exc halibut) prorated to species based on species composition of Japanese catches.

ANNEX IIIC (cont'd)

Foreign catches of groundfish in the eastern Bering Sea (east of 180°) by calendar year, 1976-77.[1/] [2/]

Species	Nation	1976	1977[3/]
Pollock	Japan	986,696	774,450
	USSR	175,539	63,383
	ROK	84,987	39,895
	ROC	0	1,334
	Total	1,247,222	879,062
Pacific cod	Japan	32,009	33,141
	USSR	17,756	178
	ROK	716	-
	ROC	0	2
	Total	50,481	33,321
Pacific ocean perch and other rockfish	Japan	3,300	7,761
	USSR	12,124	90
	ROK	578	478
	ROC	0	-
	Total	16,002	8,329
Blackcod	Japan	2,815	2,801
	USSR	29	-
	ROK	115	9
	ROC	0	53
	Total	2,959	2,863
Yellowfin sole	Japan	52,673	58,139
	USSR	2,908	284
	ROK	655	-
	ROC	0	55
	Total	56,236	58,478
Rock sole	Japan	8,598	4,906
	USSR	1,328	805
	ROK	107	-
	ROC	0	5
	Total	10,033	5,716
Flathead sole	Japan	7,379	7,025
	USSR	795	1,069
	ROK	90	-
	ROC	0	6
	Total	8,264	8,100
Alaska plaice	Japan	3,519	3,118
	USSR	102	516
	ROK	44	-
	ROC	0	3
	Total	3,665	3,637

ANNEX IIIC (cont'd)

Pacific halibut	Japan	88	-
	USSR	58	-
	ROK	-	-
	ROC	0	2
	Total	146	2
Arrowtooth flounder	Japan	1,717	6,758
	USSR	16,132	669
	ROK	2	-
	ROC	0	4
	Total	17,851	7,431
Greenland turbot	Japan	51,677	31,942
	USSR	8,867	3,082
	ROK	425	-
	ROC	0	18
	Total	60,969	35,042
Other groundfish	Japan	13,527	26,950
	USSR	12,294	614
	ROK	322	1,445
	ROC	0	-
	Total	26,143	29,009
All groundfish total	Japan	1,163,998	956,991
	USSR	247,932	70,690
	ROK	88,041	41,827
	ROC	0	1,482
All nation total		1,499,971	1,070,990

Updated footnotes for Annex 3B and 3C, Bering Sea Groundfish MP

1/ Catch statistics up to 1963 from Forrester et al. 1974 and for 1964-76 from data on file, Northwest and Alaska Fisheries Center, with the following exceptions: Pacific ocean perch and other rockfish - USSR catches for 1963-66 from Chikuni 1975; all flounders except halibut - all national catches, 1963-76 from Wakabayashi and Bakkala, 1978.

2/ 0 indicates no fishing, -- indicates fishing, but no catch reported.

3/ Catches of flounders by USSR and ROK are preliminary.

ANNEX IV

INFORMATION ON MARINE MAMMAL POPULATION

Information on distribution and migration, abundance and trends, feeding habits, and any problems induced by fisheries on seven marine mammal populations in the Bering Sea/Aleutian Region was provided by the Marine Mammal Division of the Northwest and Alaska Fisheries Center and included in this annex, the information if summarized mainly from the annual report of the Department of Commerce on the Administrative of the Marine Mammal Protection Act of 1972 for the period of April 1, 1977 through March 31, 1978 (DOC, 1978) and the Final Environmental Impact Statement on Consideration of a Waiver of the Moratorium and Return of Management of Certain Marine Mammals to the State of Alaska, Volumes I and II (DOC and DOI, 1977).

NORTHERN SEA LION (Eumetopias jubatus)

Distribution and Migration: The northern (stellar) sea lion is found in continental shelf water from the Sea of Japan and northern Honshu, Japan, northward around the North Pacific Ocean rim to Okhotsk and Bering Sea and southward to the California Channel Islands. Some seasonal movements occur in parts of its range.

Abundance and Trends: Mate (1976) estimated a world population of 250,000 to 325,000 animals. Alaska has 202 know rookeries and hauling grounds. The Alaska population has increased since exploitation diminished in the early 1900's and now exceeds 200,000 according to a 1973 ADF&G estimate. However, recent studies in the eastern Aleutian Islands indicate a 50% decline in population sizes since the late 1950's (Braham et al, 1977).

Factors which may have caused this decline include (1) a westward shift in distribution, (2) commercial fisheries interaction, (3) leptospirosis and/or (4) unidentified population control factor.

