Fishery Management Plan

for Groundfish of the

Bering Sea and Aleutian Islands Management Area

APPENDICES

Appendix A History of the Fishery Management Plan

The Fishery Management Plan (FMP) for Bering Sea and Aleutian Islands (BSAI) Groundfish was implemented on January 1, 1982. Since that time it has been amended over seventy times, and its focus has changed from the regulation of mainly foreign fisheries to the management of fully domestic fisheries. The FMP was substantially reorganized in Amendment 83. Outdated catch data or other scientific information, and obsolete references, were also removed or updated.

Section A.1 contains a list of amendments to the FMP since its implementation in 1982. A detailed account of each of the FMP amendments, including its purpose and need, a summary of the analysis and implementing regulations, and results of the amendment, is contained in Appendix C to the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries*, published by National Marine Fisheries Service (NMFS) in 2004.

A.1 Amendments to the FMP

Amendment 1, implemented January 1, 1984, supersedes Amendments 2 and 4:

Established a multi-year, multi-species optimum yield for the groundfish complex.

Established a framework procedure for determining and apportioning total allowable catch (TAC), reserves, and domestic annual harvest (DAH).

Eliminated the "Misty Moon" grounds south of the Pribilof Islands from the Winter Halibut Savings Area.

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

Allowed year-round domestic trawling in the Bristol Bay Pot Sanctuary and year-round domestic longlining in the Winter Halibut Savings Area.

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

Established the Resource Assessment Document as the biological information source for management purposes.

Specified that the fishing and FMP year is the calendar year.

Amendment 1a, implemented January 2, 1982:

Set a chinook salmon prohibited species catch (PSC) limit of 55,250 fish for the foreign trawl fisheries for 1982.

Amendment 2, implemented January 12, 1982:

1. For Yellowfin Sole, increased DAH to 26,000 mt from 2,050 mt, increased joint venture processing (JVP) 25,000 mt from 850 mt, and decreased total allowable level of foreign fishing (TALFF) by 24,150 mt.

For Other Flatfish, increased DAH to 4,200 mt from 1,300 mt, increased JVP to 3,000 mt from 100 mt, and decreased TALFF by 2,900 mt.

For Pacific Cod, decreased maximum sustainable yield to 55,000 mt from 58,700 mt, increased equilibrium yield to 160,000 mt from 58,700 mt, increased acceptable biological catch to 160,000 mt from 58,700 mt, increased optimum yield to 78,700 mt from 58,700 mt, increased reserves to 3,935 mt from 2,935 mt, increased domestic annual processing (DAP) to 26,000 mt from 7,000 mt, and increased DAH to 43,265 mt from 24,265 mt.

Amendment 3, implemented July 4, 1983, supersedes Amendments 1a and 5:

1. Established procedures for reducing the incidental catch of halibut, salmon, king crab and Tanner crab by the foreign trawl fisheries.

Established a Council policy on the domestic groundfish fisheries and their incidental catch of prohibited species.

Amendment 4, implemented May 9, 1983, supersedes Amendment 2:

1. For Pollock, increased JVP for Bering Sea to 64,000 mt from 9,050 mt, increased DAH to 74,500 mt from 19,550 mt, and decreased TALFF to 875,500 mt from 930,450 mt.

For Yellowfin Sole, increased JVP to 30,000 mt from 25,000 mt, increased DAH to 31,200 mt from 26,200 mt, and decreased TALFF to 79,950 mt from 84,950 mt.

For Other Flatfish, increased JVP to 10,000 mt from 3,000 mt, increased DAH to 11,200 mt from 4,200 mt, and decreased TALFF to 46,750 mt from 53,750 mt.

For Atka Mackerel, increased JVP to 14,500 mt from 100 mt, increased DAH to 14,500 mt from 100 mt, and decreased TALFF to 9,060 mt from 23,460 mt.

For Other Species, increased JVP to 6,000 mt from 200 mt, increased DAH to 7,800 mt from 2,000 mt, and decreased TALFF to 65,648 mt from 68,537 mt. Also corrected acceptable biological catch to 79,714 mt, optimum yield to 77,314 mt, and reserves to 3,866 mt.

For Pacific Cod, increased equilibrium yield and acceptable biological catch to 168,000 mt from 160,000 mt, increased optimum yield to 120,000 mt from 78,700 mt, increased reserves to 6,000 mt from 3,935 mt, and increased TALFF to 70,735 mt from 31,500 mt.

For Other Rockfish, assigned DAP of 1,100 mt to BSAI area combined. This caused no change in total DAP. (This conformed FMP with federal regulations.)

For Pacific Ocean Perch, assigned DAP of 550 mt to Bering Sea and 550 mt to Aleutians but caused no change in total DAP. Also assigned JVP of 830 mt to Bering Sea and 830 mt to Aleutians without changing total JVP. (This conformed FMP with federal regulations.)

For Sablefish, assigned JVP of 200 mt to Bering Sea and 200 mt to Aleutians without changing total JVP. (This conformed FMP with federal regulations.) Changed maximum sustainable yield to 11,600 mt in Bering Sea and 1,900 mt in Aleutians to eliminate inconsistencies with annexes.

Changed foreign fisheries restrictions to allow trawling outside 3 miles north of the Aleutian Islands between 170°30' W. and 172° W. longitude, and south of the Aleutian Islands between 170° W. and 172° W. longitude; and to allow longlining outside 3 miles west of 170° W. longitude.

Amendment 5, withdrawn from Secretarial review.

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

Would have established a fishery development zone for exclusive use by U.S. fishing vessels where no foreign directed fishing is permitted.

Amendment 7, implemented August 31, 1983:

Modified the December 1 to May 31 depth restriction on the foreign longline fisheries in the Winter Halibut Savings Area.

Amendment 8, implemented February 24, 1984, supplements Amendment 3:

Established 1984 and 1985 salmon PSCs for the foreign trawl fishery. This amendment was a regulatory amendment which fell within the purview of Amendment 3 and did not require formal Secretarial approval.

Amendment 9, implemented December 1, 1985:

1. Require all catcher/processors that hold their catch for more than two weeks to check in and check out by radio from a regulatory area/district and to provide a written catch report weekly to the NMFS Regional Office.

Incorporated habitat protection policy.

Established definition for directed fishing as 20 percent or more of the catch.

Amendment 10, implemented March 16, 1987:

1. Established Bycatch Limitation Zones for domestic and foreign fisheries for yellowfin sole and other flatfish (including rock sole); an area closed to all trawling within Zone 1; red king crab, *C. bairdi* Tanner crab, and Pacific halibut PSC limits for DAH yellowfin sole and other flatfish fisheries; a *C. bairdi* PSC limit for foreign fisheries; and a red king crab PSC limit and scientific data collection requirement for U.S. vessels fishing for Pacific cod in Zone 1 waters shallower than 25 fathoms.

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

Established explicit authority for reapportionment between DAP and JVP fisheries.

Established inseason management authority.

Amendment 11, implemented December 30, 1987:

1. Established a schedule for seasonal release of joint venture pollock apportionments in 1988 and 1989 (expires December 31, 1989).
2. Revised the definition of prohibited species.
3. Revised the definition of acceptable biological catch and added definitions for threshold and overfishing.

Amendment 11a, implemented April 6, 1988:

Augmented the current domestic catcher/processor and mothership/ processor reporting requirements with at-sea transfer information and modify the weekly reporting requirements.

Amendment 12, implemented May 26, 1989:

1. Revised federal permit requirements to include all vessels harvesting and processing groundfish from the EEZ.
2. Establish a PSC limit procedure for fully utilized groundfish species taken incidentally in JVP and TALFF fisheries.

3. Removed July 1 deadline for Stock Assessment and Fishery Evaluation Report (SAFE).
4. Established rock sole as a target species distinct from the "other flatfish" group.

Amendment 12a, implemented September 3, 1989, replaced Amendment 10:

Established a bycatch control procedure to limit the incidental take of *C. bairdi* Tanner crab, red king crab, and halibut in groundfish fisheries.

Amendment 13, implemented January 1, 1990:

1. Allocated sablefish in the Bering Sea and the Aleutian Islands Management Subareas.
2. Established a procedure to set fishing seasons on an annual basis by regulatory amendment.
3. Established groundfish fishing closed zones near the Walrus Islands and Cape Peirce.
4. Established a new data reporting system.
5. Established a new observer program.
6. Clarified the Secretary's authority to split or combine species groups within the target species management category by a framework procedure.

Amendment 14, implemented January 1, 1991:

1. prohibited roe-stripping of pollock; and established Council policy that the pollock harvest is to be used for human consumption to the maximum extent possible;

divided the pollock TAC into two seasonal allowances: roe-bearing ("A" season) and non roe-bearing ("B" season). The percentage of the TAC allocated to each allowance shall be determined annually during the TAC specifications process.

Amendment 15, approved by the Secretary on January 29, 1993, implemented March 15, 1995:

1. Established an Individual Fishing Quota (IFQ) program for directed fixed gear sablefish fisheries in the Bering Sea and Aleutian Islands management areas.
2. Established a Western Alaska Community Development Quota (CDQ) Program.

Amendment 16, implemented January 1, 1991, replaced Amendment 12a:

1. Extended the effective date of Amendment 12a (originally scheduled to expire December 31, 1990) with the following three changes:
   a) PSC apportionments would be established for the DAP rock sole and deep water turbot/arrowtooth flounder fisheries;
   b) PSC limits could be seasonally apportioned; and
   c) An interim incentive program established to encourage vessels to avoid excessive bycatch rates.

Established a definition of overfishing;

Established procedures for interim TAC specifications; and

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

Amendment 16a, implemented July 12, 1991.

1. Established inseason authority to temporarily close statistical areas, or portions thereof, to reduce high prohibited species bycatch rates.
2. Provided authority to the Regional Administrator, in consultation with the Council, to set a limit on the amount of the pollock TACs that may be taken with other than pelagic trawl gear.
3. Established a framework for determining an annual herring PSC limit as 1 percent of the estimated herring biomass, attainment of which triggers trawl closures in three Herring Savings Areas.

Amendment 17, implemented April 24, 1992:

1. Authorize the NMFS Regional Administrator to approve exempted fishing permits after consultation with the Council.
2. Establish a unique Bogoslof District as part of the Bering Sea subarea, for which a pollock harvest quota would be annually specified. Fishing for pollock in the remaining parts of the Bering Sea subarea will be unaffected by any closure of the Bogoslof District.

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

1. The Pollock TAC in the BSAI, after subtraction of the reserve, is allocated between inshore and offshore components during the years 1992 through 1995. The inshore component receives 35 percent of the pollock TAC, and the offshore component receives 65 percent.
2. A Catcher Vessel Operational Area (CVOA) is established to limit access to pollock within the area to catcher vessels delivering to the inshore component. This area is between 163° W. and 168° W. longitude, south of 56° N. latitude, and north of the Aleutian Islands. During the 1992 "B" season, the offshore component will not be allowed to fish within the CVOA.
3. Half of the amount of BSAI pollock assigned to the nonspecific reserve (7.5 percent of the BSAI TAC) is allocated as Western Alaska CDQ program.

Amendment 19, implemented September 23, 1992, supplemented Amendment 16:

1. Revise time and area closure (hotspot) authority in the BSAI to authorize, by regulatory amendment, the establishment of time and area closures to reduce bycatch rates of prohibited species. Any closure of an area would require a determination by the Secretary, in consultation with the Council.
2. Expand the Vessel Incentive Program to include all trawl fisheries in the BSAI.
3. Delay opening of all trawl fisheries in the BSAI until January 20. The opening date for non-trawl fisheries, including hook and line, pot and jigging, will continue to be January 1.
4. Establish, for the 1992 season only, a halibut PSC limit of 5,033 mt for the BSAI trawl fishery. Also, a 750 mt halibut PSC mortality limit for the non-trawl fisheries will be established for one year.
5. Establish new halibut and crab PSC apportionment categories. A trawl fishery category closes when it reaches a PSC bycatch allowance allocated to that category.
6. Establish new fishery definitions. The fishery definitions for both the Vessel Incentive Program and the PSC allowance limits would be the same. The definitions of fisheries for these programs would be as follows:
   a) Mid-water pollock if pollock is ≥ to 95 percent of the total catch.
   b) Other targets determined by the dominate species in terms of retained catch.
   c) For the BSAI, a flatfish fishery consisting of rocksole, yellowfin sole, and other flatfish (excluding Greenland turbot and arrowtooth flounder) will be defined and then subdivided into three fisheries.

If yellowfin sole accounts for at least 70% of the retained flatfish catch, it is a yellowfin sole fishery. Otherwise, it is a rock sole or other flatfish fishery depending on the which is dominant in terms of retained catch.

7. To allow more effective enforcement of directed fishery closures and to further limit trawl bycatch amounts of halibut after a halibut PSC bycatch allowance has been reached, changes to Directed Fishing Standards include:
   a) Directed fishing standards would be seven percent of the aggregate amounts of GOA and BSAI groundfish other than pollock, that are caught while fishing for pollock with pelagic trawl gear.
   b) For purposes of the directed fishing rule, the operator of a vessel is engaged in a single fishing trip, from the date when fishing commences or continues in an area after the effective date of a notice prohibiting directed fishing in that area, until the first date on which at least one of following occurs: 1) a weekly reporting period ends; 2) the vessel enters or leaves a reporting area for which an area specific TAC or directed fishing standard is established; or 3) any fish or fish product is offloaded or transferred from that vessel.

Amendment 20, implemented January 19, 1992:

Prohibit trawling year round in the BSAI within 10 nautical miles of 27 Steller sea lion rookeries. In addition, five of these rookeries will have 20 nautical mile trawl closures during the pollock “A” season. These closures will revert back to 10 nautical miles when the “A” season is over, either on or before April 15.

Amendment 21, implemented March 17, 1993, superseded Amendment 16:

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

Amendment 21a, implemented January 20, 1995:

Established a Pribilof Islands Habitat Conservation Area.

Amendment 21b, implemented November 29, 1995:

Established trawl closure areas called the Chinook Salmon Savings Areas.

Amendment 22, implemented December 22, 1992:

Established trawl test areas for the testing of trawl gear in preparation of the opening of fishing seasons. Fishermen are allowed to test trawl gear when the BSAI would otherwise be closed to trawling.

Amendment 23, implemented August 10, 1995 and effective on September 11, 1995:

Created a moratorium on harvesting vessels entering the BSAI groundfish fisheries other than fixed gear sablefish after January 1, 1996. The vessel moratorium will last until the Council replaces or rescinds the action, but in any case will end on December 31, 1998. The Council extended the moratorium to January 1, 1999 under Amendment 59. The Council may however extend the moratorium up to 2 additional years, if a permanent limited access program is imminent.

Amendment 24, implemented February 28, 1994, and effective through December 31, 1996:

1. Established the following gear allocations of BSAI Pacific cod TAC as follows: 2 percent to vessels using jig gear; 44.1 percent to vessels using hook-and-line or pot gear, and 53.9 percent to vessels using trawl gear.
2. Authorized the seasonal apportionment of the amount of Pacific cod allocated to gear groups. Criteria for seasonal apportionments and the seasons authorized to receive separate apportionments will be set forth in regulations.

Amendment 25, implemented May 20, 1994, superseded Amendment 21:

Eliminated the primary halibut bycatch mortality limit established for the trawl gear fisheries (3,300 mt). The overall bycatch mortality limit established for these fisheries (3,775 mt) remained unchanged.

Amendment 26, implemented July 24, 1996:

Established a Salmon Donation Program that authorizes the voluntary retention and distribution of salmon taken as bycatch in the groundfish trawl fisheries off Alaska to economically disadvantaged individuals.

Amendment 27, implemented October 6, 1994, superseded Amendments 13 and 18, repealed and replaced by Amendment 47:

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

Amendment 28, implemented August 11, 1993, supplemented Amendment 20:

Established three districts in the Aleutian Islands management subarea for purposes of distributing the groundfish TACs spatially.

Amendment 29, not submitted.

Amendment 30, implemented September 23, 1994, revised Amendment 18:

Raised the CDQ allocation limit for qualified applicants from 12 to 33 percent.

Amendment 31, implemented November 7, 1994, revised Amendment 15:

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

Amendment 32, implemented February 23, 1996, revised Amendment 15:

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

Amendment 33, implemented July 26, 1996, revised Amendment 15:

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

Amendment 34, implemented January 30, 1994:

Allocated Atka mackerel to vessels using jig gear. Annually, up to 2 percent of the TAC specified for this species in the eastern Aleutian Islands District/Bering Sea subarea will be allocated to vessels using jig gear in this area.

Amendment 35, implemented August 1, 1995:

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

Amendment 36, implemented April 16, 1998:

Defined a forage fish species category and authorized that the management of this species category be specified in regulations in a manner that prevents the development of a commercial directed fishery for forage fish which are a critical food source for many marine mammal, seabird and fish species.

Amendment 37, implemented January 1, 1997

Established a non-pelagic trawl closure area called the *Red King Crab Savings Area*, a trawl closure area called the Nearshore Bristol Bay Trawl Closure, and revised the red king crab PSC limits.

Amendment 38, implemented January 1, 1996, superseded Amendment 18:

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

Amendment 39, implemented January 1, 1999, except for some parts on January 1, 2000, replaced Amendment 23 and revised Amendment 18:

1. Created a license program for vessels targeting groundfish in the BSAI, other than fixed gear sablefish that is pending regulatory implementation. The license program will replace the vessel moratorium and will last until the Council replaces or rescinds the action.
2. Allocated 7.5 percent of groundfish TACs to the CDQ multispecies fishery.

Amendment 40, implemented January 21, 1998:

Established PSC limits for *C. opilio* crab in trawl fisheries and a snow crab bycatch limitation zone.

Amendment 41, implemented April 23, 1997, revised Amendment 12a:

Revised the *C. bairdi* Tanner crab PSC limit in Zones 1 and 2.

Amendment 42, implemented August 16, 1996, revised Amendment 15

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

Amendment 43, implemented December 20, 1996, revised Amendment 15:

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

Amendment 44, implemented January 9, 1997, revised Amendment 16:

Established a more conservative definition of overfishing.

Amendment 45, implemented January 21, 1999, superseded Amendment 38:

Reauthorized the pollock CDQ allocation.

Amendment 46, implemented January 1, 1997, superseded Amendment 24:

Replaced the three year Pacific cod allocation established with Amendment 24, with the following gear allocations in BSAI Pacific cod: 2 percent to vessels using jig gear; 51 percent to vessels using hook-and-line or pot gear; and 47 percent to vessels using trawl gear. The trawl apportionment will be divided 50 percent to catcher vessels and 50 percent to catcher processors. These allocations as well as the seasonal apportionment authority established in Amendment 24 will remain in effect until amended.

Amendment 47, not submitted.

Amendment 48, implemented December 8, 2004:

1. Revised the harvest specifications process.
2. Changed the title of the FMP.
3. Update the FMP to reflect current groundfish fisheries.

Amendment 49, implemented January 3, 1998:

Implemented an Increased Retention/Increased Utilization Program for pollock and Pacific cod beginning January 1, 1998 and rock sole and yellowfin sole beginning January 1, 2003.

Amendment 50, implemented July 13, 1998, revised Amendment 26:

Established a Prohibited Species Donation Program that expands the Salmon Donation Program to include halibut taken as bycatch in the groundfish trawl fisheries off Alaska to economically disadvantaged individuals.

Amendment 51, partially implemented January 20, 1999, superseded Amendment 38:

Replaced the three year inshore/offshore allocation established with Amendment 38, with the following allocations of BSAI pollock after subtraction of reserves: 39 percent inshore; 61 percent offshore. That portion of the Bering Sea inshore “B” season allocation which is equivalent to 2.5 percent of the BSAI pollock TAC, after subtraction of reserves, shall be made available only to vessels under 125 ft length overall for delivery to the inshore sector, prior to the Bering Sea “B” season, starting on or about August 25. Any overages or underages will be subtracted/added as part of the inshore “B” season. The rules and regulations pertaining to the CVOA shall remain the same, except that during the “B” season, operations in the CVOA will be restricted to catcher vessels delivering to the inshore sector. These allocations will remain in effect until December 31, 2001, unless replaced by another management regime approved by the Secretary.

Amendment 52, not submitted.

Amendment 53, implemented July 22, 1998:

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

Amendment 54, implemented April 29, 2002, revised Amendment 15:

Revised use and ownership provisions of the sablefish IFQ program.

Amendment 55, implemented April 26, 1999:

Implemented the Essential Fish Habitat (EFH) provisions contained in the Magnuson-Stevens Fishery Conservation and Management Act and 50 CFR 600.815. Amendment 55 describes and identifies EFH fish habitat for BSAI groundfish and describes and identifies fishing and non-fishing threats to BSAI groundfish EFH, research needs, habitat areas of particular concern, and EFH conservation and enhancement recommendations.

Amendment 56, implemented March 8, 1999, revised Amendment 44:

Revised the overfishing definition.

Amendment 57, implemented June 15, 2000, revised Amendment 37 and Amendment 40:

1. Prohibited the use of nonpelagic trawl gear in the directed pollock fishery.
2. Reduced the PSC limit for red king crab by 3,000 animals.

Amendment 58, implemented November 13, 2000, revised Amendment 21b:

Revised Chinook Salmon Savings Areas trawl closure areas.

Amendment 59, implemented January 19, 1999, superseded Amendment 23:

Extended the vessel moratorium through December 31, 1999.

Amendment 60, implemented October 24, 2001 and January 1, 2002; superseded Amendment 59:

1. Required that the vessel would be a specific characteristic of the license and could not be severed from it.
2. Authorized license designations for the type of gear to harvest LLP groundfish as either “trawl” or “non-trawl” gear (or both).
3. Rescinded the requirement that CDQ vessels hold a crab or groundfish license.
4. Added a crab recency requirement which requires one landing during 1/1/96-2/7/98 in addition to the general license and area endorsement qualifications.
5. Allowed limited processing (1 mt) for vessels less than 60 ft LOA with catcher vessel designations.

Amendment 61, implemented January 21, 2000, conformed the FMP with the American Fisheries Act (AFA) of 1998 that:

1. Removed excess capacity in the offshore pollock sector through the retirement of 9 factory trawlers.

Established U.S. ownership requirements for the harvest sector vessels.

Established specific allocations of the BSAI pollock quota as follows - 10 percent to the western Alaska CDQ program, with the remainder allocated 50 percent to the onshore sector, 40 percent to the offshore sector, and 10 percent to the mothership sector.

Identified the specific vessels and processors eligible to participate in the BSAI pollock fisheries

Established the authority and mechanisms by which the pollock fleet can form fishery cooperatives.

Established specific measures to protect the non-AFA (non-pollock) fisheries from adverse impacts resulting from the AFA or pollock fishery cooperatives.

Amendment 62 , approved by the Council in October 2002, revised Amendment 61:

1. Increases the number of times that a Bering Sea stationary floating processor may move to a different inshore location during the fishing year, from one time per year to a total of four times per year. The relocation may not result in more than one recorded landing location in a weekly reporting period.
2. Updates the use restrictions on the Bering Sea Catcher Vessel Operational Area to reflect the changes in the American Fisheries Act.

Amendment 63, pending.

Amendment 64, implemented September 1, 2000, revised Amendment 46:

Allocated the Pacific cod Total Allowable Catch to the jig gear (2 percent), fixed gear (51 percent), and trawl gear (47 percent) sectors.

Amendment 65, implemented July 28, 2006:

Identified four specific sites as habitat areas of particular concern, and established management measures to reduce potential adverse effects of fishing. The sites are: Aleutian Islands Coral Habitat Protection Areas and the Alaska Seamount Habitat Protection Areas, in which the use of bottom contact gear is prohibited; and the Bowers Ridge Habitat Conservation Zone, in which the use of mobile bottom contact gear is prohibited.

Amendment 66, implemented April 6, 2002:

Exempted squid from the CDQ program.

Amendment 67, implemented May 15, 2002, revised Amendment 39:

Established participation and harvest requirements to qualify for a BSAI Pacific cod fishery endorsement for fixed gear vessels.

Amendment 68, not submitted.

Amendment 69, implemented March 13, 2003, revised Amendment 61:

Allows an inshore pollock cooperative to contract with AFA catcher vessels that are qualified for the inshore sector, but outside their cooperative, to harvest the cooperative's pollock allocation.

Amendment 70, not submitted.

Amendment 71, not submitted.

<u>Amendment 72,</u> implemented August 28, 2003, revised Amendment 15:

Required a verbal departure report instead of a vessel clearance requirement for vessels with IFQ halibut or sablefish leaving the jurisdiction of the Council.

<u>Amendment 73,</u> recommended by the Council in April 2007, but not yet approved by the Secretary of Commerce.

Remove dark rockfish (*S. ciliatus*) from the FMP, which allows the State of Alaska to manage this species.

<u>Amendment 74,</u> unassigned.

<u>Amendment 75,</u> partially implemented May 29, 2003, revised Amendment 49:

Delayed indefinitely the implementation of the flatfish retention and utilization requirements.

<u>Amendment 76,</u> not submitted.

<u>Amendment 77,</u> implemented January 1, 2004, revised Amendment 64:

Implemented a Pacific cod fixed gear allocation between hook and line catcher processors (80 percent), hook and line catcher vessels (0.3 percent), pot catcher processors (3.3 percent), pot catcher vessels (15 percent), and catcher vessels (pot or hook and line) less than 60 feet (1.4 percent).

<u>Amendment 78,</u> implemented July 28, 2006, supersedes Amendment 55:

1. Refined and updated the description and identification of EFH for managed species.
2. Revised approach for identifying Habitat Areas of Particular Concern within EFH, by adopting a site-based approach.
3. Established a new area (Aleutian Islands Habitat Conservation Area) in which non-pelagic trawling is prohibited, to protect sensitive habitats from potential adverse effects of fishing.

<u>Amendment 79,</u> implemented on August 31, 2005.

Implemented a groundfish retention standard in the non-AFA trawl catcher-processor fleet.

<u>Amendment 80,</u> implemented on July 26, 2007, superseded Amendments 49 and 75:

1. Allocates non-pollock groundfish in the BSAI among trawl sectors
2. Creates a limited access privilege program to facilitate the formation of harvesting cooperative in the non-American Fisheries Act trawl catcher/processor sector.

<u>Amendment 81,</u> implemented August 27, 2004:

Revised the management policy and objectives.

<u>Amendment 82,</u> implemented February 24, 2005:

1. Created separate Chinook Salmon PSC limits for the Bering Sea and Aleutian Islands subareas, and modified the closures when the PSC limits are attained.
2. Allocated the non-CDQ directed pollock fishery in the AI subarea to the Aleut Corporation for the purpose of economic development in Adak, Alaska.

Amendment 83, implemented June 13, 2005:

1. Updated the FMP's descriptive sections, technically edited the language, and reorganized the content of the FMP.

Required the TAC for a species or species complex to be equal or less than ABC.

Amendment 84, implemented on June 22, 2007:

Established the salmon bycatch intercooperative agreement which allows vessels participating in the directed fisheries for pollock in the Bering Sea to utilize their internal cooperative structure to reduce salmon bycatch using a method called the ''voluntary rolling hotspot system.''

Amendment 85, partially implemented on March 5, 2007, superseded Amendments 46 and 77:

Implemented a gear allocation among all non-CDQ fishery sectors participating in the directed fishery for Pacific cod. After deduction of the CDQ allocation, the Pacific cod TAC is apportioned to vessels using jig gear (1.4 percent); catcher processors using trawl gear listed in Section 208(e)(1)-(20) of the AFA (2.3 percent); catcher processors using trawl gear as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (Public Law 108-447) (13.4 percent); catcher vessels using trawl gear (22.1 percent); catcher processors using hook-and-line gear (48.7 percent); catcher vessels ≥60' LOA using hook-and-line gear (0.2 percent); catcher processors using pot gear (1.5 percent); catcher vessels ≥60' LOA using pot gear (8.4 percent); and catcher vessels <60' LOA that use either hook-and-line gear or pot gear (2.0 percent).

Amendment 86, (Observer Program Restructuring) not yet submitted.

Amendment 87, (CDQ eligibility) recommended by the Council in April 2006, but not yet approved by the Secretary of Commerce, superseded by 2006 MSA amendments.

Amendment 88 implemented on February 19, 2008:

Revised the Aleutian Islands Habitat Conservation Area to close additional waters near Buldir Island and to open waters near Agattu Island to nonpelagic trawl gear.

Amendment 89 implemented on May 19, 2008:

1. Established new habitat conservation areas (HCA) (Bering Sea HCA; St. Matthew Island HCA; St. Lawrence Island HCA; and Nunivak Island, Etolin Strait, and Kuskokwim Bay HCA) in which nonpelagic trawling is prohibited, to protect bottom habitat from potential adverse effects of fishing.

2. Established the Northern Bering Sea Research Area in which nonpelagic trawling is prohibited except under an exempted fishing permit that is consistent with a research plan approved by the Council to study the effects of nonpelagic trawling on the management of crab species, marine mammals, ESA-listed species, and subsistence needs for Western Alaska communities.

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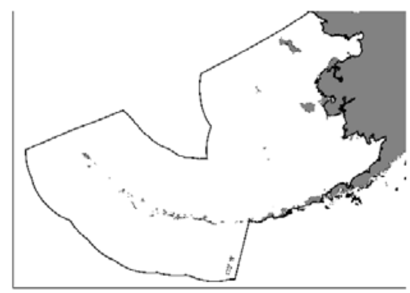
Appendix B Geographical Coordinates of Areas Described in the Fishery Management Plan

This appendix describes the geographical coordinates for the areas described in the Fishery Management Plan (FMP). This appendix divides the descriptions into three types: Bering Sea and Aleutian Islands (BSAI) management area, subareas, and districts (Section B.1), closed areas (Section B.2), and prohibited species bycatch (PSC) bycatch limitation zones (Section B.3).

B.1 Management Area, Subareas, and Districts

Management Area

The management area for the BSAI groundfish FMP is the United States (U.S.) Exclusive Economic Zone (EEZ) of the Bering Sea, including Bristol Bay and Norton Sound, and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is between 170° W. longitude and the U.S.-Russian Convention Line of 1867. To the north, the management area is bounded by the Bering Strait.

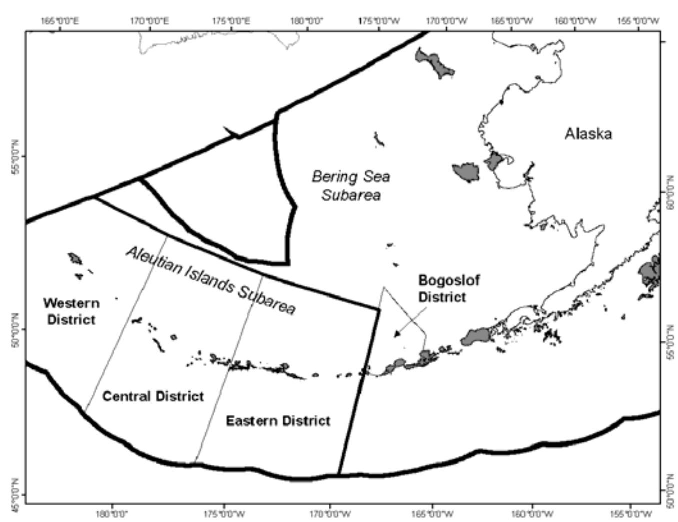


Subareas

Two subareas are described in Section 3.1 of the FMP and are defined as follows:

Bering Sea subarea: The area of the EEZ east of 170° W. longitude that is north of the Aleutian Islands, and the area of the EEZ west of 170° W. longitude that is north of 55° N. latitude.

Aleutian Islands subarea: The area of the EEZ west of 170°W. longitude and south of 55°N. latitude.



Districts

The Bering Sea subarea contains one district, defined as follows:

Bogoslof District: The area of the EEZ east of 170° W. longitude, west of 167° W. longitude, south of the straight line connecting the coordinates (55°46' N., 170° W.) and (54°30' N., 167° W.), and north of the Aleutian Islands.

The Aleutian Islands subarea is divided into three districts, defined as follows:

Eastern District: That part of the Aleutian Islands subarea between 170° W. longitude and 177° W. longitude.

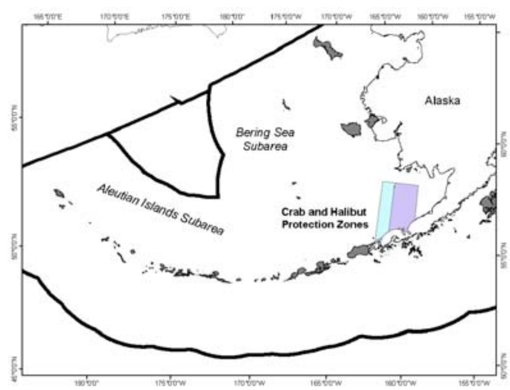
Central District: That part of the Aleutian Islands subarea between 177° W. longitude and 177° E. longitude.

Western District: That part of the Aleutian Islands subarea west of 177° E. longitude.

B.2 Closed Areas

Specific areas of the BSAI are closed to some or all fishing during certain times of the year and are described in Section 3.5.2 of the FMP.

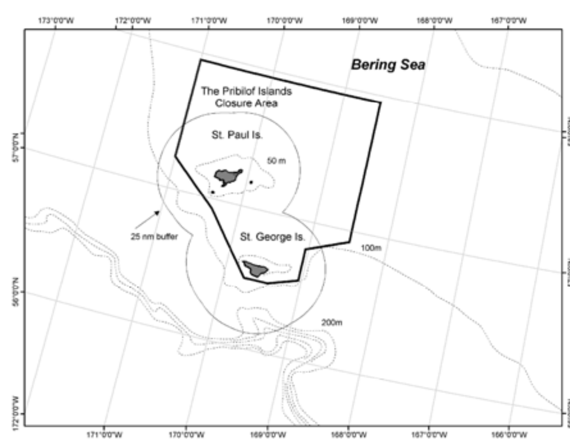
Crab and Halibut Protection Zone



For the periods January 1 - March 14 and June 16 - December 31 of each fishing year, the Crab and Halibut Protection Zone is defined as that portion of the EEZ north of the Alaska Peninsula, south of 58° N. latitude, west of 160° W. longitude and east of 162° W. longitude. For the period March 15 - June 15 of each fishing year the Crab and Halibut Protection Zone is defined as that portion of the EEZ north of the Alaska Peninsula, south of 58° N. latitude, west of 160° W. longitude and east of 163° W. longitude.

Pribilof Islands Habitat Conservation Area

Trawling is prohibited at all times in the EEZ within the area bounded by a straight line connecting the following pairs of coordinates in the following order:



(57° 57.0' N., 168° 30.0' W.)

(56° 55.2' N., 168° 30.0' W.)

(56° 48.0' N., 169° 2.4' W.)

(56° 34.2' N., 169° 2.4' W.)

(56° 30.0' N., 169° 25.2' W.)

(56° 30.0' N., 169° 44.1' W.)

(56° 55.8' N., 170° 21.6' W.)

(57° 13.8' N., 171° 0.0' W.)

(57° 57.0' N., 171° 0.0' W.)

(57° 57.0' N., 168° 30.0' W.)

Chum Salmon Savings Area

Trawling is prohibited from August 1 through August 31 within the area bounded by a straight line connecting the following pairs of coordinates in the order listed:

(56°00' N., 167°00' W.)

(56°00' N., 165°00' W.)

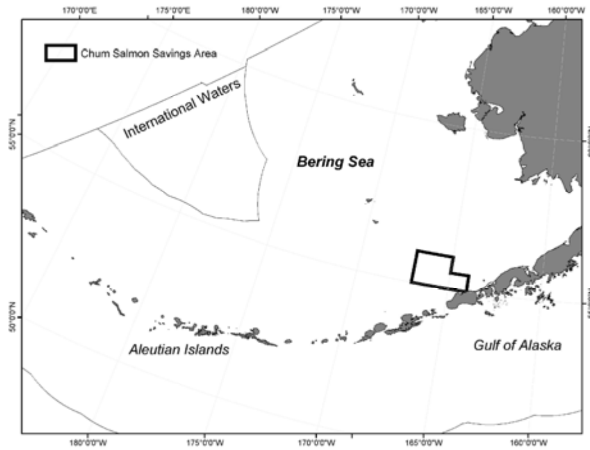
(55°30' N., 165°00' W.)

(55°30' N., 164°00' W.)

(55°00' N., 164°00' W.)

(55°00' N., 167°00' W.)

(56°00' N., 167°00' W.)



Trawling is also prohibited for the remainder of the period September 14 through October 14 upon the attainment of an 'other salmon' bycatch limit; see Section B.3.

Red King Crab Savings Area

Non-pelagic trawling is prohibited year round within the area bounded by a straight line connecting the following pairs of coordinates in the order listed below:

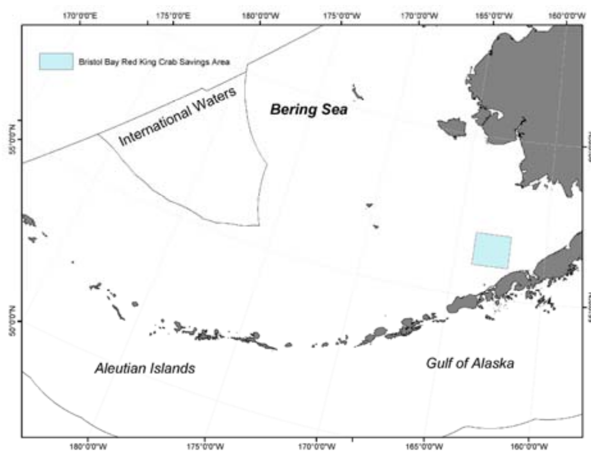
(56° N., 162° W.)

(56° N., 164° W.)

(57° N., 164° W.)

(57° N., 162° W.)

(56° N., 162° W.)



with the exception that a subarea of the Red King Crab Savings Area between 56°00' N. and 56°10' N. latitude and 162° W. and 164° W. longitude may be opened as outlined in Section 3.5.2.1.

Nearshore Bristol Bay Trawl Closure

All trawling is prohibited year round in Bristol Bay east of 162° W. longitude, except the subarea bounded by a straight line connecting the following pairs of coordinates in the order listed below that is open to trawling during the period April 1 to June 15 each year:

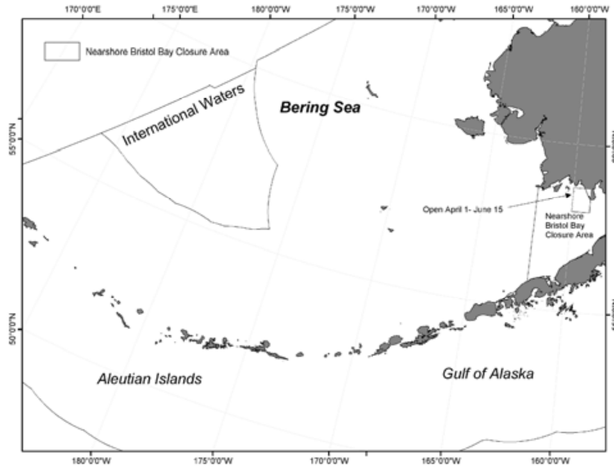
(58°00' N., 160° W.)

(58°43' N., 160° W.)

(58°43' N., 159° W.)

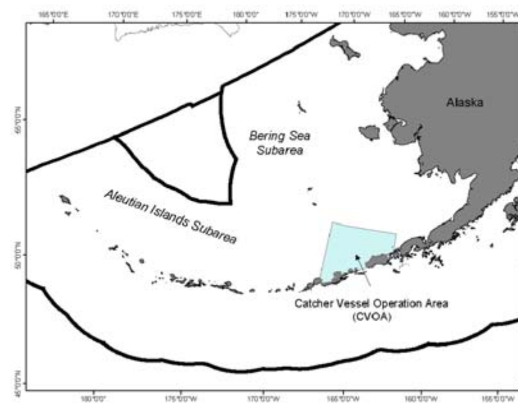
(58°00' N., 159° W.)

(58°00' N., 160° W.)



Catcher Vessel Operational Area (CVOA)

The CVOA is defined as the area of the BSAI east of 167°30' W. longitude, west of 163° W. longitude, south of 56° N. latitude, and north of the Aleutian Islands. The CVOA shall be in effect during the pollock "B" season from September 1 until the date that closes the inshore component "B" season allocation to directed fishing. Vessels in the offshore component or vessels catching pollock for processing by the offshore component are prohibited from conducting directed fishing for pollock in the CVOA unless they are participating in a CDQ fishery.



Alaska Seamount Habitat Protection Area (ASHPA)

Bottom contact gear fishing is prohibited in the portion of the Alaska Seamount Habitat Protection Area located in the BSAI. Coordinates for this habitat protection area are listed in the table below.

Name	Latitude			Longitude		
Bowers Seamount	54	9.00	N	174	52.20	E
	54	9.00	N	174	42.00	E
	54	4.20	N	174	42.00	E
	54	4.20	N	174	52.20	E

Note: The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates is connected to the first set of coordinates by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Aleutian Islands Habitat Conservation Area (AIHCA)

Nonpelagic trawl gear fishing is prohibited in the AIHCA. Note: Unless otherwise footnoted (see footnotes at end of table, beginning on page**Error! Reference source not found.Error! Bookmark not defined.**), each area is delineated by connecting in order the coordinates listed by straight lines. Except for the Amlia North/Seguam donut and the Buldir donut, each area delineated in the table is open to nonpelagic trawl gear fishing. The remainder of the entire Aleutian Islands subarea and the areas delineated by the coordinates for the Amlia North/Seguam and Buldir donuts are closed to nonpelagic trawl gear fishing, as specified at § 679.22. Unless otherwise noted, the last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Name	Latitude			Longitude			Footnote
Islands of 4 Mountains North	52	54.00	N	170	18.00	W	
	52	54.00	N	170	24.00	W	
	52	42.00	N	170	24.00	W	
	52	42.00	N	170	18.00	W	
Islands of 4 Mountains West	53	12.00	N	170	0.00	W	
	53	12.00	N	170	12.00	W	
	53	6.00	N	170	12.00	W	
	53	6.00	N	170	30.00	W	
	53	0.00	N	170	30.00	W	
	53	0.00	N	170	48.00	W	
	52	54.00	N	170	48.00	W	
	52	54.00	N	170	54.00	W	
	52	48.00	N	170	54.00	W	
	52	48.00	N	170	30.00	W	
	52	54.00	N	170	30.00	W	
	52	54.00	N	170	24.00	W	
	53	0.00	N	170	24.00	W	
	53	0.00	N	170	0.00	W	
Yunaska I South	52	24.00	N	170	30.00	W	
	52	24.00	N	170	54.00	W	
	52	12.00	N	170	54.00	W	
	52	12.00	N	170	30.00	W	
Amukta I North	52	54.00	N	171	6.00	W	
	52	54.00	N	171	30.00	W	
	52	48.00	N	171	30.00	W	
	52	48.00	N	171	36.00	W	
	52	42.00	N	171	36.00	W	
	52	42.00	N	171	12.00	W	
	52	48.00	N	171	12.00	W	
	52	48.00	N	171	6.00	W	
Amukta Pass North	52	42.00	N	171	42.00	W	
	52	42.00	N	172	6.00	W	
	52	36.00	N	172	6.00	W	
	52	36.00	N	171	42.00	W	
Amlia North/Seguam	52	42.00	N	172	12.00	W	
	52	42.00	N	172	30.00	W	

Name	Latitude			Longitude			Footnote
	52	30.00	N	172	30.00	W	
	52	30.00	N	172	36.00	W	
	52	36.00	N	172	36.00	W	
	52	36.00	N	172	42.00	W	
	52	39.00	N	172	42.00	W	
	52	39.00	N	173	24.00	W	
	52	36.00	N	173	30.00	W	
	52	36.00	N	173	36.00	W	
	52	30.00	N	173	36.00	W	
	52	30.00	N	174	0.00	W	
	52	27.00	N	174	0.00	W	
	52	27.00	N	174	6.00	W	
	52	23.93	N	174	6.00	W	1
	52	13.71	N	174	6.00	W	
	52	12.00	N	174	6.00	W	
	52	12.00	N	174	0.00	W	
	52	9.00	N	174	0.00	W	
	52	9.00	N	173	0.00	W	
	52	6.00	N	173	0.00	W	
	52	6.00	N	172	45.00	W	
	51	54.00	N	172	45.00	W	
	51	54.00	N	171	48.00	W	
	51	48.00	N	171	48.00	W	
	51	48.00	N	171	42.00	W	
	51	54.00	N	171	42.00	W	
	52	12.00	N	171	42.00	W	
	52	12.00	N	171	48.00	W	
	52	18.00	N	171	48.00	W	
	52	18.00	N	171	42.00	W	
	52	30.00	N	171	42.00	W	
	52	30.00	N	171	54.00	W	
	52	24.00	N	171	54.00	W	
	52	24.00	N	172	0.00	W	
	52	12.00	N	172	0.00	W	
	52	12.00	N	172	42.00	W	
	52	18.00	N	172	42.00	W	
	52	18.00	N	172	37.13	W	2
	52	18.64	N	172	36.00	W	
	52	24.00	N	172	36.00	W	
	52	24.00	N	172	12.00	W	6
Amlia North/Seguam donut	52	33.00	N	172	42.00	W	5

Name	Latitude			Longitude			Footnote
	52	33.00	N	173	6.00	W	5
	52	30.00	N	173	6.00	W	5
	52	30.00	N	173	18.00	W	5
	52	24.00	N	173	18.00	W	5
	52	24.00	N	172	48.00	W	5
	52	30.00	N	172	48.00	W	5
	52	30.00	N	172	42.00	W	5, 7
Atka/Amlia South	52	0.00	N	173	18.00	W	
	52	0.00	N	173	54.00	W	
	52	3.08	N	173	54.00	W	2
	52	6.00	N	173	58.00	W	
	52	6.00	N	174	6.00	W	
	52	0.00	N	174	18.00	W	
	52	0.00	N	174	12.00	W	
	51	54.00	N	174	12.00	W	
	51	54.00	N	174	18.00	W	
	52	6.00	N	174	18.00	W	
	52	6.00	N	174	21.86	W	1
	52	4.39	N	174	30.00	W	
	52	3.09	N	174	30.00	W	1
	52	2.58	N	174	30.00	W	
	52	0.00	N	174	30.00	W	
	52	0.00	N	174	36.00	W	
	51	54.00	N	174	36.00	W	
	51	54.00	N	174	54.00	W	
	51	48.00	N	174	54.00	W	
	51	48.00	N	173	24.00	W	
	51	54.00	N	173	24.00	W	
	51	54.00	N	173	18.00	W	
Atka I North	52	30.00	N	174	24.00	W	
	52	30.00	N	174	30.00	W	
	52	24.00	N	174	30.00	W	
	52	24.00	N	174	48.00	W	
	52	18.00	N	174	48.00	W	
	52	18.00	N	174	54.00	W	
	52	12.00	N	174	54.00	W	
	52	12.00	N	175	18.00	W	
	52	1.14	N	175	18.00	W	1
	52	2.19	N	175	12.00	W	
	52	6.00	N	175	12.00	W	
	52	6.00	N	174	55.51	W	1

Name	Latitude			Longitude			Footnote
	52	6.00	N	174	54.04	W	
	52	6.00	N	174	48.00	W	
	52	12.00	N	174	48.00	W	
	52	12.00	N	174	26.85	W	1
	52	12.94	N	174	18.00	W	
	52	16.80	N	174	18.00	W	1
	52	17.06	N	174	18.00	W	
	52	17.64	N	174	18.00	W	1
	52	18.00	N	174	19.12	W	
	52	18.00	N	174	20.04	W	1
	52	19.37	N	174	24.00	W	
Atka I South	52	0.68	N	175	12.00	W	2
	52	0.76	N	175	18.00	W	
	52	0.00	N	175	18.00	W	
	52	0.00	N	175	12.00	W	
Adak I East	52	12.00	N	176	36.00	W	
	52	12.00	N	176	0.00	W	
	52	2.59	N	176	0.00	W	1
	52	1.79	N	176	0.00	W	
	52	0.00	N	176	0.00	W	
	52	0.00	N	175	48.00	W	
	51	57.74	N	175	48.00	W	1
	51	55.48	N	175	48.00	W	
	51	54.00	N	175	48.00	W	
	51	54.00	N	176	0.00	W	1
	51	53.09	N	176	6.00	W	
	51	51.40	N	176	6.00	W	1
	51	49.67	N	176	6.00	W	
	51	48.73	N	176	6.00	W	1
	51	48.00	N	176	6.36	W	
	51	48.00	N	176	9.82	W	1
	51	48.00	N	176	9.99	W	
	51	48.00	N	176	16.19	W	1
	51	48.00	N	176	24.71	W	
	51	48.00	N	176	25.71	W	1
	51	45.58	N	176	30.00	W	
	51	42.00	N	176	30.00	W	
	51	42.00	N	176	33.92	W	1
	51	41.22	N	176	42.00	W	
	51	30.00	N	176	42.00	W	
	51	30.00	N	176	36.00	W	

Name	Latitude			Longitude			Footnote
	51	36.00	N	176	36.00	W	
	51	36.00	N	176	0.00	W	
	51	42.00	N	176	0.00	W	
	51	42.00	N	175	36.00	W	
	51	48.00	N	175	36.00	W	
	51	48.00	N	175	18.00	W	
	51	51.00	N	175	18.00	W	
	51	51.00	N	175	0.00	W	
	51	57.00	N	175	0.00	W	
	51	57.00	N	175	18.00	W	
	52	0.00	N	175	18.00	W	
	52	0.00	N	175	30.00	W	
	52	3.00	N	175	30.00	W	
	52	3.00	N	175	36.00	W	
Cape Adagdak	52	6.00	N	176	12.44	W	
	52	6.00	N	176	30.00	W	
	52	3.00	N	176	30.00	W	
	52	3.00	N	176	42.00	W	
	52	0.00	N	176	42.00	W	
	52	0.00	N	176	46.64	W	
	51	57.92	N	176	46.51	W	1
	51	54.00	N	176	37.07	W	
	51	54.00	N	176	18.00	W	
	52	0.00	N	176	18.00	W	
	52	0.00	N	176	12.00	W	
	52	2.85	N	176	12.00	W	1
	52	4.69	N	176	12.44	W	
Cape Kiguga/Round Head	52	0.00	N	176	53.00	W	
	52	0.00	N	177	6.00	W	
	51	56.06	N	177	6.00	W	1
	51	54.00	N	177	2.84	W	
	51	54.00	N	176	54.00	W	
	51	48.79	N	176	54.00	W	1
	51	48.00	N	176	50.35	W	
	51	48.00	N	176	43.14	W	1
	51	55.69	N	176	48.59	W	
	51	55.69	N	176	53.00	W	
Adak Strait South	51	42.00	N	176	55.77	W	
	51	42.00	N	177	12.00	W	
	51	30.00	N	177	12.00	W	
	51	36.00	N	177	6.00	W	

Name	Latitude			Longitude			Footnote
	51	36.00	N	177	3.00	W	
	51	39.00	N	177	3.00	W	
	51	39.00	N	177	0.00	W	
	51	36.00	N	177	0.00	W	
	51	36.00	N	176	57.72	W	3
Bay of Waterfalls	51	38.62	N	176	54.00	W	
	51	36.00	N	176	54.00	W	
	51	36.00	N	176	55.99	W	3
Tanaga/Kanaga North	51	54.00	N	177	12.00	W	
	51	54.00	N	177	19.93	W	
	51	51.71	N	177	19.93	W	
	51	51.65	N	177	29.11	W	
	51	54.00	N	177	29.11	W	
	51	54.00	N	177	30.00	W	
	51	57.00	N	177	30.00	W	
	51	57.00	N	177	42.00	W	
	51	54.00	N	177	42.00	W	
	51	54.00	N	177	54.00	W	
	51	50.92	N	177	54.00	W	1
	51	48.00	N	177	46.44	W	
	51	48.00	N	177	42.00	W	
	51	42.59	N	177	42.00	W	1
	51	45.57	N	177	24.01	W	
	51	48.00	N	177	24.00	W	
	51	48.00	N	177	14.08	W	4
Tanaga/Kanaga South	51	43.78	N	177	24.04	W	1
	51	42.37	N	177	42.00	W	
	51	42.00	N	177	42.00	W	
	51	42.00	N	177	50.04	W	1
	51	40.91	N	177	54.00	W	
	51	36.00	N	177	54.00	W	
	51	36.00	N	178	0.00	W	
	51	38.62	N	178	0.00	W	1
	51	42.52	N	178	6.00	W	
	51	49.34	N	178	6.00	W	1
	51	51.35	N	178	12.00	W	
	51	48.00	N	178	12.00	W	
	51	48.00	N	178	30.00	W	
	51	42.00	N	178	30.00	W	
	51	42.00	N	178	36.00	W	
	51	36.26	N	178	36.00	W	1

Name	Latitude			Longitude			Footnote
	51	35.75	N	178	36.00	W	
	51	27.00	N	178	36.00	W	
	51	27.00	N	178	42.00	W	
	51	21.00	N	178	42.00	W	
	51	21.00	N	178	24.00	W	
	51	24.00	N	178	24.00	W	
	51	24.00	N	178	12.00	W	
	51	30.00	N	178	12.00	W	
	51	30.00	N	177	24.00	W	
Amchitka Pass East	51	42.00	N	178	48.00	W	
	51	42.00	N	179	18.00	W	
	51	45.00	N	179	18.00	W	
	51	45.00	N	179	36.00	W	
	51	42.00	N	179	36.00	W	
	51	42.00	N	179	39.00	W	
	51	30.00	N	179	39.00	W	
	51	30.00	N	179	36.00	W	
	51	18.00	N	179	36.00	W	
	51	18.00	N	179	24.00	W	
	51	30.00	N	179	24.00	W	
	51	30.00	N	179	0.00	W	
	51	25.82	N	179	0.00	W	
	51	25.85	N	178	59.00	W	
	51	24.00	N	178	58.97	W	
	51	24.00	N	178	54.00	W	
	51	30.00	N	178	54.00	W	
	51	30.00	N	178	48.00	W	
	51	32.69	N	178	48.00	W	1
	51	33.95	N	178	48.00	W	
Amatignak I	51	18.00	N	178	54.00	W	
	51	18.00	N	179	5.30	W	1
	51	18.00	N	179	6.75	W	
	51	18.00	N	179	12.00	W	
	51	6.00	N	179	12.00	W	
	51	6.00	N	179	0.00	W	
	51	12.00	N	179	0.00	W	
	51	12.00	N	178	54.00	W	
Amchitka Pass Center	51	30.00	N	179	48.00	W	
	51	30.00	N	180	0.00	W	
	51	24.00	N	180	0.00	W	
	51	24.00	N	179	48.00	W	

Name	Latitude			Longitude			Footnote
Amchitka Pass West	51	36.00	N	179	54.00	E	
	51	36.00	N	179	36.00	E	
	51	30.00	N	179	36.00	E	
	51	30.00	N	179	45.00	E	
	51	27.00	N	179	48.00	E	
	51	24.00	N	179	48.00	E	
	51	24.00	N	179	54.00	E	
Petrel Bank	52	51.00	N	179	12.00	W	
	52	51.00	N	179	24.00	W	
	52	48.00	N	179	24.00	W	
	52	48.00	N	179	30.00	W	
	52	42.00	N	179	30.00	W	
	52	42.00	N	179	36.00	W	
	52	36.00	N	179	36.00	W	
	52	36.00	N	179	48.00	W	
	52	30.00	N	179	48.00	W	
	52	30.00	N	179	42.00	E	
	52	24.00	N	179	42.00	E	
	52	24.00	N	179	36.00	E	
	52	12.00	N	179	36.00	E	
	52	12.00	N	179	36.00	W	
	52	24.00	N	179	36.00	W	
	52	24.00	N	179	30.00	W	
	52	30.00	N	179	30.00	W	
	52	30.00	N	179	24.00	W	
	52	36.00	N	179	24.00	W	
	52	36.00	N	179	18.00	W	
	52	42.00	N	179	18.00	W	
	52	42.00	N	179	12.00	W	
Rat I/Amchitka I South	51	21.00	N	179	36.00	E	
	51	21.00	N	179	18.00	E	
	51	18.00	N	179	18.00	E	
	51	18.00	N	179	12.00	E	
	51	23.77	N	179	12.00	E	1
	51	24.00	N	179	10.20	E	
	51	24.00	N	179	0.00	E	
	51	36.00	N	178	36.00	E	
	51	36.00	N	178	24.00	E	
	51	42.00	N	178	24.00	E	
	51	42.00	N	178	6.00	E	
	51	48.00	N	178	6.00	E	

Name	Latitude			Longitude			Footnote
	51	48.00	N	177	54.00	E	
	51	54.00	N	177	54.00	E	
	51	54.00	N	178	12.00	E	
	51	48.00	N	178	12.00	E	
	51	48.00	N	178	17.09	E	1
	51	48.00	N	178	20.60	E	
	51	48.00	N	178	24.00	E	
	52	6.00	N	178	24.00	E	
	52	6.00	N	178	12.00	E	
	52	0.00	N	178	12.00	E	
	52	0.00	N	178	11.01	E	1
	52	0.00	N	178	5.99	E	
	52	0.00	N	177	54.00	E	
	52	9.00	N	177	54.00	E	
	52	9.00	N	177	42.00	E	
	52	0.00	N	177	42.00	E	
	52	0.00	N	177	48.00	E	
	51	54.00	N	177	48.00	E	
	51	54.00	N	177	30.00	E	
	51	51.00	N	177	30.00	E	
	51	51.00	N	177	24.00	E	
	51	45.00	N	177	24.00	E	
	51	45.00	N	177	30.00	E	
	51	48.00	N	177	30.00	E	
	51	48.00	N	177	42.00	E	
	51	42.00	N	177	42.00	E	
	51	42.00	N	178	0.00	E	
	51	39.00	N	178	0.00	E	
	51	39.00	N	178	12.00	E	
	51	36.00	N	178	12.00	E	
	51	36.00	N	178	18.00	E	
	51	30.00	N	178	18.00	E	
	51	30.00	N	178	24.00	E	
	51	24.00	N	178	24.00	E	
	51	24.00	N	178	36.00	E	
	51	30.00	N	178	36.00	E	
	51	24.00	N	178	48.00	E	
	51	18.00	N	178	48.00	E	
	51	18.00	N	178	54.00	E	
	51	12.00	N	178	54.00	E	
	51	12.00	N	179	30.00	E	

Name	Latitude			Longitude			Footnote
	51	18.00	N	179	30.00	E	
	51	18.00	N	179	36.00	E	
Amchitka I North	51	42.00	N	179	12.00	E	
	51	42.00	N	178	57.00	E	
	51	36.00	N	178	56.99	E	
	51	36.00	N	179	0.00	E	
	51	33.62	N	179	0.00	E	2
	51	30.00	N	179	5.00	E	
	51	30.00	N	179	18.00	E	
	51	36.00	N	179	18.00	E	
	51	36.00	N	179	12.00	E	
Pillar Rock	52	9.00	N	177	30.00	E	
	52	9.00	N	177	18.00	E	
	52	6.00	N	177	18.00	E	
	52	6.00	N	177	30.00	E	
Murray Canyon	51	48.00	N	177	12.00	E	
	51	48.00	N	176	48.00	E	
	51	36.00	N	176	48.00	E	
	51	36.00	N	177	0.00	E	
	51	39.00	N	177	0.00	E	
	51	39.00	N	177	6.00	E	
	51	42.00	N	177	6.00	E	
	51	42.00	N	177	12.00	E	
Buldir	52	6.00	N	177	12.00	E	
	52	6.00	N	177	0.00	E	
	52	12.00	N	177	0.00	E	
	52	12.00	N	176	54.00	E	
	52	9.00	N	176	54.00	E	
	52	9.00	N	176	48.00	E	
	52	0.00	N	176	48.00	E	
	52	0.00	N	176	36.00	E	
	52	6.00	N	176	36.00	E	
	52	6.00	N	176	24.00	E	
	52	12.00	N	176	24.00	E	
	52	12.00	N	176	12.00	E	
	52	18.00	N	176	12.00	E	
	52	18.00	N	176	30.00	E	
	52	24.00	N	176	30.00	E	
	52	24.00	N	176	0.00	E	
	52	18.00	N	176	0.00	E	
	52	18.00	N	175	54.00	E	

Name	Latitude			Longitude			Footnote
	52	6.00	N	175	54.00	E	
	52	6.00	N	175	48.00	E	
	52	0.00	N	175	48.00	E	
	52	0.00	N	175	54.00	E	
	51	54.00	N	175	54.00	E	
	51	54.00	N	175	36.00	E	
	51	42.00	N	175	36.00	E	
	51	42.00	N	175	30.00	E	
	51	36.00	N	175	30.00	E	
	51	36.00	N	175	36.00	E	
	51	30.00	N	175	36.00	E	
	51	30.00	N	175	42.00	E	
	51	36.00	N	175	42.00	E	
	51	36.00	N	176	0.00	E	
	52	0.00	N	176	0.00	E	
	52	0.00	N	176	6.00	E	
	52	6.00	N	176	6.00	E	
	52	6.00	N	176	12.00	E	
	52	0.00	N	176	12.00	E	
	52	0.00	N	176	30.00	E	
	51	54.00	N	176	30.00	E	
	51	54.00	N	177	0.00	E	
	52	0.00	N	177	0.00	E	
	52	0.00	N	177	12.00	E	
Buldir donut	51	48.00	N	175	48.00	E	5
	51	48.00	N	175	42.00	E	5
	51	45.00	N	175	42.00	E	5
	51	45.00	N	175	48.00	E	5, 7
Buldir Mound	51	54.00	N	176	24.00	E	
	51	54.00	N	176	18.00	E	
	51	48.00	N	176	18.00	E	
	51	48.00	N	176	24.00	E	
Buldir West	52	30.00	N	175	48.00	E	
	52	30.00	N	175	36.00	E	
	52	36.00	N	175	36.00	E	
	52	36.00	N	175	24.00	E	
	52	24.00	N	175	24.00	E	
	52	24.00	N	175	30.00	E	
	52	18.00	N	175	30.00	E	
	52	18.00	N	175	36.00	E	
	52	24.00	N	175	36.00	E	

Name	Latitude			Longitude			Footnote
	52	24.00	N	175	48.00	E	
Tahoma Canyon	52	0.00	N	175	18.00	E	
	52	0.00	N	175	12.00	E	
	51	42.00	N	175	12.00	E	
	51	42.00	N	175	24.00	E	
	51	54.00	N	175	24.00	E	
	51	54.00	N	175	18.00	E	
Walls Plateau	52	24.00	N	175	24.00	E	
	52	24.00	N	175	12.00	E	
	52	18.00	N	175	12.00	E	
	52	18.00	N	175	0.00	E	
	52	12.00	N	175	0.00	E	
	52	12.00	N	174	42.00	E	
	52	6.00	N	174	42.00	E	
	52	6.00	N	174	36.00	E	
	52	0.00	N	174	36.00	E	
	52	0.00	N	174	42.00	E	
	51	54.00	N	174	42.00	E	
	51	54.00	N	174	48.00	E	
	52	0.00	N	174	48.00	E	
	52	0.00	N	174	54.00	E	
	52	6.00	N	174	54.00	E	
	52	6.00	N	175	18.00	E	
	52	12.00	N	175	24.00	E	
Semichi I	52	30.00	N	175	6.00	E	
	52	30.00	N	175	0.00	E	
	52	36.00	N	175	0.00	E	
	52	36.00	N	174	48.00	E	
	52	42.00	N	174	48.00	E	
	52	42.00	N	174	33.00	E	
	52	36.00	N	174	33.00	E	
	52	36.00	N	174	24.00	E	
	52	39.00	N	174	24.00	E	
	52	39.00	N	174	0.00	E	
	52	42.00	N	173	54.00	E	
	52	45.16	N	173	54.00	E	1
	52	46.35	N	173	54.00	E	
	52	54.00	N	173	54.00	E	
	52	54.00	N	173	30.00	E	
	52	48.00	N	173	30.00	E	
	52	48.00	N	173	36.00	E	

Name	Latitude			Longitude			Footnote
	52	40.00	N	173	36.00	E	
	52	40.00	N	173	25.00	E	
	52	30.00	N	173	25.00	E	
	52	33.00	N	173	40.00	E	
	52	33.00	N	173	54.00	E	
	52	18.00	N	173	54.00	E	
	52	18.00	N	174	30.00	E	
	52	30.00	N	174	30.00	E	
	52	30.00	N	174	48.00	E	
	52	24.00	N	174	48.00	E	
	52	24.00	N	175	6.00	E	
Agattu South	52	18.00	N	173	54.00	E	
	52	18.00	N	173	24.00	E	
	52	9.00	N	173	24.00	E	
	52	9.00	N	173	36.00	E	
	52	6.00	N	173	36.00	E	
	52	6.00	N	173	54.00	E	
Attu I North	53	3.00	N	173	24.00	E	
	53	3.00	N	173	6.00	E	
	53	0.00	N	173	6.00	E	
	53	0.00	N	173	24.00	E	
Attu I West	52	54.00	N	172	12.00	E	
	52	54.00	N	172	0.00	E	
	52	48.00	N	172	0.00	E	
	52	48.00	N	172	12.00	E	
Stalemate Bank	53	0.00	N	171	6.00	E	
	53	0.00	N	170	42.00	E	
	52	54.00	N	170	42.00	E	
	52	54.00	N	171	6.00	E	

Note: Unless otherwise footnoted, each area is delineated by connecting in order the coordinates listed by straight lines. Except for the Amlia North/Seguam donut and the Buldir donut, each area delineated in the table is open to nonpelagic trawl gear fishing. The remainder of the entire Aleutian Islands subarea and the areas delineated by the coordinates for the Amlia North/Seguam and Buldir donuts are closed to nonpelagic trawl gear fishing, as specified at § 679.22. Unless otherwise noted, the last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

[1]The connection of these coordinates to the next set of coordinates is by a line extending in a clockwise direction from these coordinates along the shoreline at mean lower-low water to the next set of coordinates.
[2]The connection of these coordinates to the next set of coordinates is by a line extending in a counter clockwise direction from these coordinates along the shoreline at mean lower-low water to the next set of coordinates.
[3]The connection of these coordinates to the first set of coordinates for this area is by a line extending in a clockwise direction from these coordinates along the shoreline at mean lower-low water to the first set of coordinates.
[4]The connection of these coordinates to the first set of coordinates for this area is by a line extending in a counter clockwise direction from these coordinates along the shoreline at mean lower-low water to the first set of

coordinates.
[5] The area specified by this set of coordinates is closed to fishing with non-pelagic trawl gear.
[6] This set of coordinates is connected to the first set of coordinates listed for the area by a straight line.
[7]The last coordinate for the donut is connected to the first set of coordinates for the donut by a straight line.