Feeding Habits: Norther sea lions eat a variety of fish and cephalopods. Based on frequency of occurrence, one study revealed that fish composed 74.2% of the diet, cephalopod - 17.2 %, and decapod crustaceans - 8.6% Analysis based on percentage of total individuals provided a some what different picture. Fishes completely dominated the diet at 97.6% of total individuals. Cephalopods followed at 2.0% and decapod crustaceans at 0.6%. Groundfishes constituted 57.7% of the sea lion diet based frequency of occurrence and 90.8% based on percentage of total individuals (Clakins and Pitcher, 1977). Pollock was the dominate groundfish. Details of the diet are summarized as follows:

Area: Cape Spencer to Scotch Cap on Unimak Island
Northern Sea Lions - 68 Samples

Prev Item	No. of Occurrences	% Occurrences	No. of Individuals	% of Total Individuals
Gadidae	57	49.1	1135	89.2
Pollock	47	40.5	1072	84.3
Pacific cod	6	5.2	33	2.6
Other Gadidae	4	3.4	30	2.3
Scorpaenidae				
Rockfishes	2	1.7	6	0.5
Pleuronectidae	8	6.9	14	1.1
Starry Flounder	1	0.9	1	0.2
Rock Sole	1	0.9	1	0.1
Yellowfin sole	1	0.9	2	0.2
Flathead sole	2	1.7	2	0.2
Other Pleuronectidae	3	2.5	8	0.4
Total Groundfish	67	57.7	1155	90.8

Problems: Northern sea lions have damaged gear and destroyed fish in halibut longline, salmon purse seine, gillnet, and troll fisheries. Because groundfish make up such a large part of the sea lion's diet, this species will probably be one of the marine mammals most impacted by the groundfish fisheries and will be the species which should bear close watching as groundfish policies considered. This is important in light of recent declines in populations in the eastern Aleutian Islands.

NORTHERN FUR SEA (Callorhinus ursinus)

Distribution and Migration: Northern fur seals are found at sea along the continental shelf from the Bering Sea south along both sides of the North Pacific Ocean to latitude 32°N. Most animals are on their breeding grounds from May through November to bear young to breed.

Abundance and Trends: A program of reducing the population of Pribilof Island fur seals was begun in 1956 with the expectation that the rate of survival would improve and result in an increased yield of pelts. By 1968, the population has been reduced below levels which would yield the maximum sustainable yield. Thus female fur seals were excluded from harvest in expectation that there would be an increase in pup production. However, expected increases have not been observed. The population levels of the northern fur seal is estimated to be 1,765,000. There are in excess of 700,000 adults in the eastern Bering Sea in summer.

Feeding Habits: The northern fur seal is an opportunistic feeder, taking squid and a variety of fishes including herring, anchovy, salmon, capelin, saury, walleyed pollock, and mackerel. Fishes are estimated to constitute about 80% of the fur sea diet. Average size of pollock (the dominant food item observed in fur seal stomachs is 20 cm. Some figures, from McAlister and Perez (1977) indicated the following consumptions of groundfish by northern fur seals.

	In the Aleutians	In the Bering Sea
Walleye pollock	9.4%	39.4%
Sablefish	4.8%	1.0%
Other Gadidae	5.7%	
Pleuronectidae	—	1.4%
% Groundfish	14.2%	47.5
% Other fish	75.0%	31.8%
Total fish	89.2%	79.3%
Total squid	10.8%	20.7%

Problems: Fur seals and commercial fisheries may compete for the same species of fish.

BEARDED SEAL (Erignathus barbatus)

Distribution and Migration: The bearded seal is found in the North Pacific region in the Bering, Okhotsk, and northern Japan Seas. Bearded seals migrate seasonally in association with the advance and retreat of the ice packs. These seals do not normally come ashore.

Abundance and Trends: No satisfactory method of accurately censusing bearded seals has been attempted to date. A 1971 Soviet estimate places the level of bearded sea populations of the East-Siberian, Chukchi, Bering, Okhotsk, and Japan Seas at 450,00. The Alaska Department of Fish and Game (1973) estimated a populations of 300,000 animals in the Bering, Chukchi, East-Siberian, and Beaufort Seas. The population appears to be high and stable (DOC, 1978).

Feeding Habits: The bearded seal consumes several species of invertebrates, primarily crabs, shrimps, clams, and amphipods, and some demersal fishes. One study indicates that fishes constitute about 10% of the bearded seal's diet and another study, performed in the Beaufort Sea, stated that about 25% of this animal's diet is fishes, in this case primarily polar cod.*

Problems: None at the present. Bearded seals consume commercially important pandalid and crangoid shrimps and lithods crabs; however, they do not compete directly for commercial fish nor do they damage fishing gear.