Aleutian Islands Coral Habitat Protection Areas (AICHPAs)

The use of bottom contact gear is prohibited in the AICHPAs. The coordinates for the areas are listed in the table below. Note: Each area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Aleutian Islands Coral Habitat Protection Areas

Area Number	Name	Latitude			Longitude		
1	Great Sitkin Is	52	9.56	N	176	6.14	W
		52	9.56	N	176	12.44	W
		52	4.69	N	176	12.44	W
		52	6.59	N	176	6.12	W
2	Cape Moffett Is	52	0.11	N	176	46.65	W
		52	0.10	N	176	53.00	W
		51	55.69	N	176	53.00	W
		51	55.69	N	176	48.59	W
		51	57.96	N	176	46.52	W
3	Adak Canyon	51	39.00	N	177	0.00	W
		51	39.00	N	177	3.00	W
		51	30.00	N	177	3.00	W
		51	30.00	N	177	0.00	W
4	Bobrof Is	51	57.35	N	177	19.94	W
		51	57.36	N	177	29.11	W
		51	51.65	N	177	29.11	W
		51	51.71	N	177	19.93	W
5	Ulak Is	51	25.85	N	178	59.00	W
		51	25.69	N	179	6.00	W
		51	22.28	N	179	6.00	W
		51	22.28	N	178	58.95	W
6	Semisopochnoi Is	51	53.10	N	179	53.11	E
		51	53.10	N	179	46.55	E
		51	48.84	N	179	46.55	E
		51	48.89	N	179	53.11	E

Bowers Ridge Habitat Conservation Zone (BRHCZ)

The use of mobile bottom contact gear is prohibited in the BRHCZ. The areas are described in the table below.

Bowers Ridge Habitat Conservation Zone

Area number	Name	Latitude			Longitude		
1	Bowers Ridge	55	10.50	N	178	27.25	E
		54	54.50	N	177	55.75	E
		54	5.83	N	179	20.75	E
		52	40.50	N	179	55.00	W
		52	44.50	N	179	26.50	W
		54	15.50	N	179	54.00	W
2	Ulm Plateau	55	5.00	N	177	15.00	E
		55	5.00	N	175	60.00	E
		54	34.00	N	175	60.00	E
		54	34.00	N	177	15.00	E

Note: Each area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Bering Sea Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in Bering Sea Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Latitude			Longitude		
179	19.95	W	59	25.15	N
177	51.76	W	58	28.85	N
175	36.52	W	58	11.78	N
174	32.36	W	58	8.37	N
174	26.33	W	57	31.31	N
174	0.82	W	56	52.83	N
173	0.71	W	56	24.05	N
170	40.32	W	56	1.97	N
168	56.63	W	55	19.30	N
168	0.08	W	54	5.95	N
170	0.00	W	53	18.24	N
170	0.00	W	55	0.00	N
178	46.69	E	55	0.00	N
178	27.25	E	55	10.50	N
178	6.48	E	55	0.00	N
177	15.00	E	55	0.00	N
177	15.00	E	55	5.00	N
176	0.00	E	55	5.00	N
176	0.00	E	55	0.00	N
172	6.35	E	55	0.00	N
173	59.70	E	56	16.96	N

St. Matthew Island Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in St. Matthew Island Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
172	0.00	W	60	54.00	N
171	59.92	W	60	3.52	N
174	0.50	W	59	42.26	N
174	24.98	W	60	9.98	N
174	1.24	W	60	54.00	N

St. Lawrence Island Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in St. Lawrence Island Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
168	24.00	W	64	0.00	N
168	24.00	W	62	42.00	N
172	24.00	W	62	42.00	N
172	24.00	W	63	57.03	N
172	17.42	W	64	0.01	N

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

Nonpelagic trawl gear fishing is prohibited in Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
165	1.54	W	60	45.54	N *
162	7.01	W	58	38.27	N
162	10.51	W	58	38.35	N
162	34.31	W	58	38.36	N
162	34.32	W	58	39.16	N
162	34.23	W	58	40.48	N
162	34.09	W	58	41.79	N
162	33.91	W	58	43.08	N
162	33.63	W	58	44.41	N
162	33.32	W	58	45.62	N
162	32.93	W	58	46.80	N
162	32.44	W	58	48.11	N
162	31.95	W	58	49.22	N
162	31.33	W	58	50.43	N
162	30.83	W	58	51.42	N
162	30.57	W	58	51.97	N

163	17.72	W	59	20.16	N
164	11.01	W	59	34.15	N
164	42.00	W	59	41.80	N
165	0.00	W	59	42.60	N
165	1.45	W	59	37.39	N
167	40.20	W	59	24.47	N
168	0.00	W	59	49.13	N
167	59.98	W	60	45.55	N

* The boundary extends in a clockwise direction from this set of geographic coordinates along the shoreline at mean lower-low tide line to the next set of coordinates.

Northern Bering Sea Research Area

Nonpelagic trawl gear fishing in the Northern Bering Sea Research Area is prohibited, except as allowed through exempted fishing permits under 50 CFR 679.6 and described in section 3.5.2.1.12. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

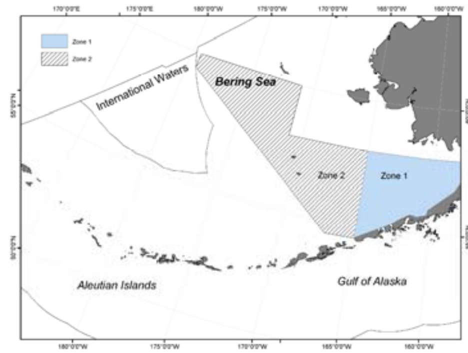
Longitude			Latitude		
168	7.48	W	65	37.48	N*
165	1.54	W	60	45.54	N
167	59.98	W	60	45.55	N
171	59.92	W	60	3.52	N
172	0.00	W	60	54.00	N
174	1.24	W	60	54.00	N
176	13.51	W	62	6.56	N
172	24.00	W	63	57.03	N
172	24.00	W	62	42.00	N
168	24.00	W	62	42.00	N
168	24.00	W	64	0.00	N
172	17.42	W	64	0.01	N
168	58.62	W	65	30.00	N
168	58.62	W	65	37.48	N

* The boundary extends in a clockwise direction from this set of geographic coordinates along the shoreline at mean lower-low tide line to the next set of coordinates.

B.3 PSC Limitation Zones

Specific areas of the management area are closed to some or all fishing during certain times of the year on attainment of a species-specific bycatch cap. These areas are described in Section 3.6.2.2 of the FMP.

Zones 1 and 2



Zones 1 and 2 are closed to directed fishing when the crab bycatch caps are attained in specified fisheries.

Zone 1: area bounded by 165° W. longitude and 58° N. latitude extending east to the shore.

Zone 2: area bounded by 165° W. longitude, north to 58° N., then west to the intersection of 58° N. and 171° W. longitude, then north to 60° N., then west to 179°20' W. longitude, then south to 59°25' N. latitude, then diagonally extending on a straight line southeast to the intersection of 167° W. longitude and 54°30' N. latitude, and then extending eastward along 54°30' N. latitude to 165° W. longitude.

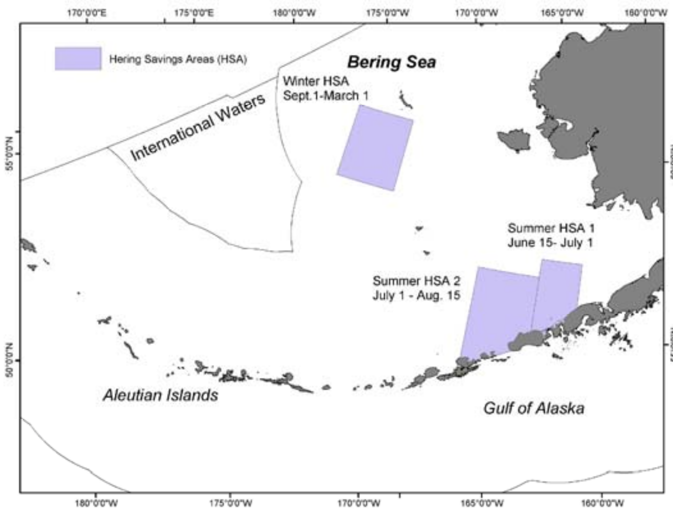
Herring Savings Areas

The herring savings areas are all located within the Bering Sea subarea and are defined as follows:

Summer Herring Savings Area 1: area south of 57° N. latitude and between 162° W. and 164° W. longitude from 12:00 noon Alaska Local Time (ALT) June 15 through 12:00 noon ALT July 1 of a fishing year

Summer Herring Savings Area 2: area south of 56°30' N. latitude and between 164° W. and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year

Winter Herring Savings Area: area between 58° N. and 60° N. latitude and between 172° W. and 175° W. longitude from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year



Chum Salmon Savings Area

Upon the attainment of the “other salmon” catch limit, trawling is prohibited for the remainder of the period September 1 through October 14 within the area bounded by a straight line connecting the following pairs of coordinates in the order listed:

(56°00' N., 167° W.)

(56°00' N., 165° W.)

(55°30' N., 165° W.)

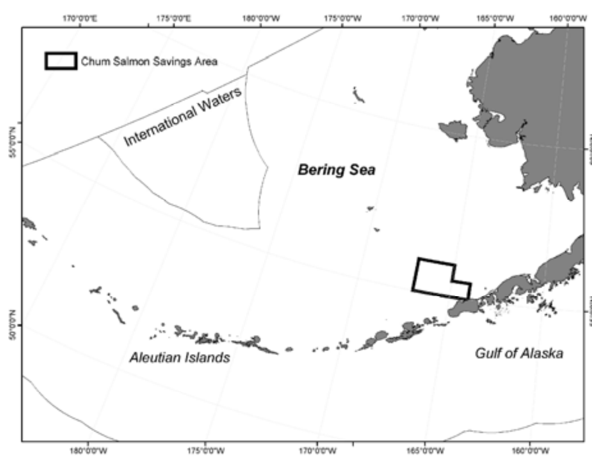
(55°30' N., 164° W.)

(55°00' N., 164° W.)

(55°00' N., 167° W.)

(56°00' N., 167° W.)

Trawling is also prohibited absolutely in the area from August 1 through August 31; see description in Section B.2 above.



Chinook Salmon Savings Areas

Area 1: The area defined by straight lines connecting the following coordinates in the order listed:

(54° N., 171° W.)

(54° N., 170° W.)

(53° N., 170° W.)

(53° N., 171° W.)

(54° N., 171° W.)

Area 2: The area defined by straight lines connecting the following coordinates in the order listed:

(56° 00' N., 165° W.)

(56° 00' N., 164° W.)

(55° 00' N., 164° W.)

(55° 00' N., 165° W.)

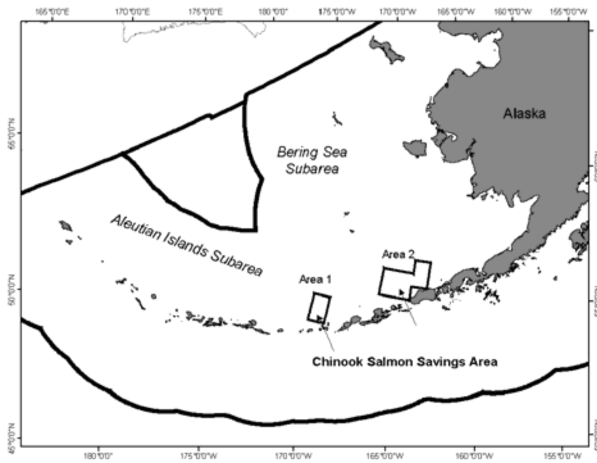
(54° 30' N., 165° W.)

(54° 30' N., 167° W.)

(55° 30' N., 167° W.)

(55° 30' N., 165° W.)

(56° 00' N., 165° W.)



C. Opilio Bycatch Limitation Zone (COBLZ)

Defined as that portion of the Bering Sea subarea north of 56°30' N. latitude and west of a line connecting the following coordinates in the order listed:

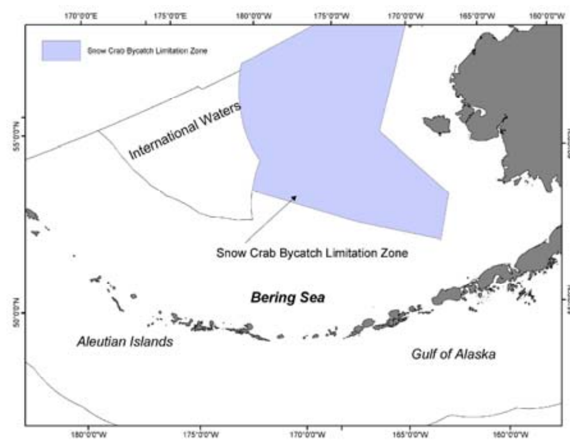
(56° 30' N., 165° W.)

(58° 00' N., 165° W.)

(59° 30' N., 170° W.)

and north along 170° W. longitude to its intersection with the U.S.-Russia boundary.

Upon attainment of the COBLZ bycatch allowance of *C. opilio* crab specified for a particular fishery category, the COBLZ will be closed to directed fishing for each category for the remainder of the year or for the remainder of the season.



Appendix C Summary of the American Fisheries Act and Subtitle II

C.1 Summary of the American Fisheries Act (AFA) Management Measures

On October 21, 1998, the President signed into law the American Fisheries Act (AFA) that superseded the previous inshore/offshore management regime for Bering Sea and Aleutian Islands (BSAI) pollock adopted under Amendment 18 and extended under Amendments 23 and 51. With respect to the fisheries off Alaska, the AFA required several new management measures: 1) regulations that limit access into the fishing and processing sectors of the pollock fishery and that allocate pollock to such sectors, 2) regulations governing the formation and operation of fishery cooperatives in the pollock fishery, 3) regulations to protect other fisheries from spillover effects from the AFA, and 4) regulations governing catch measurement and monitoring in the pollock fishery.

The AFA is a complex piece of legislation with numerous provisions that affect the management of the groundfish and crab fisheries off Alaska. The AFA is divided into two subtitles. *Subtitle I – Fisheries Endorsements* includes nationwide United States (U.S.) ownership and vessel length restrictions for U.S. vessels with fisheries endorsements. These requirements are implemented by the Maritime Administration and the U.S. Coast Guard under the Department of Transportation and Department of Homeland Security, respectively. *Subtitle II – Bering Sea Pollock Fishery* contains measures related to the management of BSAI pollock fishery.

Key provisions of the AFA are listed below.

- A requirement that owners of all U.S. flagged fishing vessels comply with a 75 percent U.S. controlling interest standard.
- A prohibition on the entry of any new fishing vessels into U.S. waters that exceed 165 ft registered length, 750 gross registered tons, or 3,000 shaft horsepower.
- The buyout of nine pollock catcher/processors and the subsequent scrapping of eight of these vessels through a combination of $20 million in federal appropriations and $75 million in direct loan obligations.
- A new allocation scheme for BSAI pollock that allocates 10 percent of the BSAI pollock total allowable catch (TAC) to the Community Development Quota (CDQ) Program, and after allowance for incidental catch of pollock in other fisheries, allocates the remaining TAC as follows: 50 percent to vessels harvesting pollock for processing by inshore processors, 40 percent to vessels harvesting pollock for processing by catcher/processors, and 10 percent to vessels harvesting pollock for processing by motherships.
- A fee of six-tenths (0.6) of one cent for each pound round weight of pollock harvested by catcher vessels delivering to inshore processors for the purpose of repaying the $75 million direct loan obligation.
- A prohibition on entry of new vessels and processors into the BSAI pollock fishery. The AFA lists by name vessels and processors and/or provides qualifying criteria for those vessels and processors eligible to participate in the non-CDQ portion of the BSAI pollock fishery.

- An increase in observer coverage and scale requirements for AFA catcher/processors.
- New standards and limitations for the creation of fishery cooperatives in the catcher/ processor, mothership, and inshore industry sectors.
- A quasi-individual fishing quota program under which National Marine Fisheries Service grants individual allocations of the inshore BSAI pollock TAC to inshore catcher vessel cooperatives that form around a specific inshore processor and agree to deliver at least 90 percent of their pollock catch to that processor.
- The establishment of harvesting and processing restrictions (commonly known as "sideboards") on fishermen and processors who have received exclusive harvesting or processing privileges under the AFA, to protect the interests of fishermen and processors who have not directly benefitted from the AFA.
- A 17.5 percent excessive share harvesting cap for BSAI pollock and a requirement that the Council develop excessive share caps for BSAI pollock processing and for the harvesting and processing of other groundfish.

Certain provisions of the AFA regarding the Aleutian Islands directed pollock fishery were superseded by the Consolidated Appropriations Act of 2004, as further described in section 3.7.3 of the FMP.

C.2 American Fisheries Act: Subtitle II Bering Sea Pollock Fishery

SEC. 205. DEFINITIONS.

As used in this subtitle –

(1) the term "Bering Sea and Aleutian Islands Management Area" has the same meaning as the meaning given for such term in part 679.2 of title 50, Code of Federal Regulations, as in effect on October 1, 1998;

(2) the term "catcher/processor" means a vessel that is used for harvesting fish and processing that fish;

(3) the term "catcher vessel" means a vessel that is used for harvesting fish and that does not process pollock onboard;

(4) the term "directed pollock fishery" means the fishery for the directed fishing allowances allocated under paragraphs (1), (2), and (3) of section 206(b);

(5) the term "harvest" means to commercially engage in the catching, taking, or harvesting of fish or any activity that can reasonably be expected to result in the catching, taking, or harvesting of fish;

(6) the term "inshore component" means the following categories that process groundfish harvested in the Bering Sea and Aleutian Islands Management Area:

(A) shoreside processors, including those eligible under section 208(f); and

(B) vessels less than 125 feet in length overall that process less than 126 metric tons per week in round-weight equivalents of an aggregate amount of pollock and Pacific cod;

(7) the term "Magnuson-Stevens Act" means the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.);

(8) the term "mothership" means a vessel that receives and processes fish from other vessels in the exclusive economic zone of the United States and is not used for, or equipped to be used for, harvesting fish;

(9) the term "North Pacific Council" means the North Pacific Fishery Management Council established under section 302(a)(1)(G) of the Magnuson-Stevens Act (16 U.S.C. 1852(a)(1)(G));

(10) the term "offshore component" means all vessels not included in the definition of inshore component that process groundfish harvested in the Bering Sea and Aleutian Islands Management Area;

(11) the term "Secretary" means the Secretary of Commerce; and

(12) the term "shoreside processor" means any person or vessel that receives unprocessed fish, except catcher/processors, motherships, buying stations, restaurants, or persons receiving fish for personal consumption or bait.

SEC. 206. ALLOCATIONS.

(a) POLLOCK COMMUNITY DEVELOPMENT QUOTA. Effective January 1,1999, 10 percent of the total allowable catch of pollock in the Bering Sea and Aleutian Islands Management Area shall be allocated as a directed fishing allowance to the western Alaska community development quota program established under section 305(i) of the Magnuson-Stevens Act (16 U.S.C. 1855(i)).

(b) INSHORE/OFFSHORE. Effective January 1, 1999, the remainder of the pollock total allowable catch in the Bering Sea and Aleutian Islands Management Area, after the subtraction of the allocation under subsection (a) and the subtraction of allowances for the incidental catch of pollock by vessels harvesting other groundfish species (including under the western Alaska community development quota program) shall be allocated as directed fishing allowances as follows –

(1) 50 percent to catcher vessels harvesting pollock for processing by the inshore component;

(2) 40 percent to catcher/processors and catcher vessels harvesting pollock for processing by catcher/processors in the offshore component; and

(3) 10 percent to catcher vessels harvesting pollock for processing by motherships in the offshore component.

SEC. 207. BUYOUT.

(a) FEDERAL LOAN. Under the authority of sections 1111 and 1112 of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f and 1279g) and notwithstanding the requirements of section 312 of the Magnuson-Stevens Act (16 U.S.C. 1861a), the Secretary shall, subject to the availability of appropriations for the cost of the direct loan, provide up to $75,000,000 through a direct loan obligation for the payments required under subsection (d).

(b) INSHORE FEE SYSTEM. Notwithstanding the requirements of section 304(d) or 312 of the Magnuson-Stevens Act (16 U.S.C. 1854(d) and 1861a), the Secretary shall establish a fee for the repayment of such loan obligations which –

(1) shall be six-tenths (0.6) of one cent for each pound round-weight of all pollock harvested from the directed fishing allowance under section 206(b)(1); and

(2) shall begin with such pollock harvested on or after January 1, 2000, and continue without interruption until such loan obligation is fully repaid; and

(3) shall be collected in accordance with section 312(d)(2)(C) of the Magnuson-Stevens Act (16 U.S.C. 1861a(d)(2)(C)) and in accordance with such other conditions as the Secretary establishes.

(c) FEDERAL APPROPRIATION. Under the authority of section 312(c)(1)(B) of the Magnuson-Stevens Act (16 U.S.C. 1861a(c)(1)(B)), there are authorized to be appropriated $20,000,000 for the payments required under subsection (d).

(d) PAYMENTS. Subject to the availability of appropriations for the cost of the direct loan under subsection (a) and funds under subsection (c), the Secretary shall pay by not later than December 31, 1998–

(1) up to $90,000,000 to the owner or owners of the catcher/processors listed in paragraphs (1) through (9) of section 209, in such manner as the owner or owners, with the concurrence of the Secretary, agree, except that –

(A) the portion of such payment with respect to the catcher/processor listed in paragraph (1) of section 209 shall be made only after the owner submits a written certification acceptable to the Secretary that neither the owner nor a purchaser from the owner intends to use such catcher/processor outside the exclusive economic zone of the United States to harvest any stock of fish (as such term is defined in section 3 of the Magnuson-Stevens Act (16 U.S.C. 1802)) that occurs within the exclusive economic zone of the United States; and

(B) the portion of such payment with respect to the catcher/processors listed in paragraphs (2) through (9) of section 209 shall be made only after the owner or owners of such catcher/processors submit a written certification acceptable to the Secretary that such catcher/processors will be scrapped by December 31, 2000 and will not, before that date, be used to harvest or process any fish; and

(2)(A) if a contract has been filed under section 210(a) by the catcher/processors listed in section 208(e), $5,000,000 to the owner or owners of the catcher/processors listed in paragraphs (10) through (14) of such section in such manner as the owner or owners, with the concurrence of the Secretary, agree; or

(B) if such a contract has not been filed by such date, $5,000,000 to the owners of the catcher vessels eligible under section 208(b) and the catcher/processors eligible under paragraphs (1) through (20) of section 208(e), divided based on the amount of the harvest of pollock in the directed pollock fishery by each such vessel in 1997 in such manner as the Secretary deems appropriate,

except that any such payments shall be reduced by any obligation to the federal government that has not been satisfied by such owner or owners of any such vessels.

(e) PENALTY. If the catcher/processor under paragraph (1) of section 209 is used outside the exclusive economic zone of the United States to harvest any stock of fish that occurs within the exclusive economic zone of the United States while the owner who received the payment under subsection (d)(1)(A) has an ownership interest in such vessel, or if the catcher/processors listed in paragraphs (2) through (9) of section 209 are determined by the Secretary not to have been scrapped by December 31, 2000 or to have been used in a manner inconsistent with subsection (d)(1)(B), the Secretary may suspend any or all of the federal permits which allow any vessels owned in whole or in part by the owner or owners who received payments under subsection (d)(1) to harvest or process fish within the exclusive economic zone of the United States until such time as the obligations of such owner or owners under subsection (d)(1) have been fulfilled to the satisfaction of the Secretary.

(f) PROGRAM DEFINED; MATURITY. For the purposes of section 1111 of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f), the fishing capacity reduction program in this subtitle shall be within the meaning of the term program as defined and used in such section. Notwithstanding section 1111(b)(4) of such Act (46 U.S.C. App. 1279f(b)(4)), the debt obligation under subsection (a) of this section may have a maturity not to exceed 30 years.

(g) FISHERY CAPACITY REDUCTION REGULATIONS. The Secretary of Commerce shall by not later than October 15, 1998 publish proposed regulations to implement subsections (b), (c), (d) and (e) of section 312 of the Magnuson-Stevens Act (16 U.S.C. 1861a) and sections 1111 and 1112 of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f and 1279g).

SEC. 208. ELIGIBLE VESSELS AND PROCESSORS.

(a) CATCHER VESSELS ONSHORE. Effective January 1, 2000, only catcher vessels which are –

(1) determined by the Secretary –

(A) to have delivered at least 250 metric tons of pollock; or

(B) to be less than 60 feet in length overall and to have delivered at least 40 metric tons of pollock,

for processing by the inshore component in the directed pollock fishery in any one of the years 1996 or 1997, or between January 1, 1998 and September 1, 1998;

(2) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary; and

(3) not listed in subsection (b),

shall be eligible to harvest the directed fishing allowance under section 206(b)(1) pursuant to a federal fishing permit.

(b) CATCHER VESSELS TO CATCHER/PROCESSORS. Effective January 1, 1999, only the following catcher vessels shall be eligible to harvest the directed fishing allowance under section 206(b)(2) pursuant to a federal fishing permit:

(1) AMERICAN CHALLENGER (United States official number 633219);

(2) FORUM STAR (United States official number 925863);

(3) MUIR MILACH (United States official number 611524);

(4) NEAHKAHNIE (United States official number 599534);

(5) OCEAN HARVESTER (United States official number 549892);

(6) SEA STORM (United States official number 628959);

(7) TRACY ANNE (United States official number 904859); and

(8) any catcher vessel –

(A) determined by the Secretary to have delivered at least 250 metric tons and at least 75 percent of the pollock it harvested in the directed pollock fishery in 1997 to catcher/processors for processing by the offshore component; and

(B) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary.

(c) CATCHERS VESSELS TO MOTHERSHIPS. Effective January 1, 2000, only the following catcher vessels shall be eligible to harvest the directed fishing allowance under section 206(b)(3) pursuant to a federal fishing permit:

(1) ALEUTIAN CHALLENGER (United States official number 603820);

(2) ALYESKA (United States official number 560237);

(3) AMBER DAWN (United States official number 529425);

(4) AMERICAN BEAUTY (United States official number 613847);

(5) CALIFORNIA HORIZON (United States official number 590758);

(6) MAR-GUN (United States official number 525608);

(7) MARGARET LYN (United States official number 615563);

(8) MARK I (United States official number 509552);

(9) MISTY DAWN (United States official number 926647);

(10) NORDIC FURY (United States official number 542651);

(11) OCEAN LEADER (United States official number 561518);

(12) OCEANIC (United States official number 602279);

(13) PACIFIC ALLIANCE (United States official number 612084);

(14) PACIFIC CHALLENGER (United States official number 618937);

(15) PACIFIC FURY (United States official number 561934);

(16) PAPADO II (United States official number 536161);

(17) TRAVELER (United States official number 929356);

(18) VESTERAALEN (United States official number 611642);

(19) WESTERN DAWN (United States official number 524423);

(20) any vessel –

(A) determined by the Secretary to have delivered at least 250 metric tons of pollock for processing by motherships in the offshore component of the directed pollock fishery in any one of the years 1996 or 1997, or between January 1, 1998 and September 1, 1998;

(B) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary; and

(C) not listed in subsection (b).

(d) MOTHERSHIPS. Effective January 1, 2000, only the following motherships shall be eligible to process the directed fishing allowance under section 206(b)(3) pursuant to a federal fishing permit:

(1) EXCELLENCE (United States official number 967502);

(2) GOLDEN ALASKA (United States official number 651041);

(3) OCEAN PHOENIX (United States official number 296779).

(e) CATCHER/PROCESSORS. Effective January 1, 1999, only the following catcher/processors shall be eligible to harvest the directed fishing allowance under section 206(b)(2) pursuant to a federal fishing permit:

(1) AMERICAN DYNASTY (United States official number 951307);

(2) KATIE ANN (United States official number 518441);

(3) AMERICAN TRIUMPH (United States official number 646737);

(4) NORTHERN EAGLE (United States official number 506694);

(5) NORTHERN HAWK (United States official number 643771);

(6) NORTHERN JAEGER (United States official number 521069);

(7) OCEAN ROVER (United States official number 552100);

(8) ALASKA OCEAN (United States official number 637856);

(9) ENDURANCE (United States official number 592206);

(10) AMERICAN ENTERPRISE (United States official number 594803);

(11) ISLAND ENTERPRISE (United States official number 610290);

(12) KODIAK ENTERPRISE (United States official number 579450);

(13) SEATTLE ENTERPRISE (United States official number 904767);

(14) US ENTERPRISE (United States official number 921112);

(15) ARCTIC STORM (United States official number 903511);

(16) ARCTIC FJORD (United States official number 940866);

(17) NORTHERN GLACIER (United States official number 663457);

(18) PACIFIC GLACIER (United States official number 933627);

(19) HIGHLAND LIGHT (United States official number 577044);

(20) STARBOUND (United States official number 944658); and

(21) any catcher/processor not listed in this subsection and determined by the Secretary to have harvested more than 2,000 metric tons of the pollock in the 1997 directed pollock fishery and determined to be eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary, except that catcher/processors eligible under this paragraph shall be prohibited from harvesting in the aggregate a total of more than one-half (0.5) of a percent of the pollock apportioned for the directed pollock fishery under section 206(b)(2).

Notwithstanding section 213(a), failure to satisfy the requirements of section 4(a) of the Commercial Fishing Industry Vessel Anti-Reflagging Act of 1987 (Public Law 100-239; 46 U.S.C. 12108 note) shall not make a catcher/processor listed under this subsection ineligible for a fishery endorsement.

(f) SHORESIDE PROCESSORS. (1) Effective January 1, 2000 and except as provided in paragraph (2), the catcher vessels eligible under subsection (a) may deliver pollock harvested from the directed fishing allowance under section 206(b)(1) only to –

(A) shoreside processors (including vessels in a single geographic location in Alaska State waters) determined by the Secretary to have processed more than 2,000 metric tons round-weight of pollock in the inshore component of the directed pollock fishery during each of 1996 and 1997; and

(B) shoreside processors determined by the Secretary to have processed pollock in the inshore component of the directed pollock fishery in 1996 and 1997, but to have processed less than 2,000 metric tons round-weight of such pollock in each year, except that effective January 1, 2000, each such shoreside processor may not process more than 2,000 metric tons round-weight from such directed fishing allowance in any year;

(2) Upon recommendation by the North Pacific Council, the Secretary may approve measures to allow catcher vessels eligible under subsection (a) to deliver pollock harvested from the directed fishing allowance under section 206(b)(1) to shoreside processors not eligible under paragraph (1) if the total allowable catch for pollock in the Bering Sea and Aleutian Islands Management Area increases by more than 10 percent above the total allowable catch in such fishery in 1997, or in the event of the actual total loss or constructive total loss of a shoreside processor eligible under paragraph (1)(A).

(g) REPLACEMENT VESSELS. In the event of the actual total loss or constructive total loss of a vessel eligible under subsections (a), (b), (c), (d), or (e), the owner of such vessel may replace such vessel with a vessel which shall be eligible in the same manner under that subsection as the eligible vessel, provided that–

(1) such loss was caused by an act of God, an act of war, a collision, an act or omission of a party other than the owner or agent of the vessel, or any other event not caused by the willful misconduct of the owner or agent;

(2) the replacement vessel was built in the United States and if ever rebuilt, was rebuilt in the United States;

(3) the fishery endorsement for the replacement vessel is issued within 36 months of the end of the last year in which the eligible vessel harvested or processed pollock in the directed pollock fishery;

(4) if the eligible vessel is greater than 165 feet in registered length, of more than 750 gross registered tons (as measured under chapter 145 of title 46) or 1,900 gross registered tons as measured under chapter 143 of that title, or has engines capable of producing more than 3,000 shaft horsepower, the replacement vessel is of the same or lesser registered length, gross registered tons, and shaft horsepower;

(5) if the eligible vessel is less than 165 feet in registered length, of fewer than 750 gross registered tons, and has engines incapable of producing more than 3,000 shaft horsepower, the replacement vessel is less than each of such thresholds and does not exceed by more than 10 percent the registered length, gross registered tons or shaft horsepower of the eligible vessel; and

(6) the replacement vessel otherwise qualifies under federal law for a fishery endorsement, including under section 12102(c) of title 46, United States Code, as amended by this Act.

(h) ELIGIBILITY DURING IMPLEMENTATION. In the event the Secretary is unable to make a final determination about the eligibility of a vessel under subsection (b)(8) or subsection (e)(21) before January 1, 1999, or a vessel or shoreside processor under subsection (a), subsection (c)(21), or subsection (f) before January 1, 2000, such vessel or shoreside processor, upon the filing of an application for eligibility, shall be eligible to participate in the directed pollock fishery pending final determination by the Secretary with respect to such vessel or shoreside processor.

(i) ELIGIBILITY NOT A RIGHT. Eligibility under this section shall not be construed –

(1) to confer any right of compensation, monetary or otherwise, to the owner of any catcher vessel, catcher/processor, mothership, or shoreside processor if such eligibility is revoked or limited in any way, including through the revocation or limitation of a fishery endorsement or any federal permit or license;

(2) to create any right, title, or interest in or to any fish in any fishery; or

(3) to waive any provision of law otherwise applicable to such catcher vessel, catcher/processor, mothership, or shoreside processor.

SEC. 209. LIST OF INELIGIBLE VESSELS.

Effective December 31, 1998, the following vessels shall be permanently ineligible for fishery endorsements, and any claims (including relating to catch history) associated with such vessels that could qualify any owners of such vessels for any present or future limited access system permit in any fishery within the exclusive economic zone of the United States (including a vessel moratorium permit or license limitation program permit in fisheries under the authority of the North Pacific Council) are hereby extinguished:

(1) AMERICAN EMPRESS (United States official number 942347);

(2) PACIFIC SCOUT (United States official number 934772);

(3) PACIFIC EXPLOYER (United States official number 942592);

(4) PACIFIC NAVIGATOR (United States official number 592204);

(5) VICTORIA ANN (United States official number 592207);

(6) ELIZABETH ANN (United States official number 534721);

(7) CHRISTINA ANN (United States official number 653045);

(8) REBECCA ANN (United States official number 592205);

(9) BROWNS POINT (United States official number 587440).

SEC. 210. FISHERY COOPERATIVE LIMITATIONS.

(a) PUBLIC NOTICE. (1) Any contract implementing a fishery cooperative under section 1 of the Act of June 25, 1934 (15 U.S.C. 521) in the directed pollock fishery and any material modifications to any such contract shall be filed not less than 30 days prior to the start of fishing under the contract with the North Pacific Council and with the Secretary, together with a copy of a letter from a party to the contract requesting a business review letter on the fishery cooperative from the Department of Justice and any response to such request. Notwithstanding section 402 of the Magnuson-Stevens Act (16 U.S.C. 1881a) or any other provision of law, but taking into account the interest of parties to any such contract in protecting the confidentiality of proprietary information, the North Pacific Council and Secretary shall –

(A) make available to the public such information about the contract, contract modifications, or fishery cooperative the North Pacific Council and Secretary deem appropriate, which at a minimum shall include a list of the parties to the contract, a list of the vessels involved, and the amount of pollock and other fish to be harvested by each party to such contract; and

(B) make available to the public in such manner as the North Pacific Council and Secretary deem appropriate information about the harvest by vessels under a fishery cooperative of all species (including by catch) in the directed pollock fishery on a vessel-by-vessel basis.

(b) CATCHER VESSELS ONSHORE

(1) CATCHER VESSEL COOPERATIVES. Effective January 1, 2000, upon the filing of a contract implementing a fishery cooperative under subsection (a) which –

(A) is signed by the owners of 80 percent or more of the qualified catcher vessels that delivered pollock for processing by a shoreside processor in the directed pollock fishery in the year prior to the year in which the fishery cooperative will be in effect; and

(B) specifies, except as provided in paragraph (6), that such catcher vessels will deliver pollock in the directed pollock fishery only to such shoreside processor during the year in which the fishery cooperative will be in effect and that such shoreside processor has agreed to process such pollock,

the Secretary shall allow only such catcher vessels (and catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) to harvest the aggregate percentage of the directed fishing allowance under section 206(b)(1) in the year in which the fishery cooperative will be in effect that is equivalent to the aggregate total amount of pollock harvested by such catcher vessels (and by such catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) in the directed pollock fishery for processing by the inshore component during 1995, 1996, and 1997 relative to the aggregate total amount of pollock harvested in the directed pollock fishery for processing by the inshore component during such years and shall prevent such catcher vessels (and catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) from harvesting in aggregate in excess of such percentage of such directed fishing allowance.

(2) VOLUNTARY PARTICIPATION. Any contract implementing a fishery cooperative under paragraph (1) must allow the owners of other qualified catcher vessels to enter into such contract

after it is filed and before the calendar year in which fishing will begin under the same terms and conditions as the owners of the qualified catcher vessels who entered into such contract upon filing.

(3) QUALIFIED CATCHER VESSEL. For the purposes of this subsection, a catcher vessel shall be considered a qualified catcher vessel if, during the year prior to the year in which the fishery cooperative will be in effect, it delivered more pollock to the shoreside processor to which it will deliver pollock under the fishery cooperative in paragraph (1) than to any other shoreside processor.

(4) CONSIDERATION OF CERTAIN VESSELS. Any contract implementing a fishery cooperative under paragraph (1) which has been entered into by the owner of a qualified catcher vessel eligible under section 208(a) that harvested pollock for processing by catcher/processors or motherships in the directed pollock fishery during 1995, 1996, and 1997 shall, to the extent practicable, provide fair and equitable terms and conditions for the owner of such qualified catcher vessel.

(5) OPEN ACCESS. A catcher vessel eligible under section 208(a) the catch history of which has not been attributed to a fishery cooperative under paragraph (1) may be used to deliver pollock harvested by such vessel from the directed fishing allowance under section 206(b)(1) (other than pollock reserved under paragraph (1) for a fishery cooperative) to any of the shoreside processors eligible under section 208(f). A catcher vessel eligible under section 208(a) the catch history of which has been attributed to a fishery cooperative under paragraph (1) during any calendar year may not harvest any pollock apportioned under section 206(b)(1) in such calendar year other than the pollock reserved under paragraph (1) for such fishery cooperative.

(6) TRANSFER OF COOPERATIVE HARVEST. A contract implementing a fishery cooperative under paragraph (1) may, notwithstanding the other provisions of this subsection, provide for up to 10 percent of the pollock harvested under such cooperative to be processed by a shoreside processor eligible under section 208(f) other than the shoreside processor to which pollock will be delivered under paragraph (1).

(c) CATCHER VESSELS TO CATCHER/PROCESSORS. Effective January 1, 1999, not less than 8.5 percent of the directed fishing allowance under section 206(b)(2) shall be available for harvest only by the catcher vessels eligible under section 208(b). The owners of such catcher vessels may participate in a fishery cooperative with the owners of the catcher/ processors eligible under paragraphs (1) through (20) of the section 208(e). The owners of such catcher vessels may participate in a fishery cooperative that will be in effect during 1999 only if the contract implementing such cooperative establishes penalties to prevent such vessels from exceeding in 1999 the traditional levels harvested by such vessels in all other fisheries in the exclusive economic zone of the United States.

(d) CATCHER VESSELS TO MOTHERSHIPS

(1) PROCESSING. Effective January 1, 2000, the authority in section 1 of the Act of June 25, 1934 (48 STAT. 1213 and 1214; 15 U.S.C. 521 et seq.) shall extend to processing by motherships eligible under section 208(d) solely for the purposes of forming or participating in a fishery cooperative in the directed pollock fishery upon the filing of a contract to implement a fishery cooperative under subsection (a) which has been entered into by the owners of 80 percent or more of the catcher vessels eligible under section 208(c) for the duration of such contract, provided that such owners agree to the terms of the fishery cooperative involving processing by the motherships.

(2) VOLUNTARY PARTICIPATION. Any contract implementing a fishery cooperative described in paragraph (1) must allow the owners of any other catcher vessels eligible under section 208(c) to enter such contract after it is filed and before the calendar year in which fishing will begin under the

same terms and conditions as the owners of the catcher vessels who entered into such contract upon filing.

(e) EXCESSIVE SHARES.

(1) HARVESTING. No particular individual, corporation, or other entity may harvest, through a fishery cooperative or otherwise, a total of more than 17.5 percent of the pollock available to be harvested in the directed pollock fishery.

(2) PROCESSING. Under the authority of section 301(a)(4) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(4)), the North Pacific Council is directed to recommend for approval by the Secretary conservation and management measures to prevent any particular individual or entity from processing an excessive share of the pollock available to be harvested in the directed pollock fishery. In the event the North Pacific Council recommends and the Secretary approves an excessive processing share that is lower than 17.5 percent, any individual or entity that previously processed a percentage greater than such share shall be allowed to continue to process such percentage, except that their percentage may not exceed 17.5 percent (excluding pollock processed by catcher/processors that was harvested in the directed pollock fishery by catcher vessels eligible under section 208(b)) and shall be reduced if their percentage decreases, until their percentage is below such share. In recommending the excessive processing share, the North Pacific Council shall consider the need of catcher vessels in the directed pollock fishery to have competitive buyers for the pollock harvested by such vessels.

(3) REVIEW BY MARITIME ADMINISTRATION. At the request of the North Pacific Council or the Secretary, any individual or entity believed by such Council or the Secretary to have exceeded the percentage in either paragraph (1) or (2) shall submit such information to the Administrator of the Maritime Administration as the Administrator deems appropriate to allow the Administrator to determine whether such individual or entity has exceeded either such percentage. The Administrator shall make a finding as soon as practicable upon such request and shall submit such finding to the North Pacific Council and the Secretary. For the purposes of this subsection, any entity in which 10 percent or more of the interest is owned or controlled by another individual or entity shall be considered to be the same entity as the other individual or entity.

(f) LANDING TAX JURISDICTION. Any contract filed under subsection (a) shall include a contract clause under which the parties to the contract agree to make payments to the State of Alaska for any pollock harvested in the directed pollock fishery which is not landed in the State of Alaska, in amounts which would otherwise accrue had the pollock been landed in the State of Alaska subject to any landing taxes established under Alaska law. Failure to include such a contract clause or for such amounts to be paid shall result in a revocation of the authority to form fishery cooperatives under section 1 of the Act of June 25, 1934 (15 U.S.C. 521 et seq.).

(g) PENALTIES. The violation of any of the requirements of this subtitle or any regulation or permit issued pursuant to this subtitle shall be considered the commission of an act prohibited by section 307 of the Magnuson-Stevens Act (16 U.S.C. 1857), and sections 308, 309, 310, and 311 of such Act (16 U.S.C. 1858, 1859, 1860, and 1861) shall apply to any such violation in the same manner as to the commission of an act prohibited by section 307 of such Act (16 U.S.C. 1857). In addition to the civil penalties and permit sanctions applicable to prohibited acts under section 308 of such Act (16 U.S.C. 1858), any person who is found by the Secretary, after notice and an opportunity for a hearing in accordance with section 554 of title 5, United States Code, to have violated a requirement of this section shall be subject to the forfeiture to the Secretary of Commerce of any fish harvested or processed during the commission of such act.

SEC. 211. PROTECTIONS FOR OTHER FISHERIES; CONSERVATION MEASURES.

(a) GENERAL. The North Pacific Council shall recommend for approval by the Secretary such conservation and management measures as it determines necessary to protect other fisheries under its jurisdiction and the participants in those fisheries, including processors, from adverse impacts caused by this Act or fishery cooperatives in the directed pollock fishery.

(b) CATCHER/PROCESSOR RESTRICTIONS.

(1) GENERAL. The restrictions in this subsection shall take effect on January 1, 1999 and shall remain in effect thereafter except that they may be superseded (with the exception of paragraph (4)) by conservation and management measures recommended after the date of the enactment of this Act by the North Pacific Council and approved by the Secretary in accordance with the Magnuson-Stevens Act.

(2) BERING SEA FISHING. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from, in the aggregate –

(A) exceeding the percentage of the harvest available in the offshore component of any Bering Sea and Aleutian Islands groundfish fishery (other than the pollock fishery) that is equivalent to the total harvest by such catcher/processors and the catcher/processors listed in section 209 in the fishery in 1995, 1996, and 1997 relative to the total amount available to be harvested by the offshore component in the fishery in 1995, 1996, and 1997;

(B) exceeding the percentage of the prohibited species available in the offshore component of any Bering Sea and Aleutian Islands groundfish fishery (other than the pollock fishery) that is equivalent to the total of the prohibited species harvested by such catcher/processors and the catcher/processors listed in section 209 in the fishery in 1995, 1996, and 1997 relative to the total amount of prohibited species available to be harvested by the offshore component in the fishery in 1995, 1996, and 1997.

(C) fishing for Atka mackerel in the eastern area of the Bering Sea and Aleutian Islands and from exceeding the following percentages of the directed harvest available in the Bering Sea and Aleutian Islands Atka mackerel fishery –

(i) 11.5 percent in the central area; and

(ii) 20 percent in the western area.

(3) BERING SEA PROCESSING. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from –

(A) processing any of the directed fishing allowances under paragraphs (1) or (3) of section 206(b); and

(B) processing any species of crab harvested in the Bering Sea and Aleutian Islands Management Area.

(4) GULF OF ALASKA. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from –

(A) harvesting any fish in the Gulf of Alaska;

(B) processing any groundfish harvested from the portion of the exclusive economic zone off Alaska known as area 630 under the fishery management plan for Gulf of Alaska groundfish; or

(C) processing any pollock in the Gulf of Alaska (other than as by catch in non-pollock groundfish fisheries) or processing, in the aggregate, a total of more than 10 percent of the cod harvested from areas 610, 620, and 640 of the Gulf of Alaska under the fishery management plan for Gulf of Alaska groundfish.

(5) FISHERIES OTHER THAN NORTH PACIFIC. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) and motherships eligible under section 208(d) are hereby prohibited from harvesting fish in any fishery under the authority of any regional fishery management council established under section 302(a) of the Magnuson-Stevens Act (16 U.S.C. 1852(a)) other than the North Pacific Council, except for the Pacific whiting fishery, and from processing fish in any fishery under the authority of any such regional fishery management council other than the North Pacific Council, except in the Pacific whiting fishery, unless the catcher/processor or mothership is authorized to harvest or process fish under a fishery management plan recommended by the regional fishery management council of jurisdiction and approved by the Secretary.

(6) OBSERVERS AND SCALES. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) shall –

(A) have two observers onboard at all times while groundfish is being harvested, processed, or received from another vessel in any fishery under the authority of the North Pacific Council; and

(B) weight its catch on a scale onboard approved by the National Marine Fisheries Service while harvesting groundfish in fisheries under the authority of the North Pacific Council.

This paragraph shall take effect on January 1, 1999 for catcher/processors eligible under paragraphs (1) through (20) of section 208(e) that will harvest pollock allocated under section 206(a) in 1999, and shall take effect on January 1, 2000 for all other catcher/processors eligible under such paragraphs of section 208(e).

(c) CATCHER VESSEL AND SHORESIDE PROCESSOR RESTRICTIONS.

(1) REQUIRED COUNCIL RECOMMENDATIONS. By not later than July 1, 1999, the North Pacific Council shall recommend for approval by the Secretary conservation and management measures to –

(A) prevent the catcher vessels eligible under subsections (a), (b), and (c) of section 208 from exceeding in the aggregate the traditional harvest levels of such vessels in other fisheries under the authority of the North Pacific Council as a result of fishery cooperatives in the directed pollock fisheries; and

(B) protect processors not eligible to participate in the directed pollock fishery from adverse effects as a result of this Act or fishery cooperatives in the directed pollock fishery.

If the North Pacific Council does not recommend such conservation and management measures by such date, or if the Secretary determines that such conservation and management measures recommended by the North Pacific Council are not adequate to fulfill the purposes of this paragraph, the Secretary may by regulation restrict or change the authority in section 210(b) to the extent the Secretary deems appropriate, including by preventing fishery cooperatives from being formed pursuant to such section and by providing greater flexibility with respect to the shoreside processor *or shoreside processors to which catcher vessels in a fishery cooperative under section 210(b) may deliver pollock.*

(2) BERING SEA CRAB AND GROUNDFISH.

(A) Effective January 1, 2000, the owners of the motherships eligible under section 208(d) and the shoreside processors eligible under section 208(f) that receive pollock from the directed pollock fishery under a fishery cooperative are hereby prohibited from processing, in the aggregate for each calendar year, more than the percentage of the total catch of each species of crab in directed fisheries under the jurisdiction of the North Pacific Council than facilities operated by such owners processed of each such species in the aggregate, on average, in 1995, 1996, and 1997. For the purposes of this subparagraph, the term facilities means any processing plant, catcher/processor, mothership, floating processor, or any other operation that processes fish. Any entity in which 10 percent or more of the interest is owned or controlled by another individual or entity shall be considered to be the same entity as the other individual or entity for the purposes of this subparagraph.

(B) Under the authority of section 301(a)(4) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(4)), the North Pacific Council is directed to recommend for approval by the Secretary conservation and management measures to prevent any particular individual or entity from harvesting or processing an excessive share of crab or of groundfish in fisheries in the Bering Sea and Aleutian Islands Management Area.

(C) The catcher vessels eligible under section 208(b) are hereby prohibited from participating in a directed fishery for any species of crab in the Bering Sea and Aleutian Islands Management Area unless the catcher vessel harvested crab in the directed fishery for that species of crab in such Area during 1997 and is eligible to harvest such crab in such directed fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary. The North Pacific Council is directed to recommend measures for approval by the Secretary to eliminate latent licenses under such program, and nothing in this subparagraph shall preclude the Council from recommending measures more restrictive than under this paragraph.

(3) FISHERIES OTHER THAN NORTH PACIFIC.

(A) By not later than July 1, 2000, the Pacific Fishery Management Council established under section 302(a)(1)(F) of the Magnuson-Stevens Act (16 U.S.C. 1852 (a)(1)(F)) shall recommended for approval by the Secretary conservation and management measures to protect fisheries under its jurisdiction and the participants in those fisheries from adverse impacts caused by this Act or by any fishery cooperatives in the directed pollock fishery.

(B) If the Pacific Council does not recommend such conservation and management measures by such date, or if the Secretary determines that such conservation and management measures recommended by the Pacific Council are not adequate to fulfill the purposes of this paragraph, the Secretary may by regulation implement adequate measures including, but not limited to, restrictions on vessels which harvest pollock under a fishery cooperative which will prevent such vessels from harvesting Pacific groundfish, and restrictions on the number of processors eligible to process Pacific groundfish.

(d) BYCATCH INFORMATION. Notwithstanding section 402 of the Magnuson-Stevens Act (16 U.S.C. 1881a), the North Pacific Council may recommend and the Secretary may approve, under such terms and conditions as the North Pacific Council and Secretary deem appropriate, the public disclosure of any

information from the groundfish fisheries under the authority of such Council that would be beneficial in the implementation of section 301(a)(9) or section 303(a)(11) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(9) and 1853(a)(11)).

(e) COMMUNITY DEVELOPMENT LOAN PROGRAM. Under the authority of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1271 et seq.), and subject to the availability of appropriations, the Secretary is authorized to provide direct loan obligations to communities eligible to participate in the western Alaska community development quota program established under section 304(i) of the Magnuson-Stevens Act (16 U.S.C. 1855(i)) for the purposes of purchasing all or part of an ownership interest in vessels and shoreside processors eligible under subsections (a), (b), (c), (d), (e), or (f) of section 208. Notwithstanding the eligibility criteria in section 208(a) and section 208(c), the LISA MARIE (United States official number 1038717) shall be eligible under such sections in the same manner as other vessels eligible under such sections.

SEC. 212. RESTRICTION ON FEDERAL LOANS.

Section 302(b) of the Fisheries Financing Act (46 U.S.C. 1274 note) is amended –

(1) by inserting "(1)" before "Until October 1, 2001" ; and

(2) by inserting at the end the following new paragraph:

"(2) No loans may be provided or guaranteed by the Federal Government for the construction or rebuilding of a vessel intended for use as a fishing vessel (as defined in section 2101 of title 46, United States Code), if such vessel will be greater than 165 feet in registered length, of more than 750 gross registered tons (as measured under chapter 145 of title 46) or 1,900 gross registered tons as measured under chapter 143 of that title, or have an engine or engines capable of producing a total of more than 3,000 shaft horsepower, after such construction or rebuilding is completed. This prohibition shall not apply to vessels to be used in the menhaden fishery or in tuna purse seine fisheries outside the exclusive economic zone of the United States or the area of the South Pacific Regional Fisheries Treaty.".

SEC. 213. DURATION.

(a) GENERAL. Except as otherwise provided in this title, the provisions of this title shall take effect upon the date of the enactment of this Act. There are authorized to be appropriated $6,700,000 per year to carry out the provisions of this Act through fiscal year 2004.

(b) EXISTING AUTHORITY. Except for the measures required by this subtitle, nothing in this subtitle shall be construed to limit the authority of the North Pacific Council or the Secretary under the Magnuson-Stevens Act.

(c) CHANGES TO FISHERY COOPERATIVE LIMITATIONS AND POLLOCK CDQ ALLOCATION. The North Pacific Council may recommend and the Secretary may approve conservation and management measures in accordance with the Magnuson-Stevens Act –

(1) that supersede the provisions of this subtitle, except for section 206 and 208, for conservation purposes or to mitigate adverse effects in fisheries or on owners of fewer than three vessels in the directed pollock fishery caused by this title or fishery cooperatives in the directed pollock fishery, provided such measures take into account all factors affecting the fisheries and are imposed fairly and equitably to the extent practicable among and within the sectors in the directed pollock fishery;

(2) that supersede the allocation in section 206(a) for any of the years 2002, 2003, and 2004, upon the finding by such Council that the western Alaska community development quota program for pollock has been adversely affected by the amendments in this subtitle; or

(3) that supersede the criteria required in paragraph (1) of section 210(b) to be used by the Secretary to set the percentage allowed to be harvested by catcher vessels pursuant to a fishery cooperative under such paragraph.

(d) REPORT TO CONGRESS. Not later than October 1, 2000, the North Pacific Council shall submit a report to the Secretary and to Congress on the implementation and effects of this Act, including the effects on fishery conservation and management, on bycatch levels, on fishing communities, on business and employment practices of participants in any fishery cooperatives, on the western Alaska community development quota program, on any fisheries outside of the authority of the North Pacific Council, and such other matters as the North Pacific Council deems appropriate.

(e) REPORT ON FILLET PRODUCTION. Not later than June 1, 2000, the General Accounting Office shall submit a report to the North Pacific Council, the Secretary, and the Congress on whether this Act has negatively affected the market for fillets and fillet blocks, including through the reduction in the supply of such fillets and fillet blocks. If the report determines that such market has been negatively affected, the North Pacific Council shall recommend measures for the Secretary's approval to mitigate any negative effects.

(f) SEVERABILITY. If any provision of this title, an amendment made by this title, or the application of such provision or amendment to any person or circumstance is held to be unconstitutional, the remainder of this title, the amendments made by this title, and the application of the provisions of such to any person or circumstance shall not be affected thereby.

(g) INTERNATIONAL AGREEMENTS. In the event that any provision of section 12102(c) or section 31322(a) of title 46, United States Code, as amended by this Act, is determined to be inconsistent with an existing international agreement relating to foreign investment to which the United States is a party with respect to the owner or mortgagee on October 1, 2001 of a vessel with a fishery endorsement, such provision shall not apply to that owner or mortgagee with respect to such vessel to the extent of any such inconsistency. The provisions of section 12102(c) and section 31322(a) of title 46, United States Code, as amended by this Act, shall apply to all subsequent owners and mortgagees of such vessel, and shall apply, notwithstanding the preceding sentence, to the owner on October 1, 2001 of such vessel if any ownership interest in that owner is transferred to or otherwise acquired by a foreign individual or entity after such date.

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Appendix D Life History Features and Habitat Requirements of Fishery Management Plan Species

This appendix describes habitat requirements and life histories of the groundfish species managed by this FMP. Each species or species group is described individually, however, summary tables that denote habitat associations (Table D-1), reproductive traits (Table D-2), and predator and prey associations (Table D-3) are also provided.

In each individual section, a species-specific table summarizes habitat. The following abbreviations are used in these habitat tables to specify location, position in the water column, bottom type, and other oceanographic features.

Location

BCH = beach (intertidal)
ICS = inner continental shelf (1-50 m)
MCS = middle continental shelf (50-100 m)
OCS = outer continental shelf (100-200 m)
USP = upper slope (200-1000 m)
LSP = lower slope (1000-3000 m)
BSN = basin (>3000 m)
BAY = nearshore bays, with depth if appropriate (e.g., fjords)
IP = island passes (areas of high current), with depth if appropriate

Water column

D = demersal (found on bottom)
SD/SP = semi-demersal or semi-pelagic, if slightly greater or less than 50% on or off bottom
P = pelagic (found off bottom, not necessarily associated with a particular bottom type)
N = neustonic (found near surface)

General

U = unknown
NA = not applicable

Bottom Type

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

Oceanographic Features

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

Table D.1 Summary of habitat associations for BSAI groundfish.

Predator to

BSAI Groundfish	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Species																															
Walleye Pollock	M				X			X			X			X						X	X	X	X	X		X			X	X	X
	LJ				X			X			X			X						X	X	X	X	X		X			X	X	X
	EJ				X			X			X									X	X	X									
	L				X			X			X																				
	E																														
Pacific Cod	M							X		X			X							X										X	
	LJ							X		X			X							X										X	
	EJ							X		X			X							X											
	L			X	X						X																				
	E																														
Atka Mackerel	M							X			X													X							
	J							X			X																				
	L										X																				
	E																														
Sablefish	M							X	X	X	X		X	X				X		X		X	X		X	X		X	X	X	
	LJ							X	X	X	X		X	X				X		X		X	X		X	X		X	X	X	
	EJ							X		X	X		X	X	X			X		X			X					X			
	L				X						X																				
	E																														
Pacifc Ocean Perch	M							X																							
	LJ							X			X																				
	EJ																														
	L			X	X																										
Flathead Sole	M							X		X	X		X			X	X	X	X		X	X								X	
	LJ							X		X	X		X			X	X	X	X											X	
	EJ				X								X			X			X											X	
	L	X		X																											
	E																														
Yellowfin Sole	M							X		X			X			X		X		X					X					X	
	LJ							X		X			X			X		X		X					X						
	EJ				X																										
	L	X		X																											
	E																														
Arrowtooth Flounder	M												X	X				X	X	X			X	X						X	
	LJ												X					X	X	X			X	X						X	
	EJ				X																										
	L	X		X																											
	E																														
Rock Sole	M									X			X			X	X														
	LJ									X			X			X	X														
	EJ				X																										
	L	X		X																											
	E																														

Prey of

BSAI Groundfish	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Hailbut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrerstrial Mammals
Walleye Pollock	M								X						X	X	X	X	X	X										
	LJ							X	X						X	X		X	X	X				X		X	X	X		
	EJ							X	X						X	X		X	X	X				X		X	X	X		
	L							X	X						X	X								X		X	X	X		
	E																													
Pacific Cod	M															X	X	X		X		X	X	X						
	LJ															X	X	X		X		X	X	X						
	EJ															X	X	X				X	X	X			X			
	L																													
	E																													
Atka Mackerel	M								X						X	X			X	X	X			X						
	J																			X						X	X			
	L																													
	E																													
Sablefish	M																													
	LJ						X									X														
	EJ																													
	L																													
	E																													
Pacifc Ocean Perch	M															X														
	LJ																													
	EJ						X																							
	L																													
Flathead Sole	M								X				X		X	X														
	LJ																													
	EJ																													
	L																													
	E																													
Yellowfin Sole	M																													
	LJ								X							X														
	EJ								X							X														
	L																													
	E																													
Arrowtooth Flounder	M																													
	LJ							X	X																					
	EJ																													
	L																													
	E																													
Rock Sole	M																													
	LJ							X	X					X		X														
	EJ																													
	L																													
	E																													

Table D.2 Summary of biological associations for BSAI groundfish.