*Lowry, Frost, and Burns. Trophic relationships Among Ice Inhabiting Seals. Environmental Assessment of the Alaska Continental Shelf, PI Annual Report, March 77, Vol. 1, p. 226.

> Area: North and east of Pt. Barrow
> Bearded seals: 3 samples
> Of the three samples, one consisted of only one shrimp. One of the seals was taken in November and 64% of the contents were invertebrates and 36% of the contents were fish, mostly saffron cod, but also polar cod, sea snail and eelpout. The third sea was taken in August and it contained 83% invertebrates, mostly isopods. Of the fish in the stomach, 53% were polar cod, 38% were sculpins, and 5% were sea snails. The authors concluded that bearded seals eat a diverse diet but the bulk of it is bivalve mollusk, crabs, shrimps, and sculpins.

RINGED SEA (Phoca hispida)

Distribution and Migration: The ringed seal is circumarctic in distributions throughout the ice pack. In the North Pacific Ocean it is found in the Bering, Chukchi, and Okhotsk Seas and in the permanent ice pack of the Polar Basin. In winter, most ringed seals occupy areas of land-fast ice, but non-breeding adults and juveniles may be found wherever ice occurs. Apparently, animals wintering in the Bering and Chukchi Seas move northward in spring as the ice recedes and southward in autumn as it advances again. In western Alaska, the ringed seal is the dominant nearshore seal during ice-free months.

Abundance and Trends: No satisfactory method of accurately censusing ringed seals, through their range, has been attempted to date. The Alaska Department of Fish & Game (1973) estimated the ringed seal population in the Bering-Chukchi Seas to be about 250,000. Annual harvest by both Soviets and Americans in this area are between 12,000 and 16,000 animals per year. Overall, the population in the Bering-Chukchi Seas appears to be high and is probably stable.

Feeding Habits: In western Alaska, this seal feeds mainly on mysids, amphipods, euphasiids, shrimps, saffron cod, polar cod, and sculpin. A recent stomach analysis of ringed seals in the Beaufort Sea reported that about 83% of the ringed seal's diet was invertebrates and about 17% was fish, almost exclusively polar cod.*

Problems: None at the present. Little competition is known to exist between ringed seals and man for fishery resources.

*Lowry, Frost, and Burns. Trophic Relationships Among Ice Inhabiting Seals. Environmental Assessment of the Alaska Continental Shelf, PI Annual, Report, March 1977. Vol. 1, p. 226

> Ringed seals - 21 samples.
> Fish constituted from 00.0-13% of the food material in various sub-samples. There were 73 polar cod (Boreagradus, saida), one saffron cod (Eleginus gracillus), and tow capelin (Mallotus villesus) found in all the samples. Invertebrates were the bulk of the contents. The authors concluded that ringed seals eat primarily nektonic creatures, small benthic crustaceans, and small to medium-size schoolingfish. Benthic fish are the minor food item.

HARBOR SEAL (Phoca vitulina)

Distribution and Migration: The harbor sea is found in the North Pacific Ocean from the Bering Sea south to Baja California and southern Japan and Korean. The harbor sea is the predominant nearshore seal in ice-free waters north of latitude 35°N.

Abundance and Trends: Overall, the world population of harbor seals appears to be high and stable. A 1976 estimate indicated a population of 312,500 to 317,500 in the Pacific (Adv. Comm. Mar. Resour. Res., 1976).

Feeding Habits: The diet of the harbor seal, which varies according to season and location of specific populations, includes primarily pelagic, demersal, and anadromous fishes, cephalopods, and crustaceans. About half of this seal's diet is fish.

Problems: These seals damage commercial fishing gear and compete with man for fish as herring, salmon, smelt, and whitefish. These animals are extremely sensitive to disturbance and may leave an area after continual harassment by people, equipment, or aircraft.

LARGE SEAL (Phoca largha)

Distribution and Migration: The larga seal is found in the Bering, Chukchi, Western Beaufort, Okhotsk, norther Sea of Japan, and the Po Hai Seas. These seals are seasonally dependent upon sea ice for the birth and nurture of their pups. During winter and early spring the entire population is concentrated along the southern edge of the seasonal pack ice, usually in central Bering Sea. These seals move northward and toward the coasts as the seasonal retreat and disintegration of sea ice progresses. During ice-free summer and early fall they occur along the entire coast of northern Alaska.