BSAI Groundfish — Predator to

Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Dover Sole	M												X				X	X													
	LJ												X				X	X													
	EJ																														
	L	X		X																											
	E																														
Rex Sole	M							X		X			X					X													
	LJ							X		X			X					X													
	EJ																														
	L	X		X																											
	E																														
Greenland Turbot	M												X					X	X	X			X	X						X	
	LJ																														
	EJ				X																										
	L	X		X																											
	E																														
Shortraker/Rougheye Rockfish	M													X						X				X							
	LJ																														
	EJ																														
	L																														
Northern Rockfish	M							X			X																				
	LJ																														
	EJ																														
	L																														
Thornyhead Rockfish	M																			X					X						
	LJ																														
	EJ																														
	L																														
	E																														
Light Dusky Rockfish	M							X																							
	LJ																														
	EJ																														
	L																														

BSAI Groundfish — Prey of

Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Halibut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrestrial Mammals
Dover Sole	M								X						X															
	LJ								X						X															
	EJ																													
	L																													
	E																													
Rex Sole	M								X						X															
	LJ								X						X															
	EJ																													
	L																													
	E																													
Greenland Turbot	M																													
	LJ																													
	EJ							X	X					X																
	L																													
	E																													
Shortraker/Rougheye Rockfish	M																													
	LJ																													
	EJ																													
	L																													
Northern Rockfish	M																													
	LJ																													
	EJ																													
	L																													
Thornyhead Rockfish	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Light Dusky Rockfish	M																													
	LJ																													
	EJ																													
	L																													

Table D.3 Summary of biological associations for BSAI groundfish

BSAI Groundfish — Predator to

Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Sculpins	M				x			x	x	x	x	x	x		x	x	x	x	x	x	x	x	x		x	x		x	x		
	LJ																														
	EJ																														
	L																														
	E																														
Skates	M									x		x	x					x		x	x		x		x	x	x	x	x	x	x
	LJ																														
	EJ																														
	L																														
	E																														
Sharks	M													x				x		x							x	x		x	x
	LJ																														
	EJ																														
	L																														
	E																														
Squid	M							x			x									x	x	x	x								
	LJ																														
	EJ																														
	L																														
	E																														
Octopus	M																x	x	x												
	LJ																														
	EJ																														
	L																														
	E																														
Eulachon	M				X			X			X																				
	LJ				X			X			X																				
	EJ				X			X			X																				
	L			X	X	X		X			X																				
	E																														
Capelin	M				X			X			X		X							X											
	LJ				X			X			X																				
	EJ				X			X			X																				
	L			X	X	X		X			X																				
	E																														
Sand Lance	M				X			X		X	X																				
	LJ				X			X		X	X																				
	EJ				X			X		X	X																				
	L			X	X	X		X		X	X																				
	E																														

BSAI Groundfish — Prey of

Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Halibut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrestrial Mammals
Sculpins	M										x		x		x	x		x	x	x	x	x								
	LJ																													
	EJ																													
	L																													
	E																													
Skates	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Sharks	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Squid	M	x					x	x	x	x	x	x	x			x		x	x	x	x	x		x		x	x	x		
	LJ																													
	EJ																													
	L																													
	E																													
Octopus	M									x			x	x		x		x	x	x		x								
	LJ																													
	EJ																													
	L																													
	E																													
Eulachon	M						X	X	X							X		X	X	X	X					X	X			X
	LJ						X	X	X							X		X	X	X	X					X	X			
	EJ					X	X	X	X							X														
	L					X	X	X	X							X														
	E																													
Capelin	M						X	X	X						X	X		X	X	X	X					X	X			
	LJ						X	X	X						X	X		X	X	X	X					X	X			
	EJ					X	X	X	X						X	X														
	L					X	X	X	X						X	X														
	E																													
Sand Lance	M						X	X	X						X	X		X	X	X	X					X	X			
	LJ						X	X	X						X	X		X	X	X	X					X	X			
	EJ					X	X	X	X						X	X														
	L					X	X	X	X						X	X														
	E																													

D.1 Walleye pollock (*Theragra calcogramma*)

The Eastern Bering Sea (EBS) and Aleutian Islands pollock stocks are managed under the BSAI groundfish fisheries management plan. Pollock occur throughout the area covered by the FMP and straddle into the Canadian and Russian EEZ, international waters of the central Bering Sea, and into the Chukchi Sea.

D.1.1 Life History and General Distribution

Pollock is the most abundant species within the eastern Bering Sea comprising 75-80% of the catch and 60% of the biomass. In the Gulf of Alaska, pollock is the second most abundant groundfish stock comprising 25-50% of the catch and 20% of the biomass.

Four stocks of pollock are recognized for management purposes: Gulf of Alaska, eastern Bering Sea, Aleutian Islands, and Aleutian Basin. There appears to be a high degree of interrelationship among the eastern Bering Sea, Aleutian Islands, and Aleutian Basin stocks with suggestions of movement from one area to the others. There appears to be stock separation between the Gulf of Alaska stocks and stocks to the north.

The most abundant stock of pollock is the eastern Bering Sea stock which is primarily distributed over the eastern Bering Sea outer continental shelf between approximately 70-200 m. Information on pollock distribution in the eastern Bering Sea comes from commercial fishing locations, annual bottom trawl surveys and triennial acoustic surveys.

The Aleutian Islands stock extends through the Aleutian Islands from 170° W to the end of the Aleutian Islands (Attu Island), with the greatest abundance in the eastern Aleutians (170° W to Seguam Pass). Most of the information on pollock distribution in the Aleutian Islands comes from triennial bottom trawl surveys. These surveys indicate that pollock are primarily located on the Bering Sea side of the Aleutian Islands, and have a spotty distribution throughout the Aleutian Islands chain. The bottom trawl data may not provide an accurate view of pollock distribution because a significant portion of the pollock biomass is likely to be unavailable to bottom trawls. Also, many areas of the Aleutian Islands shelf are untrawlable due to rough bottom.

The third stock, Aleutian Basin, appears to be distributed throughout the Aleutian Basin which encompasses the U.S. EEZ, Russian EEZ, and international waters in the central Bering Sea. This stock appears to move throughout the Basin for feeding, but concentrate in deepwater near the continental shelf for spawning. The principal spawning location is near Bogoslof Island in the eastern Aleutian Islands, but data from pollock fisheries in the first quarter of the year indicate that there are other concentrations of deepwater spawning concentrations in the western Aleutian Islands. The Aleutian Basin spawning stock appears to be derived from migrants from the eastern Bering Sea shelf stock, and possibly some western Bering Sea pollock. Recruitment to the stock occurs generally around age 5, very few pollock younger than age 5 have been found in the Aleutian Basin. Most of the pollock in the Aleutian Basin appear to originate from strong year classes.

The Gulf of Alaska stock extends from southeast Alaska to the Aleutian Islands (170° W), with the greatest abundance in the western and central regulatory areas (147° W to 170° W). Most of the information on pollock distribution in the Gulf of Alaska comes from triennial bottom trawl surveys. These surveys indicate that pollock are distributed throughout the shelf regions of the Gulf of Alaska at depths less than 300 m. The bottom trawl data may not provide an accurate view of pollock distribution because a significant portion of the pollock biomass may be pelagic and not available to bottom trawls. The principal spawning location is in Shelikof Strait, but data from pollock fisheries and exploratory surveys indicate that there are other concentrations of spawning in the Shumagin Islands, the east side of Kodiak Island and near Prince William Sound.

Peak pollock spawning occurs on the southeastern Bering Sea and eastern Aleutian Islands along the outer continental shelf around mid-March. North of the Pribilof Islands spawning occurs later (April-May) in smaller spawning aggregations. The deep spawning pollock of the Aleutian Basin appear to spawn slightly earlier, late February-early March. In the Gulf of Alaska, peak spawning occurs in late March in Shelikof Strait. Peak spawning in the Shumagin area appears to 2-3 weeks earlier than in Shelikof Strait.

Spawning occurs in the pelagic zone and eggs develop throughout the water column (70-80 m in the Bering Sea shelf, 150-200 m in Shelikof Strait). Development is dependent on water temperature. In the Bering Sea, eggs take about 17-20 days to develop at 4 degrees in the Bogoslof area and 25.5 days at 2 degrees on the shelf. In the Gulf of Alaska, development takes approximately 2 weeks at ambient temperature (5 degrees C). Larvae are also distributed in the upper water column. In the Bering Sea the larval period lasts approximately 60 days. The larvae eat progressively larger naupliar stages of copepods as they grow and then small euphausiids as they approach transformation to juveniles (~25 mm standard length). In the Gulf of Alaska, larvae are distributed in the upper 40 m of the water column and the diet is similar to Bering Sea larvae. FOCI survey data indicate larval pollock may utilize the stratified warmer upper waters of the mid-shelf to avoid predation by adult pollock which reside in the colder bottom water.

At age 1 pollock are found throughout the eastern Bering Sea both in the water column and on bottom. Age 1 pollock from strong year-classes appear to be found in great numbers on the inner shelf, and further north on the shelf than weak year classes which appear to be more concentrated on the outer continental shelf. From age 2-3 pollock are primarily pelagic and then to be most abundant on the outer and mid-shelf northwest of the Pribilof Islands. As pollock reach maturity (age 4) in the Bering Sea, they appear to move from the northwest to the southeast shelf to recruit to the adult spawning population. Strong year-classes of pollock persist in the population in significant numbers until about age 12, and very few pollock survive beyond age 16. The oldest recorded pollock was age 31.

Growth varies by area with the largest pollock occurring on the southeastern shelf. On the northwest shelf the growth rate is slower. A newly maturing pollock is around 40 cm.

The upper size limit for juvenile pollock in the eastern Bering Sea and Gulf of Alaska is about 38-42 cm. This is the size of 50% maturity. There is some evidence that this has changed over time.

D.1.2 Fishery

The eastern Bering Sea pollock fishery has, since 1990 been divided into two fishing periods; an “A season” occurring in January-March, and a “B season” occurring in August-October. The A season concentrates fishing effort on prespawning pollock in the southeastern Bering Sea. During the B season fishing is still primarily in the southeastern Bering Sea, but some fishing also occurs on the northwestern shelf. Also during the B season catcher processor vessels are required to fish north of 56° N latitude because the area to the south is reserved for catcher vessels delivering to shoreside processing plants on Unalaska and Akutan.

Since 1992, the Gulf of Alaska pollock TAC has been apportioned spatially and temporally to reduce impacts on Steller sea lions. Although the details of the apportionment scheme have evolved over time, the general objective is to allocate the TAC to management areas based on the distribution of surveyed biomass, and to establish three or four seasons between mid-January and autumn during which some fraction of the TAC can be taken. The Steller Sea Lion Protection Measures implemented in 2001 establish four seasons in the Central and Western GOA beginning January 20, March 10, August 25, and October 1, with 25% of the total TAC allocated to each season. Allocations to management areas 610, 620 and 630 are based on the seasonal biomass distribution as estimated by groundfish surveys. In addition, a new harvest control rule was implemented that requires a cessation of fishing when spawning biomass declines below 20% of unfished stock biomass.

In the Gulf of Alaska approximately 90% of the pollock catch is taken using pelagic trawls. During winter, fishing effort usually targeted primarily on pre-spawning aggregations in Shelikof Strait and near the

Shumagin Islands. The pollock fishery has a very low bycatch rate with discards averaging about 2% since 1998 (with the 1991-1997 average around 9%). Most of the discards in the pollock fishery are juvenile pollock, or pollock too large to fit filleting machines. In the pelagic trawl fishery the catch is almost exclusively pollock.

The eastern Bering Sea pollock fishery primarily harvests mature pollock. The age where fish are selected by the fishery roughly corresponds to the age at maturity (management guidelines are oriented towards conserving spawning biomass). Fishery selectivity increases to a maximum around age 6-8 and declines slightly. The reduced selectivity for older ages is due to pollock becoming increasingly demersal with age. Younger pollock form large schools and are semi-demersal, thereby being easier to locate by fishing vessels. Immature fish (ages 2 and 3) are usually caught in low numbers. Generally the catch of immature pollock increases when strong year-classes occur and the abundance of juveniles increase sharply. This occurred with the 1989 year-class, the second largest year-class on record. Juvenile bycatch increased sharply in 1991 and 1992 when this year-class was age 2 and 3. A secondary problem is that strong to moderate year-classes may reside in the Russian EEZ adjacent to the U. S. EEZ as juveniles. Russian catch-age data and anecdotal information suggest that juveniles may comprise a major portion of the catch. There is a potential for the Russian fishery to reduce subsequent abundance in the U. S. fishery.

The Gulf of Alaska pollock fishery also targets mature pollock. Fishery selectivity increases to a maximum around age 5-7 and then declines. In both the EBS and GOA, the selectivity pattern varies between years due to shifts in fishing strategy and changes in the availability of different age groups over time.

In response to continuing concerns over the possible impacts groundfish fisheries may have on rebuilding populations of Steller sea lions, NMFS and the NPFMC have made changes to the Atka mackerel (mackerel) and pollock fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska. These have been designed to reduce the possibility of competitive interactions with Steller sea lions. For the pollock fisheries, comparisons of seasonal fishery catch and pollock biomass distributions (from surveys) by area in the eastern Bering Sea led to the conclusion that the pollock fishery had disproportionately high seasonal harvest rates within critical habitat which *could* lead to reduced sea lion prey densities. Consequently, the management measures were designed to redistribute the fishery both temporally and spatially according to pollock biomass distributions. The underlying assumption in this approach was that the independently derived area-wide and annual exploitation rate for pollock would not reduce local prey densities for sea lions. Here we examine the temporal and spatial dispersion of the fishery to evaluate the potential effectiveness of the measures.

Three types of measures were implemented in the pollock fisheries:

- Additional pollock fishery exclusion zones around sea lion rookery or haulout sites,
- Phased-in reductions in the seasonal proportions of TAC that can be taken from critical habitat, and
- Additional seasonal TAC releases to disperse the fishery in time.

Prior to the management measures, the pollock fishery occurred in each of the three major fishery management regions of the north Pacific ocean managed by the NPFMC: the Aleutian Islands (1,001,780 km^2 inside the EEZ), the eastern Bering Sea (968,600 km^2), and the Gulf of Alaska (1,156,100 km^2). The marine portion of Steller sea lion critical habitat in Alaska west of 150°W encompasses 386,770 km^2 of ocean surface, or 12% of the fishery management regions.

Prior to 1999, a total of 84,100 km^2, or 22% of critical habitat, was closed to the pollock fishery. Most of this closure consisted of the 10 and 20 nm radius all-trawl fishery exclusion zones around sea lion rookeries (48,920 km^2 or 13% of critical habitat). The remainder was largely management area 518 (35,180 km^2, or 9% of critical habitat) which was closed pursuant to an international agreement to protect spawning stocks of central Bering Sea pollock.

In 1999, an additional 83,080 km^2 (21%) of critical habitat in the Aleutian Islands was closed to pollock fishing along with 43,170 km^2 (11%) around sea lion haulouts in the GOA and eastern Bering Sea. Consequently, a total of 210,350 km^2 (54%) of critical habitat was closed to the pollock fishery. The portion of critical habitat that remained open to the pollock fishery consisted primarily of the area between 10 and 20 nm from rookeries and haulouts in the GOA and parts of the eastern Bering Sea foraging area.

The Bering Sea/Aleutian Islands pollock fishery was also subject to changes in total catch and catch distribution. Disentangling the specific changes in the temporal and spatial dispersion of the EBS pollock fishery resulting from the sea lion management measures from those resulting from implementation of the 1999 American Fisheries Act (AFA) is difficult. The AFA reduced the capacity of the catcher/processor fleet and permitted the formation of cooperatives in each industry sector by 2000. Both of these changes would be expected to reduce the rate at which the catcher/processor sector (allocated 36% of the EBS pollock TAC) caught pollock beginning in 1999, and the fleet as a whole in 2000. Because of some of its provisions, the AFA gave the industry the ability to respond efficiently to changes mandated for sea lion conservation that otherwise could have been more disruptive to the industry.

In 2000, further reductions in seasonal pollock catches from BSAI sea lion critical habitat were realized by closing the entire Aleutian Islands region to pollock fishing and by phased-in reductions in the proportions of seasonal TAC that could be caught from the Sea Lion Conservation Area, an area which overlaps considerably with sea lion critical habitat. In 1998, over 22,000 t of pollock were caught in the Aleutian Island regions, with over 17,000 t caught in AI critical habitat. Since 1998 directed fishery removals of pollock have been prohibited.

D.1.3 Relevant Trophic Information

Juvenile pollock through newly maturing pollock primarily utilize copepods and euphausiids for food. At maturation and older ages pollock become increasingly piscivorous, with pollock (cannibalism) a major food item in the Bering Sea. Most of the pollock consumed by pollock are age 0 and 1 pollock, and recent research suggests that cannibalism can regulate year-class size. Weak year-classes appear to be those located within the range of adults, while strong year-classes are those that are transported to areas outside the range of adult abundance.

Being the dominant species in the eastern Bering Sea pollock is an important food source for other fish, marine mammals, and birds. On the Pribilof Islands hatching success and fledgling survival of marine birds has been tied to the availability of age 0 pollock to nesting birds.

D.1.4 Habitat and Biological Associations

Egg-Spawning: Pelagic on outer continental shelf generally over 100-200 m depth in Bering Sea. Pelagic on continental shelf over 100-200 m depth in Gulf of Alaska.

Larvae: Pelagic outer to mid-shelf region in Bering Sea. Pelagic throughout the continental shelf within the top 40 m in the Gulf of Alaska.

Juveniles: Age 0 appears to be pelagic, as is age 2 and 3. Age 1 pelagic and demersal with a widespread distribution and no known benthic habitat preference.

Adults: Adults occur both pelagically and demersally on the outer and mid-continental shelf of the Gulf of Alaska, eastern Bering Sea and Aleutian Islands. In the eastern Bering Sea few adult pollock occur in waters shallower than 70 m. Adult pollock also occur pelagically in the Aleutian Basin. Adult pollock range throughout the Bering Sea in both the U.S. and Russian waters, however, the maps provided for this document detail distributions for pollock in the U.S. Exclusive Economic Zone and the basin.

Habitat and Biological Associations: Walleye Pollock

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	14 d. at 5 C	None	Feb-Apr	OCS, UCS	P	N/A	G?	
Larvae	60 days	copepod naupli and small euphausiids	Mar-Jul	MCS, OCS	P	N/A	G? F	pollock larvae with jellyfish
Juveniles	0.4 to 4.5 years	Pelagic crustaceans, copepods and euphausiids	Aug. +	OCS, MCS, ICS	P, SD	N/A	CL, F	
Adults	4.5 - 16 years	Pelagic crustaceans and fish	Spawning Feb-Apr	OCS, BSN	P, SD	UNK	F UP	Increasingly demersal with age.

D.1.5 Additional sources of information

Eggs and Larvae:

Jeff Napp, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 206-526-4148.

Shallow water concentrations:

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

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D.2 Pacific cod (Gadus macrocephalus)

D.2.1 Life History and General Distribution

Pacific cod is a transoceanic species, occurring at depths from shoreline to 500 m. The southern limit of the species' distribution is about 34° N latitude, with a northern limit of about 63° N latitude. Adults are demersal and form aggregations during the peak spawning season, which extends approximately from January through May. Pacific cod eggs are demersal and adhesive. Eggs hatch in about 15-20 days. Little is known about the distribution of Pacific cod larvae, which undergo metamorphosis at about 25-35 mm. Juvenile Pacific cod start appearing in trawl surveys at a fairly small size, as small as 10 cm in the eastern Bering Sea. Pacific cod can grow to be more than a meter in length, with weights in excess of 10 kg. Natural mortality is believed to be somewhere between 0.3 and 0.4. Approximately 50% of Pacific cod are mature by ages 5-6. The maximum recorded age of a Pacific cod from the Bering Sea/Aleutian Islands (BSAI) or Gulf of Alaska (GOA) is 19 years.

The estimated size at 50% maturity is 67 cm.

D.2.2 Fishery

The fishery is conducted with bottom trawl, longline, pot, and jig gear. The age at 50% recruitment varies between gear types and regions. In the BSAI, the age at 50% recruitment is 6 years for trawl gear, 4 years for longline and 5 years for pot gear. In the GOA, the age at 50% recruitment is 5 years for trawl gear and 6 years for longline and pot gear. More than 100 vessels participate in each of the three largest fisheries (trawl, longline, pot). The trawl fishery is typically concentrated during the first few months of the year, whereas fixed-gear fisheries may sometimes run, intermittently, at least, throughout the year. Bycatch of crab and halibut sometimes causes the Pacific cod fisheries to close prior to reaching the total allowable catch. In the BSAI, trawl fishing is concentrated immediately north of Unimak Island, whereas the longline fishery is distributed along the shelf edge to the north and west of the Pribilof Islands. In the GOA, the trawl fishery has centers of activity around the Shumagin Islands and south of Kodiak Island, while the longline fishery is located primarily in the vicinity of the Shumagin.

D.2.3 Relevant Trophic Information

Pacific cod are omnivorous. In terms of percent occurrence, the most important items in the diet of Pacific cod in the BSAI and GOA are polychaete, amphipods, and crangonid shrimp. In terms of numbers of individual organisms consumed, the most important dietary items are euphausiids, miscellaneous fishes, and amphipods. In terms of weight of organisms consumed, the most important dietary items are walleye pollock, fishery discards, and yellowfin sole. Small Pacific cod feed mostly on invertebrates, while large Pacific cod are mainly piscivorous. Predators of Pacific cod include halibut, salmon shark, northern fur seals, sea lions, harbor porpoises, various whale species, and tufted puffin.

D.2.4 Habitat and Biological Associations

Egg/Spawning: Spawning takes place in the sublittoral-bathyal zone (40-290 m) near bottom. Eggs sink to the bottom after fertilization, and are somewhat adhesive. Optimal temperature for incubation is 3-6° C, optimal salinity is 13-23 ppt, and optimal oxygen concentration is from 2-3 ppm to saturation. Little is known about the optimal substrate type for egg incubation.

Larvae: Larvae are epipelagic, occurring primarily in the upper 45 m of the water column shortly after hatching, moving downward in the water column as they grow.

Juveniles: Juveniles occur mostly over the inner continental shelf at depths of 60-150 m.

Adults: Adults occur in depths from the shoreline to 500 m. Average depth of occurrence tends to vary directly with age for at least the first few years of life, with mature fish concentrated on the outer continental shelf. Preferred substrate is soft sediment, from mud and clay to sand.

Habitat and Biological Associations: Pacific cod

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	15-20 d	NA	winter-spring	ICS, MCS, OCS	D	M, SM, MS ,S	U	optimum 3-6°C optimum salinity 13-23 ppt
Larvae	U	copepods (?)	winter-spring	U	P (?), N (?)	U	U	
Early Juveniles	to 2 yrs	small invertebrates (mysids, euphausiids, shrimp)	all year	ICS, MCS	D	M, SM, MS, S	U	
Late Juveniles	to 5 yrs	pollock, flatfish, fishery discards, crab	all year	ICS, MCS, OCS	D	M, SM, MS, S	U	
Adults	5+ yr	pollock, flatfish, fishery discards, crab	Spawning (Jan-May)	ICS, MCS, OCS	D	M, SM, MS, S,G	U	
			non-spawning (Jun-Dec)	ICS, MCS, OCS				

D.2.5 Additional sources of information

Larvae/juveniles

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D.3 Sablefish (Anoplopoma fimbria)

D.3.1 Life History and General Distribution

Distributed from Mexico through the Gulf of Alaska to the Aleutian Chain, Bering Sea; along the Asian coast from Sagami Bay, and along the Pacific sides of Honshu and Hokkaido Islands and the Kamchatkan Peninsula. Adult sablefish occur along the continental slope, shelf gulleys, and in deep fjords such as Prince William Sound and Southeastern Alaska, at depths generally greater than 200 m. Adults are assumed to be demersal. Spawning or very ripe sablefish are observed in late winter or early spring along the continental slope. Eggs are apparently released near the bottom where they incubate. After hatching and yolk adsorption the larvae rise to the surface where they have been collected with neuston nets. Larvae are oceanic through the spring and by late summer, small pelagic juveniles (10-15 cm) have been observed along the outer coasts of Southeast Alaska, where they apparently move into shallow waters to spend their first winter. During most years, there are only a few places where juveniles have been found during their first winter and second summer. It is not clear if the juvenile distribution is highly specific or appears so because sampling is highly inefficient and sparse. During the occasional times of large year-classes the juveniles are easily found in many inshore areas during their second summer. They are typically 30-40 cm in length during their second summer, after which they apparently leave the nearshore bays. One or two years later they begin appearing on the continental shelf and move to their adult distribution as they mature.

Size of 50% maturity: Bering Sea: males 65 cm, females 67 cm; Aleutian Islands: males 61 cm, females 65 cm; Gulf of Alaska: males 57 cm, females 65 cm. At the end of the second summer (~1.5 years old) they are 35-40 cm in length. Provide source (agency, name and phone number, or literature reference) for any possible additional distribution data (do not include AFSC groundfish surveys or fishery observer data)

D.3.2 Fishery

The major fishery for sablefish in Alaska uses longlines, however sablefish are valuable in the trawl fishery as well. Sablefish enter the longline fishery at 4-5 years of age, perhaps slightly younger in the trawl fishery. The longline fishery takes place March 1 and November 15. The take of the trawl share of sablefish occurs primarily in association with openings for other species, such as the July rockfish openings, where they are taken as allowed bycatch. Deeper dwelling rockfish, such as Shortraker, Rougheye, and Thornyhead rockfish are the primary bycatch in the longline sablefish fishery. Halibut and rattails (Albatrossia pectoralis and Corphaenoides acrolepis) also are taken. By regulation, there is no directed trawl fishery for sablefish, however, directed fishing standards have allowed some trawl hauls to target sablefish, where the bycatch is similar to the longline fishery, in addition perhaps to some deep dwelling flatfish.

D.3.3 Relevant Trophic Information

Larval sablefish feed on a variety of small zooplankton ranging from copepod naupli to small amphipods. The epipelagic juveniles feed primarily on macrozooplankton and micronekton (i.e., euphausiids).

The older demersal juveniles and adults appear to be opportunistic feeders, with food ranging from variety of benthic invertebrates, benthic fishes, as well as squid, mesopelagic fishes, jellyfish and fishery discards. Gadid fish (mainly pollock) comprise a large part of the sablefish diet. Nearshore residence during their second year provide the opportunity to feed on salmon fry and smolts during the summer months.

Young of the year sablefish are commonly found in the stomachs of salmon taken in the southeast (SE) troll fishery during the late summer.

D.3.4 Habitat and Biological Associations

Egg/Spawning

Larvae

Juveniles

Adults - other than depth, none is noted.

Habitat and Biological Associations: Sablefish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	14-20 days	NA	late winter-early spring: Dec-Apr	USP, LSP, BSN	P, 200-3000 m	NA	U	
Larvae	up to 3 months	copepod nauplii, small copepodites, etc	spring-summer: Apr-July	MCS, OCS, USP, LSP, BSN	N, neustonic near surface	NA	U	
Early Juveniles	to 3 yrs	small prey fish, sandlance, salmon, herring, etc		OCS, MCS, ICS, during first summer, then obs in BAY, IP, till end of 2nd summer; not obs'd till found on shelf	P when offshore during first summer, then D, SD/SP when inshore	NA when pelagic. The bays where observed were soft bottomed, but not enough obs. to assume typical.	U	
Late Juveniles	3-5 yrs	opportunistic: other fish, shellfish, worms, jellyfish, fishery discards	all year	continental slope, and deep shelf gulleys and fjords.	caught with bottom tending gear. presumably D	varies	U	
Adults	5 yrs to 35+	opportunistic: other fish, shellfish, worms, jellyfish, fishery discards	apparently year around, spawning movements (if any) are undescribed	continental slope, and deep shelf gulleys and fjords.	caught with bottom tending gear. presumably D	varies	U	

D.3.5 Additional Sources of information

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NMFS, Alaska Fisheries Science Center, FOCI Program, Art Kendall 206-526-4108, NMFS Auke Bay Lab, Bruce Wing 907-789-????

Juveniles:

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D.4 Yellowfin sole *(Limanda aspera)*

D.4.1 Life History and General Distribution

Distributed in North American waters from off British Columbia, Canada, (approx. lat. 49° N) to the Chukchi Sea (about lat. 70° N) and south along the Asian coast to about lat. 35° N off the South Korean coast in the Sea of Japan. Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins, adults begin a migration onto the inner shelf in April or early May each year for spawning and feeding. A protracted and variable spawning period may range from as early as late May through August occurring primarily in shallow water. Fecundity varies with size and was reported to range from 1.3 to 3.3 million eggs for fish 25-45 cm long. Eggs have been found to the limits of inshore ichthyoplankton sampling over a widespread area to at least as far north as Nunivak Island. Larvae have been measured at 2.2-5.5 mm in July and 2.5-12.3 mm in late August - early September. The age or size at metamorphosis is unknown. Upon settlement in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and burrowing for protection. Juveniles are separate from the adult population, remaining in shallow areas until they reach approximately 15 cm. The estimated age of 50% maturity is 10.5 yrs (approx. 29 cm) for females based on samples collected in 1992 and 1993. Natural mortality rate is believed to range from 0.12-0.16.

The approximate upper size limit of juvenile fish is 27cm.

D.4.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 6 and they are fully selected at age 13. Historically, the fishery has occurred throughout the mid and inner Bering Sea shelf during ice-free conditions although much effort has been directed at the spawning concentrations in nearshore northern Bristol Bay. They are caught as bycatch in Pacific cod, bottom pollock and other flatfish fisheries and are caught with these species and Pacific halibut in yellowfin sole directed fisheries.

D.4.3 Relevant Trophic Information

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

D.4.4 Habitat and Biological Associations

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

Adults: Summertime spawning and feeding on sandy substrates of the eastern Bering Sea shelf. Widespread distribution mainly on the middle and inner portion of the shelf, feeding mainly on bivalves, polychaete, amphipods and echiurids. Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures, feeding diminishes.

Habitat and Biological Associations: Yellowfin sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	summer	BAY, BCH	P			
Larvae	2-3 months?	U phyto/zoo plankton?	summer autumn?	BAY, BCH ICS	P			
Early Juveniles	to 5.5 yrs	polychaete bivalves amphipods echiurids	all year	BAY, ICS OCS	D	S[1]		
Late Juveniles	5.5 to 10 yrs	polychaete bivalves amphipods echiurids	all year	BAY, ICS OCS	D	S[1]		
Adults	10+ years	polychaete bivalves amphipods echiurids	spawning/ feeding May-August non-spawning Nov.-April	BAY BEACH ICS, MCS OCS	D	S[1]	ice edge	

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

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D.5 Greenland turbot (*Reinhardtius* hippoglossoides)

D.5.1 Life History and General Distribution

Greenland turbot has an amphiboreal distribution, occurring in the North Atlantic and North Pacific, but not in the intervening Arctic Ocean. In the North Pacific, species abundance is centered in the eastern Bering Sea and, secondly, in the Aleutians. On the Asian side, they occur in the Gulf of Anadyr along the Bering Sea coast of Russia, in the Okhotsk Sea, around the Kurile Islands, and south to the east coast of Japan to northern Honshu Island (Hubbs and Wilimovsky 1964, Mikawa 1963, Shuntov 1965). Adults exhibit a benthic lifestyle, living in deep waters of the continental slope but are known to have a tendency to feed off the sea bottom. During their first few years as immature fish, they inhabit relatively shallow continental shelf waters (<200 m) until about age 4 or 5 before joining the adult population (200 - 1,000 m or more, Templeman 1973). Adults appear to undergo seasonal shifts in depth distribution moving deeper in winter and shallower in summer (Chumakov 1970, Shuntov 1965). Spawning is reported to occur in winter in the eastern Bering Sea and may be protracted starting in September or October and continuing until March with an apparent peak period in November to February (Shuntov 1970, Bulatov 1983). Females spawn relatively small numbers of eggs with fecundity ranging from 23,900 to 149,300 for fish 83 cm and smaller in the Bering Sea (D'yakov 1982).

Eggs and early larval stages are benthypelagic (Musienko 1970). In the Atlantic Ocean, larvae (10-18 cm) have been found in benthypelagic waters which gradually rise to the pelagic zone in correspondence to absorption of the yolk sac which is reported to occur at 15-18 mm with the onset of feeding (Pertseva-Ostroumova 1961 and Smidt 1969). The period of larval development extends from April to as late as August or September (Jensen 1935) which results in an extensive larval drift and broad dispersal from the spawning waters of the continental slope. Metamorphosis occurs in August or September at about 7-8 cm in length at which time the demersal life begins. Juveniles are reported to be quite tolerant of cold temperatures to less than zero degrees Celsius (Hognestad 1969) and have been found on the northern part of the Bering Sea shelf in summer trawl surveys (Alton et al. 1988).

The age of 50% maturity is estimated to range from 5-10 yrs (D'yakov 1982, 60 cm used in stock assessment) and a natural mortality rate of 0.18 has been used in the most recent stock assessments (Ianelli et al. 2002). The approximate upper size limit of juvenile fish is 59cm.

D.5.2 Fishery

Caught in bottom trawls and on longlines both as a directed fishery and in the pursuit of other bottom-dwelling species (primarily sablefish). Recruitment begins at about 50 and 60 cm in the trawl and longline fisheries, respectively. The fishery operates on the continental slope throughout the eastern Bering Sea and on both sides of the Aleutian Islands. Bycatch primarily occurs in the sablefish directed fisheries and also to a smaller extent in the Pacific cod fishery.

D.5.3 Relevant Trophic Information

Groundfish predators include Pacific cod, pollock and yellowfin sole, mostly on fish ranging from 2 to 5 cm standard length (probably age 0).

D.5.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for up to 9 months until metamorphosis occurs, usually with a widespread distribution inhabiting shallow waters. Juveniles live on continental shelf until about age 4 or 5 feeding primarily on euphausiids, polychaete and small walleye pollock..

Adults: Inhabit continental slope waters with annual spring/fall migrations from deeper to shallower waters. Diet consists of walleye pollock and other miscellaneous fish species.

Habitat and Biological Associations: Greenland turbot

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	OCS, MCS	SD, SP			
Larvae	8-9 months	U phyto/zoo plankton?	Spring summer	OCS, ICS MCS	P			
Juveniles	1-5 yrs	euphausiids polychaetes small pollock	all year	ICS, MCS OCS, USP	D, SD	M/S+M[1]		
Adults	5+ years	pollock small fish	Spawning Nov-February	OCS, USP LSP	D, SD	M/S+M[1]		
			non-spawning March-October	USP, LSP				

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

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D.6 Arrowtooth flounder (*Atheresthes stomias*)

D.6.1 Life History and General Distribution

Distributed in North American waters from central California to the eastern Bering Sea on the continental shelf and upper slope.

Adults exhibit a benthic lifestyle and occupy separate winter and summer distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins and upper slope areas, adults begin a migration onto the middle and outer shelf in April or early May each year with the onset of warmer water temperatures. A protracted and variable spawning period may range from as early as September through March (Rickey 1994, Hosie 1976). Little is known of the fecundity of arrowtooth flounder. Larvae have been found from ichthyoplankton sampling over a widespread area of the eastern Bering Sea shelf in April and May and also on the continental shelf east of Kodiak Island during winter and spring (Waldron and Vinter 1978, Kendall and Dunn 1985). The age or size at metamorphosis is unknown. Juveniles are separate from the adult population, remaining in shallow areas until they reach the 10-15 cm range (Martin and Clausen 1995). The estimated length at 50% maturity is 28 cm for males (4 years) and 37 cm for females (5 years) from samples collected off the Washington coast (Rickey 1994). The natural mortality rate used in stock assessments differs by sex and is estimated at 0.2 for females and 0.35 - 0.37 for females (Turnock et. al 2002, Wilderbuer and Sample 2002).

The approximate upper size limit of juvenile fish is 27cm for males and 37cm for females.

D.6.2 Fishery

Caught in bottom trawls usually in pursuit of other higher value bottom-dwelling species. Historically have been undesirable to harvest due to a flesh softening condition caused by protease enzyme activity. Recruitment begins at about age 3 and females are fully selected at age 10. They are caught as bycatch in Pacific cod, bottom Pollock, sablefish and other flatfish fisheries by both trawls and longline.

D.6.3 Relevant Trophic Information

Very important as a large, aggressive and abundant predator of other groundfish species. Groundfish predators include Pacific cod and pollock, mostly on small fish.

D.6.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, juveniles usually inhabit shallow areas until about 10 cm in length.

Adults: Widespread distribution mainly on the middle and outer portions of the continental shelf, feeding mainly on walleye pollock and other miscellaneous fish species when arrowtooth flounder attain lengths greater than 30 cm. Wintertime migration to deeper waters of the shelf margin and upper continental slope to avoid extreme cold water temperatures and for spawning.

Habitat and Biological Associations: Arrowtooth flounder

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano- graphic Features	Other
Eggs		NA	winter, spring?	ICS, MCS, OCS	P			
Larvae	2-3 months?	U phyto/zoo plankton?	Spring summer?	BAY, ICS, MCS, OCS	P			
Early Juveniles	to 2 yrs	euphausiids crustaceans amphipods pollock	all year	ICS, MCS	D	GMS[1]		
Late Juveniles	males 2-4 yrs females 2-5 yrs	euphausiids crustaceans amphipods pollock	all year	ICS, MCS, OCS, USP	D	GMS[1]		
Adults	males - 4+ yrs females- 5+ yrs	pollock misc. fish Gadidae sp. Euphausiids	Spawning Nov-March non-spawning April-Oct	MCS, OCS, USP	D	GMS[1]	ice edge (EBS)	

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

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D.7 Rock sole (*Lepidopsetta bilineatus*)

D.7.1 Life History and General Distribution

Distributed from California waters north into the Gulf of Alaska and Bering Sea to as far north as the Gulf of Anadyr. The distribution continues along the Aleutian Islands westward to the Kamchatka Peninsula and then southward through the Okhotsk Sea to the Kurile Islands, Sea of Japan, and off Korea. Centers of abundance occur off the Kamchatka Peninsula (Shubnikov and Lisovenko 1964), British Columbia (Forrester and Thompson 1969), the central Gulf of Alaska, and in the southeastern Bering Sea (Alton and Sample 1975). Two forms were recently found to exist in Alaska by Orr and Matarese (2000), a southern rock sole (*L. bilineatus*) and a northern rock sole (*L. polyxystra*). Adults exhibit a benthic lifestyle and, in the eastern Bering Sea, occupy separate winter (spawning) and summertime feeding distributions on the continental shelf. Rock sole spawn during the winter-early spring period of December-March. Soviet investigations in the early 1960s established two spawning concentrations: an eastern concentration north of Unimak Island at the mouth of Bristol Bay and a western concentration eastward of the Pribilof Islands between 55°30' and 55°0' N and approximately 165°2' W (Shubnikov and Lisovenko, 1964). Rock sole spawning in the eastern and western Bering Sea was found to occur at depths of 125-250 m, close to the shelf/slope break. Spawning females deposit a mass of eggs which are demersal and adhesive (Alton and Sample 1975). Fertilization is believed to be external. Incubation time is temperature dependent and may range from 6.4 days at 11 degrees C to about 25 days at 2.9 degrees C (Forrester 1964). Newly hatched larvae are pelagic and have occurred sporadically in eastern Bering Sea plankton surveys (Waldron and Vinter, 1978). Kamchatka larvae are reportedly 20 mm in length when they assume their side-swimming, bottom-dwelling form (Alton and Sample 1975). Norcross et al. (1996) found newly settled larvae in the 40-50 mm size range. Forrester and Thompson (1969) report that by age 1 they are found with adults on the continental shelf during summer.

In the springtime, after spawning, rock sole begin actively feeding and commence a migration to the shallow waters of the continental shelf. This migration has been observed on both the eastern (Alton and Sample, 1975) and western (Shvetsov 1978) areas of the Bering Sea. During this time they spread out and form much less dense concentrations than during the spawning period . Summertime trawl surveys indicate most of the population can be found at depths from 50-100 m (Armistead and Nichol 1993). The movement from winter/spring to summer grounds is in response to warmer temperatures in the shallow waters and the distribution of prey on the shelf seafloor (Shvetsov 1978). In September, with the onset of cooling in the northern latitudes, rock sole begin the return migration to the deeper wintering grounds. Fecundity varies with size and was reported to be 450,00 eggs for fish 42 cm long. Larvae are pelagic but their occurrence in plankton surveys in the eastern Bering Sea are rare (Musienko 1963). Juveniles are separate from the adult population, remaining in shallow areas until they reach age 1 (Forrester 1969). The estimated age of 50% maturity is 9 yrs (approx. 35 cm) for southern rock sole females and 7 years for northern rock sole females (Stark and Somerton 2002). Natural mortality rate is believed to range from 0.18 - 0.20.

The approximate upper size limit of juvenile fish is 34cm.

D.7.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 4 and they are fully selected at age 11. Historically, the fishery has occurred throughout the mid and inner Bering Sea shelf during ice-free conditions and on spawning concentrations north of the Alaska Peninsula during winter for their high-value roe. They are caught as bycatch in Pacific cod, bottom Pollock, yellowfin sole and other flatfish fisheries and are caught with these species and Pacific halibut in rock sole directed fisheries.

D.7.3 Relevant Trophic Information

Groundfish predators include Pacific cod, walleye pollock, skates, Pacific halibut and yellowfin sole, mostly on fish ranging from 5 to 15 cm standard length.

D.7.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, juveniles inhabit shallow areas at least until age 1.

Adults: Summertime feeding on primarily sandy substrates of the eastern Bering Sea shelf. Widespread distribution mainly on the middle and inner portion of the shelf, feeding on bivalves, polychaete, amphipods and miscellaneous crustaceans. Wintertime migration to deeper waters of the shelf margin for spawning and to avoid extreme cold water temperatures, feeding diminishes.

Habitat and Biological Associations: Rock sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	OCS	D			
Larvae	2-3 months?	U phyto/zoo plankton?	winter/spring	OCS, MCS, ICS	P			
Early Juveniles	to 3.5 yrs	polychaete bivalves amphipods misc. crust.	all year	BAY, ICS	D	S[1] G		
Late Juveniles	to 9 years	polychaete bivalves amphipods misc. crust.	all year	BAY, ICS, MCS, OCS	D	S[1] G		
Adults	9+ years	polychaete bivalves amphipods misc. crust.	Feeding May-September Spawning Dec.-April	MCS, ICS OCS	D	S[1] G	ice edge	

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D.8 Alaska Plaice (Pleuronectes quadrituberculatus)

Formerly a constituent of the "other flatfish" management category, Alaska plaice were split out in recent years and are managed as a separate stock.

D.8.1 Life History and General Distribution

Alaska plaice inhabit continental shelf waters of the North Pacific ranging from the Gulf of Alaska to the Bering and Chukchi Seas and in Asian waters as far south as Peter the Great Bay (Pertseva-Ostroumova 1961; Quast and Hall 1972). Adults exhibit a benthic lifestyle and live year round on the shelf and move seasonally within its limits (Fadeev 1965). From over-winter grounds near the shelf margins, adults begin a migration onto the central and northern shelf of the eastern Bering Sea, primarily at depths of less than 100 m. Spawning usually occurs in March and April on hard sandy ground (Zhang 1987). The eggs and larvae are pelagic and transparent and have been found in ichthyoplankton sampling in late spring and early summer over a widespread area of the continental shelf (Waldron and Favorite 1977).

Fecundity estimates (Fadeev 1965) indicate female fish produce an average of 56 thousand eggs at lengths of 28 to 30 cm and 313 thousand eggs at lengths of 48 to 50 cm. The age or size at metamorphosis is unknown. The estimated length of 50% maturity is 32 cm from collections made in March and 28 cm from April, which corresponds to an age of 6 to 7 years. Natural mortality rate estimates range from 0.19 to 0.22 (Wilderbuer and Zhang 1999).

The approximate upper size limit of juvenile fish is 27cm.

D.8.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 6 and they are fully selected at age 12. The fishery occurs throughout the mid and inner Bering Sea shelf during ice-free conditions .In recent years catches have been low due to a lack of targeting and they are now primarily caught as bycatch in Pacific cod, bottom pollock, yellowfin sole and other flatfish fisheries and are caught with these species and Pacific halibut the directed fishery.

D.8.3 Relevant Trophic Information

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

D.8.4 Habitat and Biological Associations

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 polychaete, amphipods and echiurids (Livingston and DeReynier 1996). Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures. Feeding diminishes until spring after spawning.

Habitat and Biological Associations: Alaska plaice

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	spring and summer	ICS, MCS OCS	P			
Larvae	2-4 months?	U phyto/zoo plankton?	spring and summer	ICS, MCS	P			
Juveniles	up to 7 years	polychaete amphipods echiurids	all year	ICS, MCS	D	S+M[1]		
Adults	7+ years	polychaete amphipods echiurids	Spawning March-May Non-spawning and feeding June.-February	ICS, MCS ICS, MCS	D	S+M[1]	 ice edge	

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

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D.9 Rex sole (Glyptocephalus zachirus)

Rex sole are a constituent of the "other flatfish" management category in the BSAI where they are less abundant than in the Gulf of Alaska.

Other members of the "other flatfish" category include:

Dover sole (*Microstomus pacificus*)

Starry flounder (*Platichthys stellatus*)

Longhead dab (*Pleuronectes proboscidea*)

Butter sole (*Pleuronectes isolepis*)

D.9.1 Life History and General Distribution

Distributed from Baja California to the Bering Sea and western Aleutian Islands (Hart 1973, Miller and Lea 1972), and are widely distributed throughout the Gulf of Alaska. Adults exhibit a benthic lifestyle and are generally found in water deeper than 300 meters. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year. The spawning period off Oregon is reported to range from January through June with a peak in March and April (Hosie and Horton 1977). Spawning in the Gulf of Alaska was observed from February through July, with a peak period in April and May (Hirschberger and Smith 1983). Eggs have been collected in neuston and bongo nets mainly in the summer, east of Kodiak Island (Kendall and Dunn 1985), but the duration of the incubation period is unknown.. Larvae were captured in bongo nets only in summer over midshelf and slope areas (Kendall and Dunn 1985). Fecundity estimates from samples collected off the Oregon coast ranged from 3,900 to 238,100 ova for fish 24-59 cm (Hosie and Horton 1977). The age or size at metamorphosis is unknown Maturity studies from Oregon indicate that males were 50% mature at 16 cm and females at 24 cm. Juveniles less than 15 cm are rarely found with the adult population. The natural mortality rate used in recent stock assessments is 0.2 (Spencer et al. 2002).

The approximate upper size limit of juvenile fish is 15cm for males and 23cm for females.

D.9.2 Fishery

Caught in bottom trawls mostly in the pursuit of other bottom-dwelling species. Recruitment begins at about age 3 or 4. They are caught as bycatch in the Pacific ocean perch, Pacific cod, bottom pollock and other flatfish fisheries.

D.9.3 Relevant Trophic Information

Groundfish predators include Pacific cod and most likely arrowtooth flounder.

D.9.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for an unknown time period until metamorphosis occurs, juvenile distribution is unknown.

Adults: Spring spawning and summer feeding on a combination of sand, mud and gravel substrates of the continental shelf. Widespread distribution mainly on the middle and outer portion of the shelf, feeding mainly on polychaete, amphipods, euphausids and snow crabs.

Habitat and Biological Associations: Rex sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	Feb - May	ICS? MCS, OCS	P			
Larvae	U	U phyto/zoo plankton?	spring summer	ICS? MCS, OCS	P			
Juveniles	2 years	polychaete amphipods euphausiids Tanner crab	all year	MCS, ICS, OCS	D	G, S, M		
Adults	2+ years	polychaete amphipods euphausiids Tanner crab	Spawning Feb-May Non-spawning May-January	MCS, OCS USP MCS, OCS, USP	D	G, S, M		

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D.10 Dover sole (Microstomus pacificus)

D.10.1 Life History and General Distribution

Dover sole are distributed in deep waters of the continental shelf and upper slope from northern Baja California to the Bering Sea and the western Aleutian Islands (Hart 1973, Miller and Lea 1972), and exhibit a widespread distribution throughout the Gulf of Alaska. Adults are demersal and are mostly found in water deeper than 300 meters. The spawning period off Oregon is reported to range from January through May (Hunter et al. 1992). Spawning in the Gulf of Alaska has been observed from January through August, with a peak period in May (Hirschberger and Smith 1983). Eggs have been collected in neuston and bongo nets in the summer, east of Kodiak Island (Kendall and Dunn 1985), but the duration of the incubation period is unknown. Larvae were captured in bongo nets only in summer over mid-shelf and slope areas (Kendall and Dunn 1985). The age or size at metamorphosis is unknown but the pelagic larval period is known to be protracted and may last as long as two years (Markle et al. 1992). Pelagic postlarvae as large as 48 mm have been reported and the young may still be pelagic at 10 cm (Hart 1973). Dover sole are batch spawners and Hunter et al. (1992) concluded that the average 1 kg. female spawns its 83,000 advanced yolked oocytes in about nine batches. Maturity studies from Oregon indicate that females were 50% mature at 33 cm total length. Juveniles less than 25 cm are rarely found with the adult population from bottom trawl surveys (Martin and Clausen 1995). The natural mortality rate used in recent stock assessments is 0.2 (Turnock et al. 1996).

The approximate upper size limit of juvenile fish is 32cm.

D.10.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 5. They are caught as bycatch in the rex sole, thornyhead and sablefish fisheries and are caught with these species and Pacific halibut in Dover sole directed fisheries.

D.10.3 Relevant Trophic Information

Groundfish predators include Pacific cod and most likely arrowtooth flounder.

D.10.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for up to 2 years until metamorphosis occurs, juvenile distribution is unknown.

Adults: Winter and spring spawning and summer feeding on soft substrates (combination of sand and mud) of the continental shelf and upper slope. Shallower summer distribution mainly on the middle to outer portion of the shelf and upper slope, feeding mainly on polychaete, annelids, crustaceans and molluscs (Livingston and Goiney 1983).

Habitat and Biological Associations: Dover sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	spring summer	ICS? MCS, OCS, UCS	P			
Larvae	up to 2 years	U phyto/ zooplankton?	all year	ICS? MCS, OCS, UCS	P			
Early Juveniles	to 3 years	polychaetes amphipods annelids	all year	MCS? ICS?	D	S, M		
Late Juveniles	3-5 years	polychaetes amphipods annelids	all year	MCS? ICS?	D	S, M		
Adults	5+ years	polychaetes amphipods annelids molluscs	spawning Jan-August non-spawning July-Jan	MCS, OCS, UCS	D	S, M		

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D.11 Flathead sole (Hippoglossoides elassodon)

D.11.1 Life History and General Distribution

Distributed from northern California, off Point Reyes, northward along the west coast of North America and throughout the Gulf of Alaska and the Bering Sea, the Kuril Islands and possibly the Okhotsk Sea (Hart 1973).

Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf and in the Gulf of Alaska. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year for feeding. The spawning period may range from as early as January but is known to occur in March and April, primarily in deeper waters near the margins of the continental shelf. Eggs are large (2.75-3.75 mm) and females have egg counts ranging from about 72,000 (20 cm fish) to almost 600,000 (38 cm fish). Eggs hatch in 9 to 20 days depending on incubation temperatures within the range of 2.4 to 9.8°C (Forrester and Alderdice 1967) and have been found in ichthyoplankton sampling on the southern portion of the Bering Sea shelf in April and May (Waldron 1981). Larvae absorb the yolk sac in 6 to 17 days but the extent of their distribution is unknown. The age or size at metamorphosis is unknown as well as the age at 50% maturity. Juveniles less than age 2 have not been found with the adult population, remaining in shallow areas. The natural mortality rate used in recent stock assessments is 0.2 (Spencer et al. 2002).

D.11.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 3. Historically, the fishery has occurred throughout the mid and outer Bering Sea shelf during ice-free conditions (mostly summer and fall). They are caught as bycatch in Pacific cod, bottom pollock and other flatfish fisheries and are caught with these species and Pacific halibut in flathead sole directed fisheries.

D.11.3 Relevant Trophic Information

Groundfish predators include Pacific cod, Pacific halibut, arrowtooth flounder and also cannibalism by large flathead sole, mostly on fish less than 20 cm standard length (Livingston and DeReynier 1996).

D.11.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for an unknown time period until metamorphosis occurs, usually inhabiting shallow areas.

Adults: Winter spawning and summer feeding on sand and mud substrates of the continental shelf. Widespread distribution mainly on the middle and outer portion of the shelf, feeding mainly on ophiuroids, tanner crab, osmerids, bivalves and polychaete (Pakunski 1990).

Habitat and Biological Associations: Flathead sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	ICS, MCS, OCS	P			
Larvae	U	U phyto/zoo plankton?	spring summer	ICS, MCS, OCS	P			
Early Juveniles	to 2 yrs	polychaete bivalves ophiuroids	all year	MCS, ICS	D	S+M[1]		
Late	3 yrs	polychaete bivalves ophiuroids pollock and Tanner crab	all year	MCS, ICS, OCS	D	S+M[1]	Juveniles	
Adults	U	polychaete bivalves ophiuroids pollock and Tanner crab	Spawning Jan-April non-spawning May-December	MCS, OCS, ICS	D	S+M[1]	ice edge	

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D.12 Pacific ocean perch (*Sebastes alutus*)

D.12.1 Life History and General Distribution

Pacific ocean perch has a wide distribution in the North Pacific from southern California around the Pacific rim to northern Honshu Is., Japan, including the Bering Sea. The species appears to be most abundant in northern British Columbia, the Gulf of Alaska, and the Aleutian Islands. Adults are found primarily offshore along the continental slope in depths 180-420 m. Seasonal differences in depth distribution have been noted by many investigators. In the summer, adults inhabit shallower depths, especially those between 180 and 250 m. In the fall, the fish apparently migrate farther offshore to depths of ~300-420 m. They reside in these deeper depths until about May, when they return to their shallower summer distribution. This seasonal pattern is probably related to summer feeding and winter spawning. Although small numbers of Pacific ocean perch are dispersed throughout their preferred depth range on the continental slope, most of the population occurs in patchy, localized aggregations. At present, the best evidence indicates that Pacific ocean perch is mostly a demersal species. A number of investigators have speculated that there is also a pelagic component to their distribution, especially at night when they may move off-bottom to feed, but hard evidence for this is lacking.

There is much uncertainty about the life history of Pacific ocean perch, although generally more is known than for other rockfish species. The species appears to be viviparous, with internal fertilization and the release of live young. Insemination occurs in the fall, and sperm are retained within the female until fertilization takes place ~2 months later. The eggs develop and hatch internally, and parturition (release of larvae) occurs in April-May. Information on early life history is very sparse, especially for the first year of life. Positive identification of Pacific ocean perch larvae is not possible at present, but the larvae are thought to be pelagic and to drift with the current. Transformation to an adult form and the assumption of a demersal existence may take place within the first year. Small juveniles probably reside inshore in very rocky, high relief areas, and by age 3 begin to migrate to deeper offshore waters of the continental shelf. As they grow, they continue to migrate deeper, eventually reaching the continental slope, where they attain adulthood.

Pacific ocean perch is a very slow growing species, with a low rate of natural mortality (estimated at 0.05), a relatively old age at 50% maturity (10.5 years for females in the Gulf of Alaska), and a very old maximum age of 98 years in Alaska. Despite their viviparous nature, the fish is relatively fecund with number of eggs/female in Alaska ranging from 10,000-300,000, depending upon size of the fish.

For Gulf of Alaska, the approximate upper size limit of juvenile fish is: 38 cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of Sebastes. For Aleutian Islands and Bering Sea: unknown for both sexes.

D.12.2 Fishery

Pacific ocean perch are caught almost exclusively with bottom trawls. Age at 50% recruitment has been estimated to be about 6.6 years. The fishery is concentrated in the summer months due to management regulations and opens in July, when most of the harvest is taken. Harvest data from 2000-2002 indicates that approximately 80% of the POP in the BSAI are harvested during this month; there is no directed fishing for POP in the EBS management area. The harvest of POP is distributed across the Aleutian Islands subareas in proportion to relative biomass. From 2000-2002, approximately 44% of the harvest occurred in area 543, with 23% and 26% in the eastern and central Aleutians, respectively. POP are patchily distributed, and are harvested in relatively few areas within the broad management subareas of the Aleutian Islands.

The 2000-2002 blend data indicates that about 15% of the harvested BSAI POP is obtained as bycatch in the Atka mackerel fishery, with ~80% of the harvest of POP occurring in the POP fishery. Similarly, BSAI POP target fishery consists largely of POP, with percentages ranging from 71% to 91% from 2000 to 2002. Other species obtained as bycatch in the BSAI POP fishery include Atka mackerel, arrowtooth flounder, walleye pollock, northern rockfish, and shortraker/rougheye.

D.12.3 Relevant Trophic Information

All food studies of Pacific Ocean perch have shown them to be overwhelmingly planktivorous. Small juveniles eat mostly calanoid copepods, whereas larger juveniles and adults consume euphausiids as their major prey items. Adults, to a much lesser extent, may also eat small shrimp and squids. It has been suggested that Pacific ocean perch and walleye pollock compete for the same euphausiid prey. Consequently, the large removals of Pacific ocean perch by foreign fishermen in the Gulf of Alaska in the 1960s may have allowed walleye pollock stocks to greatly expand in abundance.

Documented predators of adult Pacific ocean perch include Pacific halibut and sablefish, and it is likely that Pacific cod and arrowtooth flounder also prey on Pacific ocean perch. Pelagic juveniles are consumed by salmon, and benthic juveniles are eaten by lingcod and other large demersal fish.

D.12.4 Habitat and Biological Associations

Egg/Spawning: Little information is known. Insemination is thought to occur after adults move to deeper offshore waters in the fall. Parturition is reported to occur from 20-30 m off bottom at depths of 360-400 m.

Larvae: Little information is known. Earlier information suggested that after parturition, larvae rise quickly to near surface, where they become part of the plankton. More recent data from British Columbia indicates that larvae may remain at depths >175 m for some period of time (perhaps two months), after which they slowly migrate upward in the water column.

Juveniles: Again, information is very sparse, especially for younger juveniles. After metamorphosis from the larval stage, juveniles may reside in a pelagic stage for an unknown length of time. They eventually become demersal, and at age 1-3 probably live in very rocky inshore areas. Afterward, they move to progressively deeper waters of the continental shelf. Older juveniles are often found together with adults at shallower locations of the continental slope in the summer months.

Adults: Commercial fishery data have consistently indicated that adult Pacific ocean perch are found in aggregations over reasonably smooth, trawlable bottom of the continental slope. Generally, they are found in shallower depths (180-250 m) in the summer, and deeper (300-420 m) in the fall, winter, and early spring. In addition, investigators in the 1960s and 1970s speculated that the fish sometimes inhabited the mid-water environment off bottom and also might be found in rough, untrawlable areas. Hard evidence to support these latter two conjectures, however, has been lacking. The best information available at present suggests that adult Pacific ocean perch is mostly a demersal species that prefers a flat, pebbled substrate along the continental slope. More research is needed, however, before definitive conclusions can be drawn as to its habitat preferences.

Habitat and Biological Associations: Pacific ocean perch

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	Internal incubation; ~90 d	NA	Winter	NA	NA	NA	NA	NA
Larvae	U; assumed between 60 and 180 days	U; assumed to be micro-zooplankton	Spring-summer	ICS, MCS, OCS, USP, LSP, BSN	P	NA	U	U
Juveniles	3-6 months to 10 years	Early juv: calanoid copepods; late juv: euphausiids	All year	ICS, MCS, OCS, USP	?P (early juv. only), D	R (<age 3)	U	U
Adults	10-98 years of age	Euphausiids	Insemination (fall); Fertilization, incubation (winter); Larval release (spring); Feeding in shallower depths (summer)	OCS, USP	D	CB, G,?M, ?SM,?MS	U	U

D.12.5 Additional sources of information

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D.13 Northern Rockfish (*Sebastes polyspinus*)

D.13.1 Life History and General Distribution

Northern rockfish range from northern British Columbia through the Gulf of Alaska and Aleutian Islands to eastern Kamchatka, including the Bering Sea. The species is most abundant from about Portlock Bank in the central Gulf of Alaska to the western end of the Aleutian Islands. Within this range, adult fish appear to be concentrated at discrete, relatively shallow offshore banks of the outer continental shelf. Typically, these banks are separated from land by an intervening stretch of deeper water. The preferred depth range is ~75-125 m in the Gulf of Alaska, and ~100-150 m in the Aleutian Islands. The fish appear to be demersal, although small numbers are occasionally taken in pelagic tows. In common with many other rockfish species, northern rockfish tend to have a localized, patchy distribution, even within their preferred habitat, and most of the population occurs in aggregations. Most of what is known about northern rockfish is based on data collected during the summer months from the commercial fishery or in research surveys. Consequently, there is little information on seasonal movements or changes in distribution for this species.

Life history information on northern rockfish is extremely sparse. The fish are assumed to be viviparous, as are other Sebastes, with internal fertilization and incubation of eggs. Observations during research surveys in the Gulf of Alaska suggest that parturition (larval release) occurs in the spring, and is mostly completed by summer. Pre-extrusion larvae have been described, but field-collected larvae cannot be identified to species at present. Length of the larval stage is unknown, but the fish apparently metamorphose to a pelagic juvenile stage, which also has been described. There is no information on when the juveniles become benthic or what habitat they occupy. Older juveniles are found on the continental shelf, generally at locations inshore of the adult habitat.

Northern rockfish is a slow growing species, with a low rate of natural mortality (estimated at 0.06), a relatively old age at 50% maturity (12.8 years for females in the Gulf of Alaska), and an old maximum age of 57 years in Alaska. No information on fecundity is available.

For Gulf of Alaska: 38 cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of *Sebastes*. For Aleutian Islands and Bering Sea: unknown for both sexes. Because northern rockfish in the Aleutian Islands attain a much smaller size than in the Gulf, the upper size limit of juveniles there is probably much less than in the Gulf.

D.13.2 Fishery

In the BSAI area, there is no directed fishery for northern rockfish. Harvest data from 2000-2002 indicates that approximately 90% of the BSAI northern rockfish are harvested in the Atka mackerel fishery, with a large amount of the catch occurring in September in the western Aleutians (area 543). The distribution of northern rockfish harvest by Aleutian Islands subarea reflects both the spatial regulation of the Atka mackerel fishery and the increased biomass of northern rockfish in the western Aleutian Islands. The average proportion of northern rockfish biomass occurring in the western, central, and eastern Aleutian Islands, based on trawl surveys from 1991-2002, were 72%, 22% and 5%, respectively. Northern rockfish are patchily distributed, and are harvested in relatively few areas within the broad management subareas of the Aleutian Islands, with important fishing grounds being Petral Bank, Sturdevant Rock, south of Amchitka I., and Seguam Pass (Dave Clausen, NMFS-AFSC, personal communication).