Abundance and Trends: No satisfactory method of accurate censusing lara seals has been attempted to date. Indirect methods and relative indices of abundances indicate that the population level of this species is high and probably stable. In 1976, the Bering Sea larga seal population was estimated to contain from 135,000 to 200,000 animals. The Okhotsk Sea population estimates is 135,00 to 200,000 animals (DOC, 1978).

Feeding Habits: The diet of these seals, which varies with the season and location, includes primarily pelagic, demersal and anadromous fishes, cephalopods and crustaceans.

Ecological Problems: Competition presently exists between these seals and man with respect to commercially important fishes (i.e., herring, smelt, whitefish, and salmon) and with respect to fishing gear. These seals are extremely responsive to disturbance and will leave a hauling area after only minor harassment.

RIBBON SEAL (Phoca fasciata)

Distribution and Migration: Geographically, the ribbon seal is separable into Okhotsk and Bering-Chukchi Sea populations and interchanges between the two groups are not known to occur. During winter and spring, the entire population is concentrated along the southern edge of the seasonal ice pack. Only a few ribbon seals remain with the ice edge of the seasonal ice pack. Only a few ribbon seals remain with the ice edge as it retreats northward through the Bering Strait. In summer and autumn, ribbon seas are believed to be pelagic, mainly in the ice-free Bering Sea.

Abundance and Trends: The population of ribbon seals is relatively low, having been markedly reduced by commercial sealers of the Soviet Union during the 1960s. In recent years the species has been afforded increased protection by Soviet sealing regulations and its numbers may be increasing again. U.S. citizens harvest very few ribbon seals. The Alaska Department of Fish& Game (1973) estimated that the population probably numbers between 90,000 and 100,000 animals. Soviet estimates indicate a population of 133,000 in the Okhotsk in 1969 (Popov, 1976). Soviet sealers took less than 3,000 ribbon seals in 1973 form Bering and Okhotsk Seas. In Alaska, the native harvest is usually less than 250 per year.

Food Habits: The diet of the ribbon seal during late winter and early spring (in the ice edge zone) includes mainly pelagic and demersal fishes, cephalopods, and small crustaceans. About 40% of this animal's summer diet is fishes and about 90% of its winter diet is fishes.

Problems: Little competition is known to exist between ribbon seals and man for fishery resources.

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ANNEX VI -- Species Categories Which Apply to the Bering Sea/Aleutian Groundfish Fishery

Prohibited Species[1]	Target Species[2]	"Other" Species[3]	Forage Fish Species[4]	Nonspecified Species[5]
Finfishes				
Domestic:	Pollock	Sculpins	Osmeridae family (eulachon, capelin and other smelts)	Eelpouts (family Zoarcidae)
Pacific halibut	Cod	Sharks	Myctophidae family (lanternfishes)	Poachers (family Agonidae) and alligator fish
Pacific herring	Atka Mackerel	Skates	Bathylagidae family (deep-sea smelts)	Snailfish, Lumpfishes, Lumpsuckers (family Cyclopteridae)
Pacific salmon	Sablefish		Ammodytidae family (Pacific sand lance)	Rattails (family Macrounidae)
Steelhead	Pacific Ocean Perch		Trichodontidae family (Pacific sand fish)	Ronquils, Searchers (family Bathymasteridae)
Other Rockfishes	Capelin		Pholidae family (gunnels)	Lancetfish (family Alepisanvidae)
Foreign:	Yellowfin Sole		Stichaeidae family (pricklebacks, warbonnets, eelbiennys, cockscombs and shannys)	Prowfish (Zaprora silenus)
Pacific halibut	Turbots		Gonostomatidae family (bristlemouths, lightfishes, and anglemouths)	Hagfish (Eptatretus sp.)
Pacific herring	Other Flatfishes		Order Euphausiacea (krill)	Lampreys (Lampetra sp.)
Salmonids				
Invertebrates				
Domestic:	Squids	Octopus		Anemones, Jellyfishes
King crab				Starfishes, Tunicates
Tanner crab				Egg Cases, Sea Cucumber
				Sea Mouse, Sea Pen
Foreign:				Sea Slug, Isopods
King crab				Sea Potato, Barnacles
Tanner crab				Sand Dollar, Polychaetes
Other unallocated species				Hermit Crab, Crinoids
				Mussels, Crab - unident.
				Sea Urchins, Misc. - unident.
				Sponge - unident.