D.13.3 Relevant Trophic Information

Although no comprehensive food study of northern rockfish has been done, several smaller studies have all shown euphausiids to be the predominate food item of adults in both the Gulf of Alaska and Bering Sea. Copepods, hermit crabs, and shrimp have also been noted as prey items in much smaller quantities.

Predators of northern rockfish have not been documented, but likely include species that are known to consume rockfish in Alaska, such as Pacific halibut, sablefish, Pacific cod, and arrowtooth founder.

D.13.4 Habitat and Biological Associations

Egg/Spawning: No information known, except that parturition probably occurs in the spring.

Larvae: No information known.

Juveniles: No information known for small juveniles (<20 cm), except that juveniles apparently undergo a pelagic phase immediately after metamorphosis from the larval stage. Larger juveniles have been taken in bottom trawls at various localities of the continental shelf, usually inshore of the adult fishing grounds.

Adults: Commercial fishery and research survey data have consistently indicated that adult northern rockfish are primarily found over reasonably flat, trawlable bottom of offshore banks of the outer continental shelf at depths of 75-150 m. Preferred substrate in this habitat has not been documented, but observations from trawl surveys suggest that large catches of northern rockfish are often associated with hard bottoms. Generally, the fish appear to be demersal, and most of the population occurs in large aggregations. There is no information on seasonal migrations. Northern rockfish often co-occur with dusky rockfish.

Habitat and Biological Associations: Northern Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	NA	U	NA	NA	NA	NA	NA
Larvae	U	U	?Spring-summer	U	P (assumed)	NA	U	U
Early Juveniles	From end of larval stage to ?	U	All year	ICS, MCS, OCS	?P (early juv. only), D	U (juv.<20 cm); substrate (juv.>20 cm)	U	U
Late Juveniles	to 13 yrs	U	All year	OCS		CB, R	U	U
Adults	13-57 years of age	Euphausiids	U, except that larval release is probably in the spring in the Gulf of Alaska	OCS, USP	SD	CB, R	U	U

D.13.5 Additional sources of information

Eggs and Larvae

None at present

Older juveniles and adults

NMFS, Alaska Fisheries Science Center, Auke Bay Laboratory, David Clausen, (907) 789-6049.

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D.14 Shortraker Rockfish (*Sebastes borealis*) and Rougheye Rockfish (*Sebastes aleutianus*)

D.14.1 Life History and General Distribution

Shortraker and rougheye rockfishes are found along the northwest slope of the eastern Bering Sea, throughout the Aleutian Islands and south to Point Conception, California. Both species are demersal and can be found at depths ranging from 25 to 875 m; however, commercial concentrations usually occur at depths from 300 to 500 m. Though relatively little is known about their biology and life history, both species appear to be K-selected with late maturation, slow growth, extreme longevity, and low natural mortality. Rougheye rockfish attain maturity relatively late in life, at about 20+ years of age. Both species are among the largest *Sebastes* species in Alaskan waters, attaining sizes of up to 104 cm for shortraker and 96 cm for rougheye rockfish. Shortraker rockfish have been estimated to attain ages in excess of 120 years and rougheye rockfish in excess of 140 years. Natural mortality for both species is low, estimated to be on the order of 0.01 to 0.04.

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

D.14.2 Fishery

A directed fishery does not exist for shortraker rockfish or rougheye rockfish in the BSAI area. Harvest data from 2000-2000 indicates that over 90% of the harvest of BSAI shortraker and rougheye rockfish is taken in the Aleutian Islands, with the proportion among the three subareas ranging from 26% to 34%. Rougheye and shortraker rockfish are most commonly caught in July, with 58% of the harvest from 2000-2002, and the bulk of this harvest is obtained as bycatch in the POP trawl fishery. Rougheye and shortraker are also caught in the sablefish longline fishery, particularly in the eastern and central Aleutian Islands, and in the Pacific cod longline fishery, particularly in the central and western Aleutians.

D.14.3 Relevant Trophic Information

Shortraker and rougheye rockfishes prey primarily on shrimps, squids, and myctophids. It is uncertain what are the main predators on both species.

D.14.4 Habitat and Biological Associations

Egg/Spawning: The timing of reproductive events is apparently protracted. One study indicated that vitellogenesis was present for four to five months and lasted from about July until late October and November. Parturition apparently occurs mainly in early spring through summer.

Larvae: No information is available regarding the habitats and biological associations of shortraker and rougheye rockfish larvae.

Juveniles: Very little information is available regarding the habitats and biological associations of shortraker and rougheye rockfish juveniles. It is suspected, however, that the juveniles of both species occupy shallower habitats than that of the adults.

Adults: Adults are demersal and can be found at depths ranging from 25 to 875 m. Submersible observations indicate that adults occur over a wide range of habitats. Soft substrates of sand or mud usually had the highest densities; whereas hard substrates of bedrock, cobble or pebble usually had the lowest adult densities. Habitats with steep slopes and frequent boulders were used at a higher rate than habitats with gradual slopes and few boulders.

Habitat and Biological Associations: Shortraker and Rougheye Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	U	U	U	U	U	U	
Larvae	U	U	Spawning: Early spring through summer	U	U	U	U	
Early Juveniles	U	U Shrimp & amphipods?	U	U, MCS, OCS?	U	U	U	
Late Juveniles								
Adults	15+ yrs of age	Shrimp Squid Myctophids	Year-round?	OCS, USP	D	M, S, R, SM, CB, MS, G	U	

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D.15 Thornyhead Rockfish (*Sebastolobus sp.*)

D.15.1 Life History and General Distribution

Thornyheads of the northeastern Pacific Ocean are comprised of two species, the shortspine thornyhead (*Sebastolobus alascanus*) and the longspine thornyhead (*S. altivelis*). The longspine thornyhead is not common in the Gulf of Alaska. The shortspine thornyhead is a demersal species which inhabits deep waters from 93 to 1,460 m from the Bering Sea to Baja California. This species is common throughout the Gulf of Alaska, eastern Bering Sea and Aleutian Islands. The population structure of shortspine thornyheads, however, is not well defined. Thornyheads are slow-growing and long-lived with maximum age in excess of 50 years and maximum size greater than 75 cm and 2 kg. Thornyheads spawn buoyant masses of eggs during the late winter and early spring that resemble bilobate “balloons” which float to the surface (Pearcy 1962). Juvenile shortspine thornyheads have a pelagic period of about 14-15 months and settle out on the shelf (100 m) at about 22 to 27 mm (Moser 1974). Fifty percent of female shortspine thornyheads are sexually mature at about 21 cm and 12-13 years of age.

The approximate upper size limit of juvenile fish is 27 mm at the pelagic stage, and 60 mm at the benthic stage (see Moser 1974). Female shortspine thornyheads appear to be mature at about 21-22 cm (Miller 1985).

D.15.2 Fishery

Trawl and longline gear are the primary methods of harvest. The bulk of the fishery occurs in late winter or early spring through the summer. In the past, this species was seldom the target of a directed fishery. Today thornyheads are one of the most valuable of the rockfish species, with most of the domestic harvest exported to Japan. Thornyheads are taken with some frequency in the longline fishery for sablefish and cod and is often part of the bycatch of trawlers concentrating on pollock and Pacific ocean perch.

D.15.3 Relevant Trophic Information

Shortspine thornyheads prey mainly on epibenthic shrimp and fish. Yang (1996, 2003) showed that shrimp were the top prey item for shortspine thornyheads in the Gulf of Alaska; whereas, cottids were the most important prey item in the Aleutian Islands region. Differences in abundance of the main prey between the two areas might be the main reason for the observed diet differences. Predator size might by another reason for the difference since the average shortspine thornyhead in the Aleutian Islands area was larger than that in the Gulf of Alaska (33.4 cm vs 29.7 cm).

D.15.4 Habitat and Biological Associations

Egg/Spawning: Eggs float in masses of various sizes and shapes. Frequently the masses are bilobed with the lobes 15 cm to 61 cm in length, consisting of hollow conical sheaths containing a single layer of eggs in a gelatinous matrix. The masses are transparent and not readily observed in the daylight. Eggs are 1.2 to 1.4 mm in diameter with a 0.2 mm oil globule. They move freely in the matrix. Complete hatching time is unknown but is probably more than 10 days.

Larvae: Three day-old larvae are about 3 mm long and apparently float to the surface. It is believed that the larvae remain in the water column for about 14-15 months before settling to the bottom.

Juveniles: Very little information is available regarding the habitats and biological associations of juvenile shortspine thornyheads.

Adults: Adults are demersal and can be found at depths ranging from about 90 to 1,500 m. Groundfish species commonly associated with thornyheads include: arrowtooth flounder (*Atheresthes stomias*), Pacific ocean perch (*Sebastes alutus*), sablefish (*Anoplopoma fimbria*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), shortraker rockfish (*Sebastes borealis*), rougheye rockfish (*Sebastes aleutianus*), and grenadiers (family Macrouridae). Two congeneric thornyhead species, the longspine thornyhead (*Sebastolobus altivelis*) and a species common off of Japan , *S. Macrochir*, are infrequently encountered in the Gulf of Alaska.

Habitat and Biological Associations: Thornyheads

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	U	Spawning: Late winter and early spring	U	P	U	U	
Larvae	<15 Months	U	Early spring through summer	U	P	U	U	
Juveniles	> 15 months when settling to bottom occurs (?)	U Shrimp, Amphipods, Mysids, Euphausiids?	U	MCS, OCS, USP	D	M, S, R, SM, CB, MS, G	U	
Adults	U	Shrimp Fish (cottids), Small crabs	Year-round?	MCS, OCS, USP, LSP	D	M, S, R, SM, CB, MS, G	U	

D.15.5 Additional sources of information

NMFS Alaska Fisheries Science Center

D.15.6 Literature

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D.16 Light Dusky Rockfish (*Sebastes cilianus*)

Note: The taxonomy of dusky rockfish is unclear. Two varieties occur which are likely distinct species: an inshore, shallow water, dark-colored variety; and a lighter-colored variety found in deeper water offshore. A taxonomic study is in progress that will probably describe the light variety as a new species. To avoid confusion, and because the light variety appears to be more abundant and is the object of a large, directed trawl fishery, this discussion of essential habitat will deal only with "light" dusky rockfish.

D.16.1 Life History and General Distribution

Light dusky rockfish range from Dixon Entrance at the U.S./Canada boundary, around the arc of the Gulf of Alaska, and westward throughout the Aleutian Islands. They are also found in the eastern Bering Sea north to about Zhemchug Canyon west of the Pribilof Is. Their distribution south of Dixon Entrance in Canadian waters is uncertain; dusky rockfish have been reported as far south as Johnstone Strait, Vancouver Is., but it is likely these were of the dark variety. The center of abundance for light dusky rockfish appears to be the Gulf of Alaska (Reuter 1999). The species is much less abundant in the Aleutian Islands and Bering Sea (Reuter and Spencer 2002). Adult light dusky rockfish have a very patchy distribution, and are usually found in large aggregations at specific localities of the outer continental shelf. These localities are often relatively shallow offshore banks. Because the fish are taken with bottom trawls, they are presumed to be mostly demersal. Whether they also have a pelagic distribution is unknown, but there is no evidence of a pelagic tendency based on the information available at present. Most of what is known about light dusky rockfish is based on data collected during the summer months from the commercial fishery or in research surveys. Consequently, there is little information on seasonal movements or changes in distribution for this species.

Life history information on light dusky rockfish is extremely sparse. The fish are assumed to be viviparous, as are other *Sebastes*, with internal fertilization and incubation of eggs. Observations during research surveys in the Gulf of Alaska suggest that parturition (larval release) occurs in the spring, and is probably completed by summer. Another, older source, however, lists parturition as occurring "after May." Pre-extrusion larvae have been described, but field-collected larvae cannot be identified to species at present. Length of the larval stage, and whether a pelagic juvenile stage occurs, are unknown. There is no information on habitat and abundance of young juveniles (<25 cm fork length), as catches of these have been virtually nil in research surveys. Even the occurrence of older juveniles has been very uncommon in surveys, except for one year. In this latter instance, older juveniles were found on the continental shelf, generally at locations inshore of the adult habitat.

Light dusky rockfish is a slow growing species, with a low rate of natural mortality estimated at 0.09. However, it appears to be faster growing than many other rockfish species. Maximum age is 49-59 years. No information on age of maturity or fecundity is available.

The approximate upper size limit for juvenile fish is 47cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of *Sebastes*.

D.16.2 Fishery

Light dusky rockfish are caught almost exclusively with bottom trawls. Age at 50% recruitment is unknown. The fishery in the Gulf of Alaska in recent years has mostly occurred in the summer months, especially July, due to management regulations. Catches are concentrated at a number of relatively shallow, offshore banks of the outer continental shelf, especially the "W" grounds west of Yakutat, and Portlock Bank. Other fishing grounds include Albatross Bank, the "Snakehead" south of Kodiak Island, and Shumagin Bank. Outside of these banks, catches are generally sparse. Catch distribution by depth has not been summarized, but most of the fish are apparently taken at depths of 75-200 m. There is no directed fishery in the Aleutians and Bering Sea, and catches there have been generally sparse.

For NPFMC-managed species, the major bycatch species in the Gulf of Alaska light dusky rockfish trawl fishery in 1993-95 included (in descending order by percent): "other" species of slope rockfish, northern rockfish, and Pacific ocean perch. There is no information available on the bycatch of non-NPFMC-managed species in the Gulf of Alaska light dusky rockfish fishery.

D.16.3 Relevant Trophic Information

Although no comprehensive food study of light dusky rockfish has been done, one smaller study in the Gulf of Alaska showed euphausiids to be the predominate food item of adults. Larvaceans, cephalopods, pandalid shrimp, and hermit crabs were also consumed.

Predators of light dusky rockfish have not been documented, but likely include species that are known to consume rockfish in Alaska, such as Pacific halibut, sablefish, Pacific cod, and arrowtooth founder.

D.16.4 Habitat and Biological Associations

Egg/Spawning: No information known, except that parturition probably occurs in the spring, and may extend into summer.

Larvae: No information known.

Juveniles: No information known for small juveniles <25 cm fork length. Larger juveniles have been taken infrequently in bottom trawls at various localities of the continental shelf, usually inshore of the adult fishing grounds.

Adults: Commercial fishery and research survey data suggest that adult light dusky rockfish are primarily found over reasonably flat, trawlable bottom of offshore banks of the outer continental shelf at depths of 75-200 m. Type of substrate in this habitat has not been documented. During submersible dives on the outer shelf (40-50m) in the eastern Gulf, light dusky rockfish were observed in association with rocky habitats and in areas with extensive sponge beds where adult dusky rockfishes were observed resting in large vase sponges (Pers. Comm., V. O'Connell). Generally, the fish appear to be demersal, and most of the population occurs in large aggregations. Light dusky rockfish are the most highly aggregated of the rockfish species caught in Gulf of Alaska trawl surveys. Outside of these aggregations, the fish are sparsely distributed. Because the fish are taken with bottom trawls, they are presumed to be mostly demersal. Whether they also have a pelagic distribution is unknown, but there is no evidence of a pelagic tendency based on the information available at present. There is no information on seasonal migrations. Light dusky rockfish often co-occur with northern rockfish.

Habitat and Biological Associations: Light Dusky Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	NA	U	NA	NA	NA	NA	NA
Larvae	U	U	?Spring-summer	U	P (assumed)	NA	U	U
Early Juveniles	U	U	All year	ICS, MCS, OCS,	U (small juv.< 25 cm): ?D (Larger juv.)	U (juv.<25 cm); ?Trawlable substrate (juv.>25 cm)	U	U
Late Juveniles	U	U	U	U	U	CB, R, G	U	Observed associated with *primnoa* coral
Adults	Up to 49-50 years.	Euphausiids	U, except that larval release may be in the spring in the Gulf of Alaska	OCS, USP	SD, SP	CB, R, G	U	Observed associated with large vase type sponges

D.16.5 Additional sources of information

Eggs, Larvae, and Juveniles:

None at present.

Adults:

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D.17 Atka mackerel (*Pleurogrammus monopterygius*)

D.17.1 Life History and General Distribution

Distributed from the Gulf of Alaska to the Kamchatka Peninsula, most abundant along the Aleutians. Adult Atka mackerel occur in large localized aggregations usually at depths less than 200 m and generally over rough, rocky and uneven bottom near areas where tidal currents are swift. Adults are pelagic during much of the year, but migrate annually to moderately shallow waters where they become demersal during spawning. Spawning peaks in June through September, but may occur intermittently throughout the year. Atka mackerel deposit eggs in nests built and guarded by males on rocky substrates or on kelp in shallow water. Eggs hatch in 40-45 days, releasing planktonic larvae which have been found up to 800 km from shore. Little is known of the distribution of young Atka mackerel prior to their appearance in trawl surveys and the fishery at about age 2-3 years. Atka mackerel exhibit intermediate life history traits. R-traits include young age at maturity (approximately 50% are mature at age 3), fast growth rates, high natural mortality (M=0.3) and young average and maximum ages (about 5 and 14 years, respectively). K-selected traits include low fecundity (only about 30,000 eggs/female/year, large egg diameters (1-2 mm) and male nest-guarding behavior).

The approximate upper size limit of juvenile fish is 35cm.

D.17.2 Fishery

Bottom trawls, some pelagic trawling, recruit at about age 3, conducted in the Aleutian Islands and western GOA at depths between about 70-225 m, in trawlable areas on rocky, uneven bottom, along edges, and in lee of submerged hills during periods of high current. Currently, the fishery occurs on reefs west of Kiska Island, south and west of Amchitka Island, in Tanaga Pass and near the Delarof Islands, and south of Seguam and Umnak Islands. Historically fishery occurred east into the GOA as far as Kodiak Island (through the mid-1980s), but is no longer there. Fishery used to be entirely during summer, during spawning season; now occurs throughout the year. Very “clean” fishery; bycatch of other species is minimal.

D.17.3 Relevant Trophic Information

Important food for Steller sea lions in the Aleutian Islands, particularly during summer, and for other marine mammals (minke whales, Dall's porpoise and northern fur seal). Juveniles eaten by thick billed murres and tufted puffins. Main groundfish predators are Pacific halibut, arrowtooth flounder, and Pacific cod.

D.17.4 Habitat and Biological Associations

Egg/Spawning: Eggs deposited in nests built and guarded by males on rocky substrates or on kelp in shallow water.

Larvae/Juveniles: Planktonic larvae have been found up to 800 km from shore, usually in upper water column (neuston), but little is known of the distribution of Atka mackerel until they are about 2 years old and appear in fishery and surveys.

Adults: Adults occur in localized aggregations usually at depths less than 200 m and generally over rough, rocky and uneven bottom near areas where tidal currents are swift. Adults are semi-demersal/pelagic during much of the year, but migrate annually to moderately shallow waters where the males become demersal during spawning; females move between nesting and offshore feeding areas.

Habitat and Biological Associations: Atka mackerel

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	40-45 d	NA	summer	IP, ICS	D	GR, R, K	U	develop 3-20°C optimum 9-13°C
Larvae	up to 6 mos	U copepods?	fall-winter	U	U, N?	U	U	2-12°C optimum 5-7°C
Juveniles	½-2 yrs of age	U copepods & euphausiids?	all year	U	U	U	U	3-5°C
Adults	3+ yrs of age	copepods euphausiids meso-pelagic fish (myctophids)	Spawning (May-Oct) Non-spawning (Nov-Apr) tidal/diurnal, year-round?	ICS and MCS, IP MCS and OCS, IP ICS, MCS, OCS, IP	D (males) SD females SD/D all sexes D when currents high/day SD slack tides/night	GR, R, K	F, E	3-5°C all stages >17 ppt only

D.17.5 Additional sources of information

NMFS Alaska Fisheries Science Center

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D.18 Squid (*Cephalopoda*, *Teuthida*)

The species representatives for squid are:

Gonaditae:	Red or magistrate armhook squid (*Berryteuthis magister*)
Onychoteuthidae:	Boreal clubhook squid (*Onychoteuthis banksii borealjaponicus)*
	Giant or robust clubhook squid (*Moroteuthis robusta*)
Sepiolidae:	eastern Pacific bobtail squid (*Rossia pacifica*)

D.18.1 Life History and General Distribution:

Squid are members of the molluscan class Cephalopoda, along with octopus, cuttlefish and nautiloids. In the BSAI and GOA, gonatid and onychoteuthid squids are generally the most common, along with chiroteuthids. All cephalopods are stenohaline, occurring only at salinities > 30 ppt. Fertilization is internal, and development is direct ("larval" stages are only small versions of adults). The eggs of inshore neritic species are often enveloped in a gelatinous matrix attached to rocks, shells or other hard substrates, while the eggs of some offshore oceanic species are extruded as large, sausage-shaped drifting masses. Little is known of the seasonality of reproduction, but most species probably breed in spring-early summer, with eggs hatching during the summer. Most small squid are generally thought to live only 2-3 years, but the giant *Moroteuthis robusta* clearly lives longer.

> ***B magister*** is widely distributed in the boreal north Pacific from California, throughout the Bering Sea, to Japan in waters of depth 30-1500 m; adults most often found at mesopelagic depths or near bottom on shelf, rising to the surface at night; juveniles are widely distributed across shelf, slope and abyssal waters in meso- and epipelagic zones, and rise to surface at night. Migrates seasonally, moving northward and inshore in summer, and southward and offshore in winter, particularly in the western north Pacific. Maximum size: females-50 cm mantle length (ML); males-40 cm ML. Spermatophores transferred into the mantle cavity of female, and eggs are laid on the bottom on the upper slope (200-800 m). Fecundity estimated at 10,000 eggs/female. Spawning of eggs occurs in Feb-Mar in Japan, but apparently all year-round in the Bering Sea. Eggs hatch after 1-2 months of incubation; development is direct. Adults are gregarious prior to, and most die after mating.
>
> ***O. banksii borealjaponicus**,* an active, epipelagic species, is distributed in the north Pacific from the Sea of Japan, throughout the Aleutian Islands and south to California, but is absent from the Sea of Okhotsk and not common in the Bering Sea. Juveniles can be found over shelf waters at all depths and near shore. Adults apparently prefer the upper layers over slope and abyssal waters; diel migrators and gregarious. Development includes a larval stage; maximum size about 55 cm.
>
> ***M. robusta***, a giant squid, lives near the bottom on the slope, and mesopelagically over abyssal waters; rare on the shelf. It is distributed in all oceans, and is found in the Bering Sea, Aleutian Islands and Gulf of Alaska. Mantle length can be up to 2.5 m long; with tentacles, at least 7 m, but most are about 2 m long.
>
> ***R. pacifica*** is a small (maximum length with tentacles of less than 20 cm) demersal, neritic and shelf, boreal species, distributed from Japan to California in the North Pacific and in the Bering Sea in waters of about 20-300 m depth. Other *Rossia* spp. deposit demersal egg masses.

For *B. magister*, the approximate upper size limit of juvenile fish is 20 cm ML for males, 25 cm ML for females; both at approximately 1 year of age.

D.18.2 Fishery

Not currently a target of groundfish fisheries of BSAI or GOA. A Japanese fishery catching up to 9,000 mt of squid annually existed until the early 1980s for *B. magister* in the Bering Sea and *O. banksii borealjaponicus* in the Aleutian Islands. Since 1990, annual squid bycatch has been about 1,000 mt or less in the BSAI, and between 30-150 mt in the GOA; in the BSAI, almost all squid bycatch is in the midwater pollock fishery near the continental shelf break and slope, while in the GOA, trawl fisheries for rockfish and pollock (again mostly near the edge of the shelf and on the upper slope) catch most of the squid bycatch.

D.18.3 Relevant Trophic Information

The principal prey items of squid are small forage fish pelagic crustaceans (e.g., euphausiids and shrimp), and other cephalopods; cannibalism is not uncommon. After hatching, small planktonic zooplankton (copepods) are eaten. Squid are preyed upon by marine mammals, seabirds, and, to a lesser extent by fish, and occupy an important role in marine food webs worldwide. Perez (1990) estimated that squids comprise over 80% of the diets of sperm whales, bottlenose whales and beaked whales, and about half of the diet of Dall's porpoise in the eastern Bering Sea and Aleutian Islands. Seabirds (e.g., kittiwakes, puffins, murres) on island rookeries close to the shelf break (e.g., Buldir Island, Pribilof Islands) are also known to feed heavily on squid (Hatch et al. 1990; Byrd et al. 1992; Springer 1993). In the Gulf of Alaska, only about 5% or less of the diets of most groundfish consisted of squid (Yang 1993). However, squid play a larger role in the diet of salmon (Livingston and Goiney 1983).

D.18.4 Habitat and Biological Associations for B. magister

<u>Egg/Spawning</u>: Eggs are laid on the bottom on the upper slope (200-800 m); incubate for 1-2 months.

<u>Young Juveniles</u>: Distributed epipelagically (top 100 m) from the coast to open ocean.

<u>Old Juveniles and Adults</u>: Distributed mesopelagically (most from 150-500 m) on the shelf (summer only?), but mostly in outer shelf/slope waters (to lesser extent over the open ocean). Migrate to slope waters to mate and spawn demersally.

Habitat and Biological Associations: *Berryteuthis magister* (red squid)

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	1-2 months	NA	varies	USP, LSP	D	M, SM, MS	U	
Young juveniles	4-6 months	zooplankton		All shelf, slope, BSN	P, N	NA	UP, F?	
Older Juveniles and Adults	1-2 years (may be up to 4 yrs)	euphausiids, shrimp, small forage fish, and other cephalopods	summer	All shelf, USP, LSP, BSN	SP	U	UP, F?	Euhaline waters, 2-4°C
			winter	OS, USP, LSP, BSN	SP	U	UP, F?	

D.18.5 Additional sources of information

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D.19 Sculpins (*cottidae*)

The species representatives for sculpins are:

Yellow Irish lord (*Hemilepidotus jordani)*

Red Irish lord (*Hemilepidotus hemilepidotus*)

Butterfly sculpin (*Hemilepidotus papilio*)

Bigmouth sculpin (*Hemitripterus bolini*)

Great sculpin (*Myoxocephalus polyacanthocephalus*)

Plain sculpin (*Myoxocephalus jaok*)

D.19.1 Life History and General Distribution

The Cottidae (sculpins) is a large circumboreal family of demersal fishes inhabiting a wide range of habitats in the north Pacific Ocean and Bering Sea. Most species live in shallow water or in tidepools, but some inhabit the deeper waters (to 1000 m) of the continental shelf and slope. Most species do not attain a large size (generally 10-15 cm), but those that live on the continental shelf and are caught by fisheries can be 30-50 cm; the cabezon is the largest sculpin and can be as long as 100 cm. Most sculpins spawn in the winter. All species lay eggs, but in some genera, fertilization is internal. The female commonly lays demersal eggs amongst rocks where they are guarded by males. Egg incubation duration is unknown; larvae were found across broad areas of the shelf and slope, and were found all year-round, in ichthyoplankton collections from the southeast Bering Sea and Gulf of Alaska. Larvae exhibit diel vertical migration (near surface at night and at depth during the day). Sculpins generally eat small invertebrates (e.g., crabs, barnacles, mussels), but fish are included in the diet of larger species; larvae eat copepods.

Yellow Irish lords: distributed from subtidal areas near shore to the edge of the continental shelf (down to 200 m) throughout the Bering Sea, Aleutian Islands, and eastward into the GOA as far as Sitka, AK; up to 40 cm in length. 12-26 mm larvae collected in spring on the western GOA shelf.

Red Irish lords: distributed from rocky, intertidal areas to about 100 m depth on the middle continental shelf (most shallower than 50 m), from California (Monterey Bay) to Kamchatka; throughout the Bering Sea and Gulf of Alaska; rarely over 30 cm in length. Spawns masses of pink eggs in shallow water or intertidally. Larvae were 7-20 mm long in spring in the western GOA.

Butterfly sculpins: distributed primarily in the western north Pacific and northern Bering Sea, from Hokkaido, Japan, Sea of Okhotsk, Chukchi Sea, to southeast Bering Sea and in Aleutian Islands; depths of 20-250 m, most frequent 50-100 m.

Bigmouth sculpin: distributed in deeper waters offshore, between about 100-300 m in the Bering Sea, Aleutian Islands, and throughout the Gulf of Alaska; up to 70 cm in length.

Great sculpin: distributed from the intertidal to 200 m, but may be most common on sand and muddy/sand bottoms in moderate depths (50-100 m); up to 80 cm in length. Found throughout the Bering Sea, Aleutian Islands, and Gulf of Alaska, but may be less common east of Prince William Sound. *Myoxocephalus* spp. larvae ranged in length from 9-16 mm in spring ichthyoplankton collections in the western GOA.

Plain sculpin: distributed throughout the Bering Sea and Gulf of Alaska (not common in the Aleutian Islands) from intertidal areas to depths of about 100 m, but most common in shallow waters (<50 m); up to 50 cm in length. *Myoxocephalus* spp. larvae ranged in length from 9-16 mm in spring ichthyoplankton collections in the western GOA.

The approximate upper size limit of juvenile fish is unknown.

D.19.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but sculpin bycatch (second to skates in weight amongst the Other Species) has ranged from 6,000-11,000 mt per year in the BSAI from 1992-95, and 500-1,400 mt per year in the GOA. Bycatch occurs principally in bottom trawl fisheries for flatfish, Pacific cod and pollock, but also while longlining for Pacific cod; almost all is discarded. Annual sculpin bycatch in the BSAI ranges between 1-4% of annual survey biomass estimates, however little is known of the species distribution of the bycatch.

D.19.3 Relevant Trophic Information

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

D.19.4 Habitat and Biological Associations

Egg/Spawning: Lay demersal eggs in nests guarded by males; many species in rocky shallow waters near shore.

Larvae: Distributed pelagically and in neuston across broad areas of shelf and slope, but predominantly on inner and middle shelf; have been found all year-round.

Juveniles and Adults: Sculpins are demersal fish, and live in a broad range of habitats from rocky intertidal pools to muddy bottoms of the continental shelf, and rocky, upper slope areas. Most commercial bycatch occurs on middle and outer shelf areas used by bottom trawlers for Pacific cod and flatfish.

Habitat and Biological Associations: Sculpins

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	na	winter?	BCH, ICS (MSC, OSC?)	D	R (others?)	U	
Larvae	U	copepods	all year?	ICS, MSC, OCS, US	N, P	na?	U	
Juveniles and Adults	U	bottom invertebrates (crabs, molluscs, barnacles) and small fish	all year	BCH, ICS, MSC, OSC, US	D	R, S, M, SM	U	

D.19.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.19.6 Literature

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D.20 Sharks

The species representatives for sharks are:

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

D.20.1 Life History and General Distribution

Sharks of the order Squaliformes (which includes the two families Lamnidae and Squalidae) are the higher sharks with five gill slits and two dorsal fins. The Lamnidae are large, ovoviviparous (with small litters, 1-4; embryos nourished by intrauterine cannibalism), widely migrating sharks which are highly aggressive predators (salmon and white sharks). The Lamnidae are partly warm-blooded; the heavy trunk muscles are warmer than water for greater power and efficiency. Salmon sharks are distributed epipelagically along the shelf (can be found in shallow waters) from California through the Gulf of Alaska (where they occur all year and are probably most abundant in our area), the Bering Sea and off Japan. In groundfish fishery and survey data, occur chiefly on outer shelf/upper slope areas in the Bering Sea, but near coast to the outer shelf in the Gulf of Alaska, particularly near Kodiak Island. Not commonly seen in Aleutian Islands. They are believed to eat primarily fish, including salmon, sculpins and gadids, and can be up to 3 m in length.