1/ Must be returned to the sea, no fee.
2/ TAC for each item; fee as in fee schedule.
3/ Aggregate TAC for group.
4/ Management measures for forage fish are established in regulations implementing the FMP
5/ List not exclusive; includes any species not listed under Prohibited, Target, "Other," or Forage fish species categories; no fee charged.

ANNEX VII Information on Important Habitat for Non-FMP Species Pacific Halibut and Pacific Herring

An FMP may include a description and identification of the habitat for a species that is not Federally managed by a Council FMP; however, such habitat may not be considered EFH. Pacific halibut and Pacific herring are not managed under this FMP. Nevertheless, these species are recognized as important components of the BSAI ecosystem. Therefore, habitat assessments for these species were prepared and are appended to the BSAI groundfish FMP. While this information may be used in the development of FMP management measures to protect these species, these habitat assessments are not considered EFH for the purposes of sections 303(a)(7) and 305(b) of the Magnuson-Stevens Act.

Habitat Assessment for Pacific Halibut

Life History and Distribution

Pacific halibut are found on the continental shelf of the North Pacific Ocean and the Bering Sea. They have been recorded on the North American coast from Santa Barbara, California to Nome, Alaska and along the Aleutian Islands, and also along the Asiatic Coast from the Gulf of Anadyr, Russia to Hokkaido, Japan. Adult halibut are demersal, living on or near the bottom, and can be found in a wide range of bottom habitat including rock, sand, gravel, and mud. Preferred water temperature is 3 to 8 degrees Celsius (Thompson and VanCleve 1936) although Best and Hardmann (1982) reported finding concentrations of halibut at temperatures as low as 0 degrees Celsius.

From November to March, mature halibut concentrate annually on spawning grounds along the edge of the continental shelf at depths from 185 to 460 meters. The summer months are spent in more shallow coastal waters ranging in depth from 25 to 275 meters.

The major spawning sites in North America are shown in Figure 1 and include Cape St. James, Langara Island (Whaleback), and Frederick Island in British Columbia; Yakutat, Cape Suckling - Yakataga ("W" grounds), Portlock Bank, and Chirikof Island in Alaska. Other reported spawning locations include Goose Islands, Hecate Strait, and Rose Spit in British Columbia, Cape Ommaney, Cape Spencer, and Cape St. Elias in Alaska, and the 200 m edge in the Bering Sea from Unimak Pass to the Pribilof Islands (St-Pierre 1984). In addition to these major grounds, there is reason to conclude that spawning is widespread and occurs in many areas, although not in as dense concentrations as those mentioned above. Evidence to support this conclusion is based on the widespread distribution of sexually mature halibut during the winter months as indicated by research and commercial fishing.

The number of eggs produced by a female is related to its size. A 31 kg[6] female will produce about 500,000 eggs, whereas a female over 151 kg may produce 4 million eggs. The age of 50% maturity is 8 years old for males and 12 years old for females (St-Pierre 1984). The free-floating eggs are about 3 mm in diameter when released and fertilization takes place externally. Developing ova generally are found at depths of 75 to 185 meters, but occur as deep as 500 meters. The temperature at which eggs are found varies from 2.3 to 9.7 degrees Celsius (St-Pierre 1984). The eggs hatch after 15 to 20 days at 5-6 degrees Celsius, and more quickly in warmer water (12 to 14 days at 7-8 degrees Celsius) (McFarlane et al., 1991). The larvae have a greater specific gravity than the eggs and are found below 200 m (St-Pierre 1989), drifting passively in the deep ocean currents. As the larvae grow, their specific gravity decreases and they gradually move towards the surface and drift to shallower waters on the continental shelf. Postlarvae in North American waters may be transported

[6]All weights in this report are head-on round weight.

many hundreds of miles by the Alaskan Stream which flows counter-clockwise in the Gulf of Alaska and westward along the Alaska Peninsula and Aleutian Islands. Some of the larvae are carried into the Bering Sea.

Larvae begin life in an upright position with an eye on each side of the head. When the larvae are 2.5 cm long, the left eye moves over the snout to the right side of the head and pigmentation on the left side fades. When the young fish are about 6 months old and measure 3.5 cm, they have the characteristic adult form and settle to the bottom in shallow inshore areas (Thompson and VanCleve, 1936).

To counter the egg drift with ocean currents in a counter-clockwise direction, the young halibut migrate in a clockwise direction (IPHC 1987). One and two-year-old Pacific halibut are commonly found in inshore areas of central and western Alaska, but are virtually missing from southeast Alaska and British Columbia. They tend to move further offshore at age 2 or 3-years old and can be found off southeast Alaska and British Columbia by age 4 and older. IPHC tagging studies suggest that there is some intermixing of halibut between the North American and Asian populations, but the extent is not known (IPHC 1978).

By the time Pacific halibut are about 8 years old and measure approximately 82 cm, most of the extensive counter-migration to balance egg and larval drift has taken place. However, adult halibut migrate annually, moving to deeper depths on the edge of the continental shelf during the winter for spawning, and into shallow coastal waters in the summer months for feeding (St-Pierre 1984). Although halibut have been caught as deep as 550 meters, they are most often caught between 25 and 275 meters (Table 1).

Adult halibut are long-lived and the largest of all flatfish. The oldest halibut on record to date was 55 years old (Forsberg, J.E., IPHC, pers. comm.). Documented weights of up to 303 kg exist; however, few males reach 48 kg and nearly all halibut over 60 kg are females (IPHC 1987).

Removals from the population

The IPHC takes into account all removals of halibut from the North Pacific and Bering Sea within the Exclusive Economic Zones of the U.S. and Canada. Fishing for halibut does occur off the coasts of Japan and Russia, but those removals are not included in the IPHC population assessment.

The IPHC stock assessment is based on biological and fishery data obtained through port sampling, IPHC and National Marine Fisheries Service surveys, and special projects. Since the 1930s, biologists have collected lengths, otoliths for aging and catch per unit of effort data. More recently, IPHC surveys have also collected data on gender composition and maturity. Logbook information is supplied by the fishers either through interviews by IPHC staff in the landing ports or via mail post-season.

In North America, Pacific halibut is removed in a number of ways from the population; targeted commercially, for sport, for personal use, as bycatch in other commercial fisheries, as waste from the halibut fishery, and natural mortality (the IPHC uses a natural mortality rate of 0.2). In 1996, an estimated 42,336 metric tons of directed and non-directed catch was removed from the population (Sullivan and Parma, Unpub. [1997]).

The directed commercial fishery is conducted by hook and line gear only. Fish begin recruiting to this gear type at approximately 60 cm in length, but the commercial minimum size limit is 82 cm. The fishery takes place from March to November ranging from shallow inshore waters to as deep as 275 meters along the continental shelf (Figures 2-10). The directed catch consists of individuals chiefly from 7 to 121 kg. The average size in the commercial catch in 1996 was between 9 and 20 kg depending on the area caught, and the average age was 12 years old (Forsberg, J., Unpub [1997]).

Today's commercial fishing fleet is diverse, using various types of longline gear and strategies to obtain their quarry. Both Alaska and British Columbia have implemented an individual quota (IQ) system, which enables a vessel to fish anytime between March and November. The U.S. West Coast fishery continues to use short, 10 hour seasons and fishing period limits to manage the fishery.

Interception of juvenile halibut (~30 cm and greater) often occurs in trawl fisheries targeting other groundfish species (such as rock sole, pollock, yellowfin sole, and Pacific cod). Incidental catch of halibut also occurs in groundfish hook and line and pot fisheries. Regulations in both Canada and U.S. currently dictate that all halibut caught incidentally must be discarded regardless of whether the fish is living or dead. These fisheries take place throughout the range of halibut and throughout most of the year. The total mortality of halibut since 1990 has averaged 10,323 metric tons per year (Williams, G.H. Unpub [1997].

Trophic Information

Adult halibut are only rarely found as prey of other fish, and mortality on halibut by marine mammals seems low (Best and St-Pierre, 1986). The size, active nature, and bottom dwelling habits make halibut less vulnerable to predation than other species. However, the juvenile fish are much more vulnerable and are preyed upon by larger groundfish such as Pacific cod.

Halibut are opportunistic, carnivorous feeders. In larval halibut, nutrition is derived from a yolk sac until it is absorbed during the early postlarval stage, about 2 months after hatching. The young fish then begin feeding on zooplankton. Halibut 1 to 3 years old are usually less than 30 cm in length and feed on small shrimp, crab, and fish (Best and Hardman, 1982). As halibut increase in size, fish become a more important part of the diet. They are both benthic and pelagic feeders. The species of fish frequently observed in stomachs of large halibut include cod, sablefish, pollock, rockfish, sculpins, turbot, other flatfish, sand lance, and herring (Best and St-Pierre, 1986; Brodeur and Livingston, 1988). Octopus, crabs, clams, and occasional smaller halibut also contribute to their diet although Pacific halibut do not appear to be a primary predator of these species.

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Table 1. Summary of habitat information for Pacific halibut.

Life stage	Age	Diet	Season	Location	Water column	Bottom type	Oceanographic features
Eggs level 0	0-20 days	n/a	November - March	Continental shelf edge - pelagic	75-185 m (found as deep as 500 m)		2-10°C
Larvae level 0	20 days - 2 months	yolk sac	December - May	Continental shelf edge - pelagic	> 200 m		
Post larvae level 0	2 - 6 months	zoo-plankton	January - August	Continental shelf - pelagic	0-200 m		
Juveniles level 1	6 months - 7 years	small crustaceans and fish	Year round	Continental shelf - demersal	25-275 m	Rock, sand, mud, gravel	Prefer 3-8°C
Adults level 2	8+ years	pelagic and demersal fish and crustaceans	(spawning) Nov. - Mar. (not spawning) Mar. -Nov.	(spawning) Cont. shelf edge - demersal (not spawning) Cont. shelf - demersal	(spawning) 185-460 m (not spawning) 25-275 m	Rock, sand, mud, gravel	Prefer 3-8°C

Habitat Assessment for Pacific Herring

Life History and General Distribution In North America, Pacific herring are found from San Diego Bay, California, to Cape Bathurst in the Beaufort Sea (Hart 1973). In Alaska, herring can be found at some time of the year along most of the coastline from Dixon Entrance in Southeastern Alaska to Kotzebue. Pacific herring spawn on submerged vegetation in shallow coastal intertidal and subtidal areas, although substantial spawning occurs on rock substrates in the northern Bering Sea where vegetation is sparse. Spawning is first observed in the southeastern archipelago in mid-march, with spawning in Bering Sea coastal areas occurring during May and June. The eggs are adhesive and cling to nearshore vegetation, often deposited in layers that are several eggs thick. After spawning, adult herring move to offshore feeding areas. The largest concentrations of herring in the Bering Sea spawn along the north shore of Bristol Bay. Following spawning these herring move clockwise along the Alaskan Peninsula, reaching the Unimak Pass area by mid-summer (Funk 1990). Later in the summer these herring move to wintering areas to the north in the general vicinity of the Pribilof Islands (Shaboneev 1968). Smaller concentrations of herring spawn to the north up the Bering Sea coast, but the offshore feeding and wintering grounds for these herring at not well known.

Fishery (e.g., gear types, age at 50% recruitment, when/where conducted, bycatch) Purse seine and gillnet fisheries harvest herring for sac roe on the inshore spawning grounds, just prior to spawning. Age of 50% recruitment in the purse seine fisheries is estimated to be 5, in the gillnet fisheries age 7. In the vicinity of the village of Togiak along northern Bristol Bay coastline, a small locally-based fishery hand picks 170 metric tons of herring spawn on kelp (primarily *Fucus* sp.) annually. A small purse seine fishery for food and bait herring occurs during the summer in the vicinity of Dutch Harbor. Herring are taken as bycatch in trawl fisheries, primarily for pollock, near Unimak pass during the summer months.

Relevant Trophic Information Pacific herring are opportunistic planktivores, and are themselves preyed on by most piscivorous fish and marine mammals.

Potential gear impacts on the habitats of this or other species Except during the spawning period, Pacific herring occur pelagically and are not likely to be impacted by fishing gear impacts on habitat. A small (170 m.t.), controlled amount of spawning substrate is removed annually during the directed spawn on kelp fishery in Bristol Bay. Purse seine or gillnet gear occasionally scrapes the bottom in areas where some spawning substrate is removed. However fishermen generally try to avoid much contact with rocky, kelp-containing substrates to preclude loss or damage to fishing gear.

What is the approximate upper size limit of juvenile fish: 23 cm.

Habitat and Biological Associations

Egg/Spawning: In the Bering Sea, spawning occurs on rocky headlands or in shallow lagoons and bays. Eggs are deposited both subtidally and intertidally on aquatic vegetation. Predominant vegetative types along the Bering Sea coastline are eelgrass (*Zostera spp*), rockweed (*Fucus spp.*), and ribbon kelp (*Laminaria spp*) (Barton 1978). Herring north of Norton Sound spawn in brackish bays and estuaries (Barton 1978). Spawning activity is related to water temperatures and occurs soon after water has become ice-free. Water temperatures on Bering Sea spawning grounds between Norton Sound and Bristol Bay have ranged between 5.6° and 11.7°C (Barton 1979). Optimum temperature for egg development in the laboratory is from 5° to 9°C. Below 5°C, eggs die (Alderdice and Velsen 1971). Eggs take to 10 to 21 days to hatch, depending on the water temperature (Wespestad and Barton 1981). In Bristol Bay, at temperatures to 8° to 11°C, 13 to 14 days are required for hatching (Barton 1979).

Larvae: Newly hatched larvae are about 8 mm in size. Larvae will grow to 30 mm in 6 to 10 weeks and begin to metamorphose into free-swimming juveniles. Larvae are at the mercy of water currents until they develop the ability to swim (Hourston and Haegele 1980). Larvae migrate downwards during the day and to the surface at night, following their planktonic food supply (Hart 1973). Herring larvae and postlarvae feed on ostracods, small copepods and nauplii, small fish larvae, and diatoms (Hart 1973). The first food eaten by larval herring may be limited to relatively small, microscopic planktonic organisms that the larvae must nearly run into to notice and capture. Early food items may be comprised of more than 50% microscopic eggs (Wespestad and Barton 1979). Oceanographic conditions that retain larvae in productive inshore areas is thought to enhance larval survival (Wespestad 1991).

Juveniles: Immature Pacific herring remain offshore and do not participate in the inshore spawning movements of mature adults. The distribution of juvenile herring is not well known. Juveniles consume mostly crustaceans such as copepods, amphipods, cladocerans, decapods, barnacle larvae, and euphasiids. Consumption of some small fish, marine worms, and larval clams has also been documented (Hart 1973). In the western Bering Sea and Kamchatka area in November and December, the diet of juveniles has consisted of medium forms of zooplankton (Chaetognaths, mysids, copepods, and tunicates) (Kachina and Akinova 1972).

Adults: After spawning, herring move to offshore feeding and overwintering areas and are not closely associated with the bottom and likely not affected by bottom substrates. Adults were found to overwinter at depths of from 107 to 137 m in the Bering Sea (Dudnik and Usoltsev 1964). In the Bering Sea, temperature may have the greatest influence on the seasonal distribution of herring (Wespestad and Barton 1981). Dense schools of overwintering adult herring have been found at temperatures of from 2 to 3.5°C in the Bering Sea (Dudnik and Usoltsev 1964). Herring moving from the overwintering grounds in the Bering Sea to spawning grounds have passed through water at subzero temperatures (Wespestad and Barton 1981). Immature herring may occupy less saline waters than adults (Taylor 1964). Juveniles, however, are found in a wide range of salinities in British Columbia, with most concentrations located at 25 parts per thousand (o/oo) (Hourston 1959). Herring eggs and fry were found in Imuruk Basin near Port Clarence, Alaska, in water of 4 o/oo salinity (Barton 1978). Immature fish in the Bering Sea exhibit greater tolerance or preference for colder, less saline areas on their overwintering grounds on the continental shelf than do adult fish (Wespestad and Barton 1981). The timing of spawning in the western Bering Sea is related to winter and spring water temperatures, with early maturation occurring in warm years and delayed development in colder years (Prokhorov 1968). In Bristol Bay and Port Heiden, herring appeared on the spawning grounds when temperatures reached 6°C.

In the eastern Bering Sea, August diets of adults were comprised of 84% euphausiids, 8% fish fry, 6% calanoid copepods, 2% gammarid amphipods; fish fry, in order of importance, were walleye pollock, sandlance, capelin, and smelt. During spring months, food items were mainly Themisto (amphipoda) and Sagitta (chaetognath). After spawning (eastern Bering Sea), adults preferred euphausiids, copepods (Calanus spp.), and arrow worms (Sagitta spp.) (Dudnik and Usoltsev 1964). In demersal areas, stomach contents included polychaete worms, bivalve molluscs, amphipods, copepods, juvenile fish, and detritus (Kachina and Akinova 1972), Barton (1978) found cladocerans, flatworms (Platyhelminthes), copepods, and cirripeds in herring captured during spring months. Rather than exhibiting a preference for certain food items, adult herring feed opportunistically on any large organisms predominating among the plankton in a given area (Kaganovskii 1955).

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SPECIES: Pacific Herring

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs level 2	10-21 days	NA	Spring	BCH	D	K, SAV, R		
Larvae level 0	2-3 months	Small zooplankton, eggs	Spring/ Summer	Bay ICS	P	NA	G	
Juveniles level 0	1-5 years	Opportunistic zooplanktivore	All year	ICS MCS OCS	P	NA	F, E	
Adults level 2	5+ years	Opportunistic zooplanktivore	Spawning (May-June) Other	BCH Bay Bay ICS MCS OCS	P P	NA NA	F, E	