The Pacific sleeper shark is distributed from California around the Pacific rim to Japan and in the Bering Sea principally on the outer shelf and upper slope (but has been observed nearshore), generally demersal (but also seen near surface). Other members of the Squalidae are ovoviviparous, but fertilization and development of sleeper sharks are not known; adults up to 8 m in length. Voracious, omnivorous predator of flatfish, cephalopods, rockfish, crabs, seals, salmon; may also prey on pinnipeds. In groundfish fishery and survey data, occur chiefly on outer shelf/upper slope areas in the Bering Sea, but near coast to the outer shelf in the Gulf of Alaska, particularly near Kodiak Island.

Spiny dogfish (or closely related species?) are widely distributed through the Atlantic, Pacific and Indian Oceans. In the north Pacific, may be most abundant in the Gulf of Alaska, but also common in the Bering Sea. Pelagic species, found at surface and to depths of 700 m; mostly 200 m or less on shelf and neritic; often found in aggregations. Ovoviviparous, with litter size proportional to size of female, from 2-9; gestation may be 22-24 months. Young are 24-30 cm at birth, with growth initially rapid, then slows dramatically. Maximum adult size is about 1.6 m, and 10 kg; maximum age about 40 years. 50% of females are mature at 94 cm and 29 years old; males, 72 cm and 19 years old. Females give birth in shallow coastal waters, usually in Sept-Jan. Dogfish eat a wide variety of foods, including fish (smelts, herring, sand lance, and other small schooling fish), crustaceans (crabs, euphausiids, shrimp), and cephalopods (octopus). Tagging experiments indicate local indigenous populations in some areas and widely migrating groups in others. May move inshore in summer and offshore in winter.

The approximate upper size limit of juvenile fish is unknown for salmon sharks and sleeper sharks; for spiny dogfish, it is 94 cm for females, and 72 cm for males.

D.20.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but shark bycatch has ranged from 300-700 mt per year in the BSAI from 1992-95; 500-1,400 mt per year in the GOA) principally by pelagic trawl fishery for pollock, longline fisheries for Pacific cod and sablefish, and bottom trawl fisheries for pollock, flatfish and cod; almost all discarded. Little is known of shark biomass in BSAI or GOA.

D.20.3 Habitat and Biological Associations

Egg/Spawning: Salmon sharks and spiny dogfish are ovoviviparous; reproductive strategy of sleeper sharks is not known. Spiny dogfish give birth in shallow coastal waters, while salmon sharks probably offshore and pelagic.

Juveniles and Adults: Spiny dogfish are widely dispersed throughout the water column on shelf in the GOA, and along outer shelf in the EBS; apparently not as commonly found in the Aleutian Islands and not commonly at depths > 200 m.

Salmon sharks found throughout the GOA, but less common in the EBS and AI; epipelagic, primarily over shelf/slope waters in GOA, and outer shelf in EBS.

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

Habitat and Biological Associations: Sharks

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs								
Larvae								
Juveniles and Adults								
Salmon shark	U	fish (salmon, sculpins and gadids)	all year	ICS, MSC, OCS, US in GOA; OCS, US in BSAI	P	NA	U	
Sleeper shark	U	omnivorous; flatfish, cephalopods, rockfish, crabs, seals, salmon, pinnipeds	all year	ICS, MSC, OCS, US in GOA; OCS, US in BSAI	D	U	U	
Spiny dogfish	40 years	fish (smelts, herring, sand lance, and other small schooling fish), crustaceans (crabs, euphausiids, shrimp), and cephalopods (octopus)	all year	ICS, MSC, OCS in GOA; OCS in BSAI give birth ICS in fall/winter?	P	U	U	Euhaline 4-16°C

D.20.4 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.20.5 Literature

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D.21 Skates (*Rajidae*)

The species representatives for skates are:

Alaska skate (*Bathyraja parmifera*)

Aleutian skate (*Bathyraja aleutica*)

Bering skate (*Bathyraja interrupta*)

D.21.1 Life History and General Distribution:

Skates (Rajidae) that occur in the BSAI and GOA are grouped into two genera: *Bathyraja* sp., or soft-nosed species (rostral cartilage slender and snout soft and flexible), and *Raja* sp., or hard-nosed species (rostral cartilage is thick making the snout rigid). Skates are oviparous; fertilization is internal and eggs (one to five or more in each case) are deposited in horny cases for incubation. Adults and juveniles are demersal, and feed on bottom invertebrates and fish. Adult distributions from survey: Alaska skate: mostly 50-200 m on shelf in eastern Bering Sea (EBS) and Aleutian Islands (AI), less common in the Gulf of Alaska (GOA); Aleutian skate: throughout EBS and AI, but less common in GOA, mostly 100-350 m; Bering Skate: throughout EBS and GOA, less common in AI, mostly 100-350 m. Little is known of their habitat requirements for growth or reproduction, nor of any seasonal movements. BSAI skate biomass estimate more than doubled between 1982-96 from bottom trawl survey; may have decreased in GOA and remained stable in the AI in the 1980s.

The approximate upper size limit of juvenile fish is unknown.

D.21.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but caught as bycatch (13,000-17,000 mt per year in the BSAI from 1992-95; 1,000-2,000 mt per year in the GOA) principally by the longline Pacific cod and bottom trawl pollock and flatfish fisheries; almost all discarded. Skate bycatches in the EBS groundfisheries ranged between 1-4% of the annual EBS trawl survey biomass estimates in 1992-95.

D.21.3 Relevant Trophic Information

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

D.21.4 Habitat and Biological Associations

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.

Habitat and Biological Associations: Skates

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs	U	na	U	MCS, OCS, USP	D	U	U	
Larvae	NA	na	na	na	na	na	na	
Juveniles	U	Invertebrates small fish	all year	MCS, OCS, USP	D	U	U	
Adults	U	Invertebrates small fish	all year	MCS, OCS, USP	D	U	U	

D.21.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.21.6 Literature

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D.22 Octopus

The species representatives for octopus are:

Octopoda: Octopus *(Octopus gilbertianus; O. dofleini*)

Vampyromorpha: Pelagic octopus (*Vampyroteuthis infernalis*)

D.22.1 Life History and General Distribution

Octopus are members of the molluscan class Cephalopoda, along with squid, cuttlefish and nautiloids. In the BSAI and GOA, the most commonly encountered octopods are the shelf demersal species *O. gilbertianus* and *O. dofleini*, and the bathypelagic finned species, *V. infernalis*. Octopods, like other cephalopods are dioecious, with fertilization of eggs (usually within the mantle cavity of the female) requiring transfer of spermatophores during copulation. Octopods probably do not live longer than about 2-4 years, and females of some species (e.g., *O. vulgaris*) die after brooding their eggs on the bottom.

O. gilbertianus - Medium sized octopus (up to 2 m in total length) distributed across the shelf (to 500 m depth) in the eastern and western Bering Sea (where it is the most common octopus), Aleutian Islands, and Gulf of Alaska (endemic to the North Pacific). Little is known of its reproductive or trophic ecology, but eggs laid on the bottom and tended by females. Lives mainly among rocks and stones.

O. dofleini - Giant octopus (up to 10 m in total length, though mostly about 3-5 m) distributed in the southern boreal region from Japan and Korea, through the Aleutian Islands, Gulf Alaska, and south along the Pacific coast of North America to California. Inhabits the sublittoral to upper slope. Egg length 6-8 mm; laid on bottom. Copulation may occur in late fall-winter, but oviposition the following spring; each female lays several hundred eggs.

V. infernalis - Relatively small (up to about 40 cm total length) bathypelagic species, living at depths well below the thermocline; may be most commonly found at 700-1500 m. Found throughout the world's oceans. Eggs are large (3-4 mm in diameter) and are shed singly into the water. Hatched juveniles resemble adults, but with different fin arrangements, which change to the adult form with development. Little is known of their food habits, longevity, or abundance.

D.22.2 Fishery

Not currently a target of groundfish fisheries of BSAI or GOA. Bycatch has ranged between 200-1,000 mt in the BSAI and 40-100 mt in the GOA, chiefly in the pot fishery for Pacific cod and bottom trawl fisheries for cod and flatfish, but sometimes in the pelagic trawl pollock fishery. Directed octopus landings have been less than 8 mt/year for 1988-95. Age/size at 50% recruitment is unknown. Most of the bycatch occurs on the outer continental shelf (100-200 m depth), chiefly north of the Alaskan peninsula from Unimak I. to Port Moller and northwest to the Pribilof Islands; also around Kodiak Island and many of the Aleutian Islands.

D.22.3 Relevant Trophic Information

Octopus are eaten by pinnipeds (principally Steller sea lions, and spotted, bearded, and harbor seals) and a variety of fishes, including Pacific halibut and Pacific cod (Yang 1993). When small, octopods eat planktonic and small benthic crustaceans (mysids, amphipods, copepods). As adults, octopus eat benthic crustaceans (crabs) and molluscs (clams).

D.22.4 Habitat and Biological Associations

Egg/Spawning: shelf; eggs laid on bottom, maybe preferentially among rocks and cobble.

Young Juveniles: semi-demersal; widely dispersed on shelf, upper slope

Old Juveniles and Adults: demersal, widely dispersed on shelf and upper slope, preferentially among rocks, cobble, but also on sand/mud.

Habitat and Biological Associations: *Octopus dofleini*, *O. gilbertianus*

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U (1-2 months?)	NA	spring-summer?	U, ICS, MCS	D	R, G?	U	Euhaline waters
Young juveniles	U	zooplankton	summer-fall?	U, ICS, MCS, OCS, USP	D, SD	U	U	Euhaline waters
Older Juveniles and Adults	U (2-3 yrs? for *O.gilbertianus*; older for *O.dofleini*)	crustaceans, molluscs	all year	ICS, MCS, OCS, USP	D	R, G, S, MS?	U	Euhaline waters

D.22.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.22.6 Literature

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D.23 Capelin (*osmeridae*)

The species representative for capelin is *Mallotus villosus*.

D.23.1 Life History and General Distribution

Capelin is a short-lived marine (neritic), pelagic, filter-feeding schooling fish distributed along the entire coastline of Alaska and the Bering Sea, and south along British Columbia to the Strait of Juan de Fuca; circumpolar. In the N. Pacific, capelin grow to a maximum of 25 cm and 5 years of age. Spawn at ages 2-4 in spring and summer (May-Aug; earlier in south, later in north) when about 11-17 cm on coarse sand, fine gravel beaches, especially in Norton Sound, northern Bristol Bay, along the Alaska Peninsula and near Kodiak. Age at 50% maturity=2 years. Fecundity: 10,000-15,000 eggs per female. Eggs hatch in 2-3 weeks. Most capelin die after spawning. Larvae and juveniles are distributed on inner-mid shelf in summer (rarely found in waters deeper than about 200 m), and juveniles and adults congregate in fall in mid-shelf waters east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands, and north into the Gulf of

Anadyr. Distributed along outer shelf and under ice edge in winter. Larvae, juveniles and adults have diurnal vertical migrations following scattering layers - night near surface, at depth during the day. Smelts are captured during trawl surveys, but their patchy distribution both in space and time reduces the validity of biomass estimates.

The approximate upper size limit of juvenile fish is 13cm.

D.23.2 Fishery

Not a target species in groundfish fisheries of BSAI or GOA, but caught as bycatch (up to several hundred tons per year in the 1990s) principally by yellowfin sole trawl fishery in Kuskokwim and Togiak Bays in spring in BSAI; almost all discarded. Small local coastal fisheries occur in spring and summer.

D.23.3 Relevant Trophic Information

Capelin are important prey for marine birds and mammals as well as other fish. Surface feeding (e.g., gulls and kittiwakes), as well as shallow and deep diving piscivorous birds (e.g., murres and puffins) largely consume small schooling fishes such as capelin, eulachon, herring, sand lance and juvenile pollock (Hunt et al. 1981a; Sanger 1983). Both pinnipeds (Steller sea lions, northern fur seals, harbor seals, and ice seals) and cetaceans (such as harbor porpoise, and fin, sei, humpback, beluga whales) feed on smelts, which may provide an important seasonal food source near the ice-edge in winter, and as they assemble nearshore in spring to spawn (Frost and Lowry 1987; Wespestad 1987). Smelts are also found in the diets of some commercially exploited fish species, such as Pacific cod, walleye pollock, arrowtooth flounder, Pacific halibut, sablefish, Greenland turbot and salmon, throughout the North Pacific Ocean and the Bering Sea (Allen 1987; Yang 1993; Livingston, in prep.).

D.23.4 Habitat and Biological Associations

Egg/Spawning: Spawn adhesive eggs (about 1 mm in diameter) on fine gravel or coarse sand (0.5-1 mm grain size) beaches intertidally to depths of up to 10 m in May-July in Alaska (later to the north in Norton Sound). Hatching occurs in 2-3 weeks. Most intense spawning when coastal water temperatures are 5-9°C.

Larvae: After hatching, 4-5 mm larvae remain on the middle-inner shelf in summer; distributed pelagically; centers of distribution are unknown, but have been found in high concentrations north of Unimak Island, in the western GOA, and around Kodiak Island.

Juveniles: In fall, juveniles are distributed pelagically in mid-shelf waters (50-100 m depth; -2-3°C), and have been found in highest concentrations east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands and north into the Gulf of Anadyr.

Adults: Found in pelagic schools in inner-mid shelf in spring-fall, feed along semi-permanent fronts separating inner, mid, and outer shelf regions (~50 and 100 m). In winter, found in concentrations under ice-edge and along mid-outer shelf.

Habitat and Biological Associations: Capelin

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	2-3 weeks to hatch	na	May-August	BCH (to 10 m)	D	S, CB		5-9°C peak spawning
Larvae	4-8 months?	Copepods phytoplankton	summer/fall/ winter	ICS, MCS	N, P	U NA?	U	
Juveniles	1.5+ yrs up to age 2	Copepods Euphausiids	all year	ICS, MCS	P	U NA?	U F? Ice edge in winter	
Adults	2 yrs ages 2-4+	Copepods Euphausiids polychaetes small fish	Spawning (May-August) non-spawning (Sep-Apr)	BCH (to 10 m) ICS, MCS, OCS	D, SD P	S, CB, G NA?	F Ice edge in winter	-2 - 3°C Peak distributions in EBS?

D.23.5 Additional Sources of information

Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961

Jim Blackburn, ADFG, Kodiak AK 907-486-1861

Mark W. Nelson, NMFS/REFM, Seattle WA 206-526-4699

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D.24 Eulachon (*osmeridae*)

The species representative for eulachon is the candlefish *(Thaleichthys pacificus*).

D.24.1 Life History and General Distribution

Eulachon is a short-lived anadromous, pelagic schooling fish distributed from the Pribilof Islands in the eastern Bering Sea, throughout the Gulf of Alaska, and south to California. Consistently found pelagically in Shelikof Strait (hydroacoustic surveys in late winter-spring) and between Unimak Island and the Pribilof Islands (bycatch in groundfish trawl fisheries) from the middle shelf to over the slope. In the North Pacific, eulachon grow to a maximum of 23 cm and 5 years of age. Spawn at ages 3-5 in spring and early summer (April-June) when about 14-20 cm in rivers on coarse sandy bottom. Age at 50% maturity=3 years. Fecundity: ~25,000 eggs per female. Eggs adhere to sand grains and other substrates on river bottom. Eggs hatch in 30-40 days in BC at 4-7°C. Most eulachon die after first spawning. Larvae drift out of rivers and develop at sea. Smelts are captured during trawl surveys, but their patchy distribution both in space and time reduces the validity of biomass estimates.

The approximate upper size limit of juvenile fish is 14cm.

D.24.2 Fishery

Not a target species in groundfish fisheries of BSAI or GOA, but caught as bycatch (up to several hundred tons per year in the 1990s) principally by midwater pollock fisheries in Shelikof Strait (GOA), on the east side of Kodiak (GOA), and between the Pribilof Islands and Unimak Island on the outer continental shelf and slope (EBS); almost all discarded. Small local coastal fisheries occur in spring and summer.

D.24.3 Relevant Trophic Information

Eulachon may be important prey for marine birds and mammals as well as other fish. Surface feeding (e.g., gulls and kittiwakes), as well as shallow and deep diving piscivorous birds (e.g., murres and puffins) largely consume small schooling fishes such as capelin, eulachon, herring, sand lance and juvenile pollock (Hunt et al. 1981a; Sanger 1983). Both pinnipeds (Steller sea lions, northern fur seals, harbor seals, and ice seals) and cetaceans (such as harbor porpoise, and fin, sei, humpback, beluga whales) feed on smelts, which may provide an important seasonal food source near the ice-edge in winter, and as they assemble nearshore in spring to spawn (Frost and Lowry 1987; Wespestad 1987). Smelts also comprise significant portions of the diets of some commercially exploited fish species, such as Pacific cod, walleye pollock, arrowtooth flounder, Pacific halibut, sablefish, Greenland turbot and salmon, throughout the North Pacific Ocean and the Bering Sea (Allen 1987; Yang 1993; Livingston, in prep.).

D.24.4 Habitat and Biological Associations

Egg/Spawning: Anadromous; return to spawn in spring (May-June) in rivers; demersal eggs adhere to bottom substrate (sand, cobble, etc.). Hatching occurs in 30-40 days.

Larvae: After hatching, 5-7 mm larvae drift out of river and develop pelagically in coastal marine waters; centers of distribution are unknown.

Juveniles and Adults: Distributed pelagically in mid-shelf to upper slope waters (50-1000 m water depth), and have been found in highest concentrations between the Pribilof Islands and Unimak Island on the outer shelf, and in Shelikof east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands and north into the Gulf of Anadyr.

Habitat and Biological Associations: Eulachon (Candlefish)

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	30-40 days	na	April-June	Rivers, FW	D	S (CB?)		4 - 8°C for egg development
Larvae	1-2 months?	Copepods phytoplankton mysids, larvae	summer/fall	ICS ?	P?	U, NA?	U	
Juveniles	2.5+ yrs up to age 3	Copepods Euphausiids	all year	MCS, OCS, USP	P	U, NA?	U F?	
Adults	3 yrs ages 3-5+	 Copepods Euphausiids	Spawning (May-June) non-spawning (July-Apr)	Rivers-FW MCS, OCS, USP	D P	S (CB?) NA?	 F?	

D.24.5 Literature

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Appendix E Maps of Essential Fish Habitat

Maps of essential fish habitat are included in this section for the following species (life stage is indicated in parentheses):

Figures E-1 to E-3	Walleye pollock (eggs, larvae, late juveniles/adults)
Figures E-4 to E-5	Pacific cod (larvae, late juveniles/adults)
Figure E-6	Yellowfin sole (late juveniles/adults)
Figures E-7 to E-9	Greenland turbot (eggs, larvae, late juveniles/adults)
Figure E-10	Arrowtooth flounder (late juveniles/adults)
Figures E-11 to E-12	Rock sole (larvae, late juveniles/adults)
Figures E-13 to E-14	Alaska Plaice (eggs, late juveniles/adults)
Figure E-15	Rex sole (late juveniles/adults)
Figure E-16	Dover sole (late juveniles/adults)
Figures E-17 to E-19	Flathead sole (eggs, larvae, late juveniles/adults)
Figures E-20 to E-21	Sablefish (larvae, late juveniles/adults)
Figure E-22	Rockfish (larvae)
Figure E-23	Pacific ocean perch (late juveniles/adults)
Figure E-24	Shortraker and rougheye rockfish (adults)
Figure E-25	Northern rockfish (adults)
Figure E-26	Thornyhead rockfish (late juveniles/adults)
Figure E-27	Yelloweye rockfish (late juveniles/adults)
Figure E-28	Dusky rockfish (adults)
Figures E-29 to E-30	Atka mackerel (larvae, adults)
Figure E-31	Skates species (adults)
Figure E-32	Sculpin species (adults)
Figure E-33	Squid (late juveniles/adults)

Figure E-1 EFH Distribution - BSAI Walleye Pollock (Eggs)

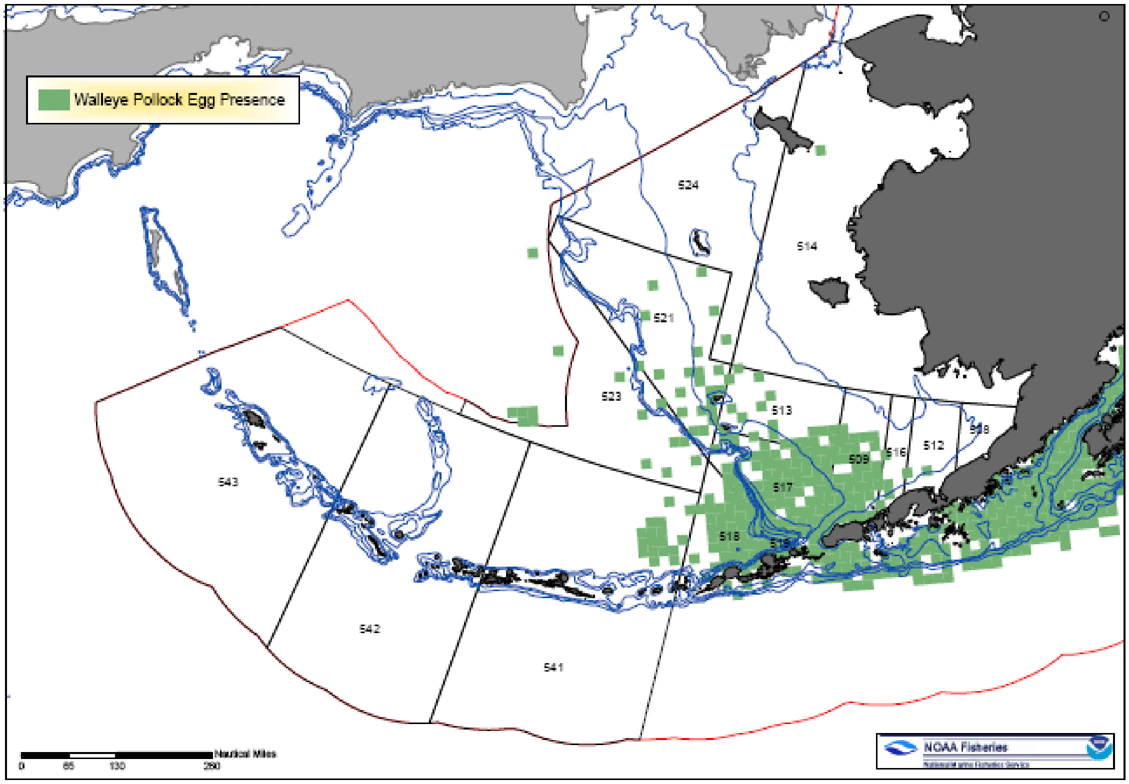


Figure E-2 EFH Distribution - BSAI Walleye Pollock (Larvae)

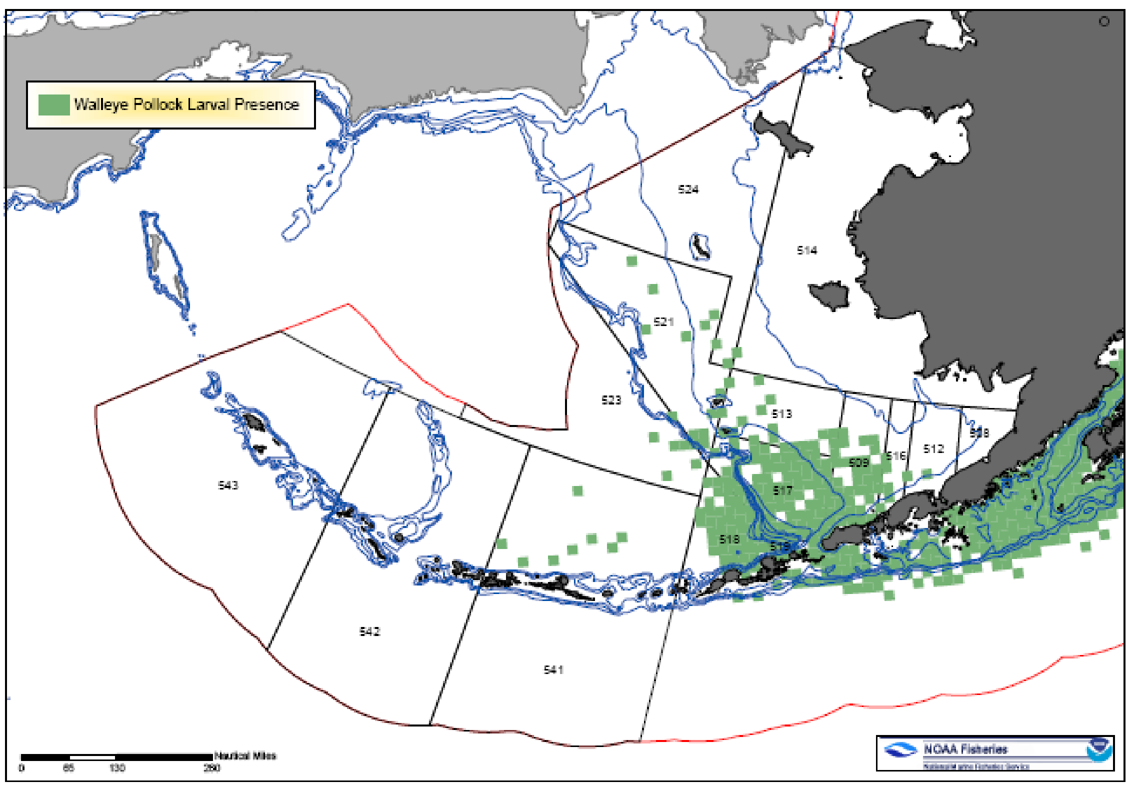


Figure E-3 EFH Distribution - BSAI Walleye Pollock (Late Juveniles/Adults)

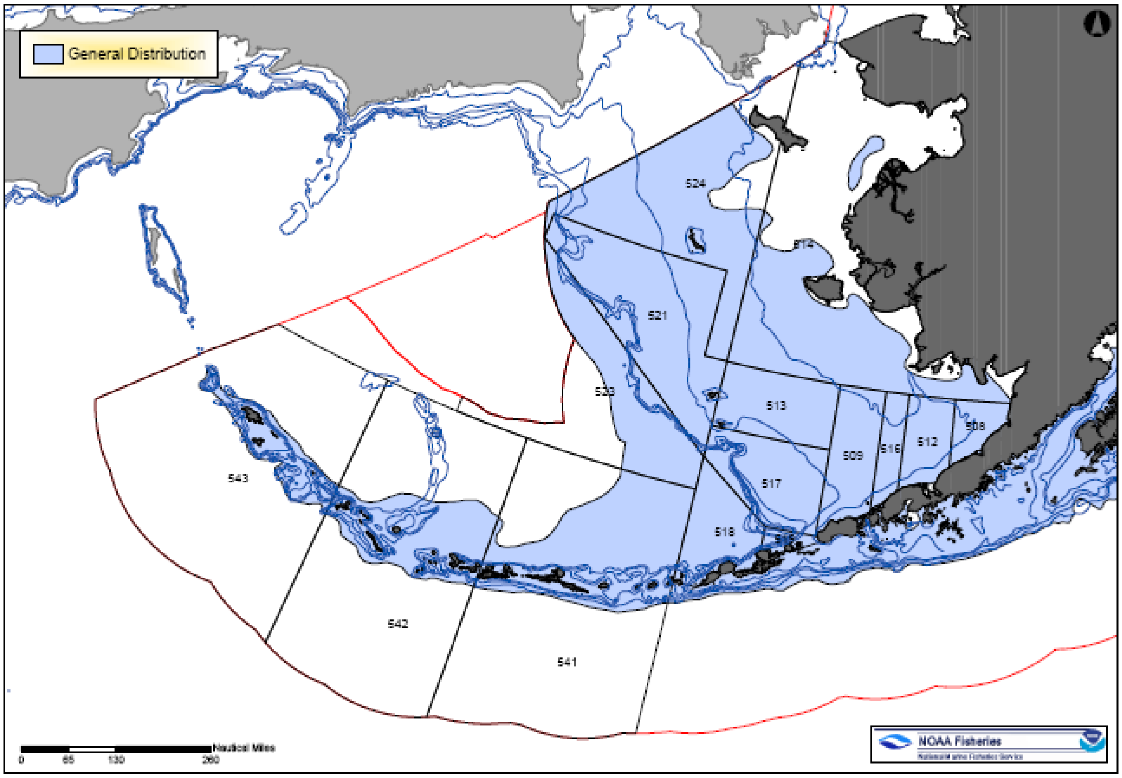


Figure E-4 EFH Distribution - BSAI Pacific Cod (Larvae)

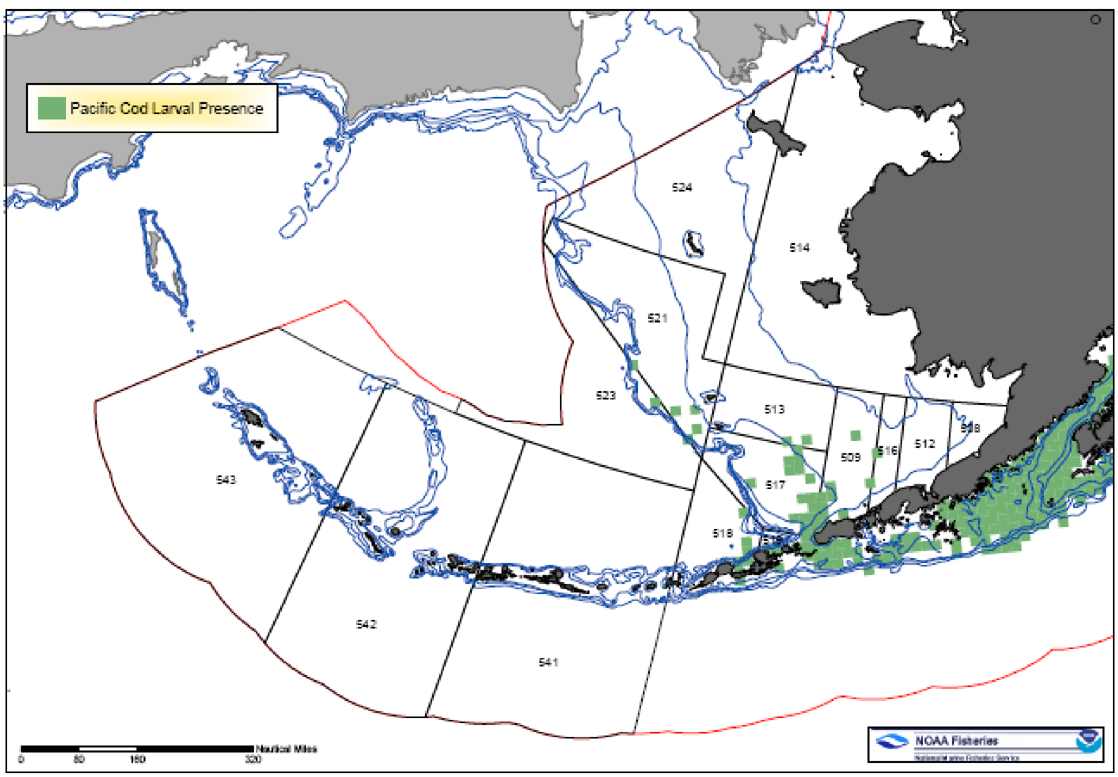


Figure E-5 EFH Distribution - BSAI Pacific Cod (Late Juveniles/Adults)

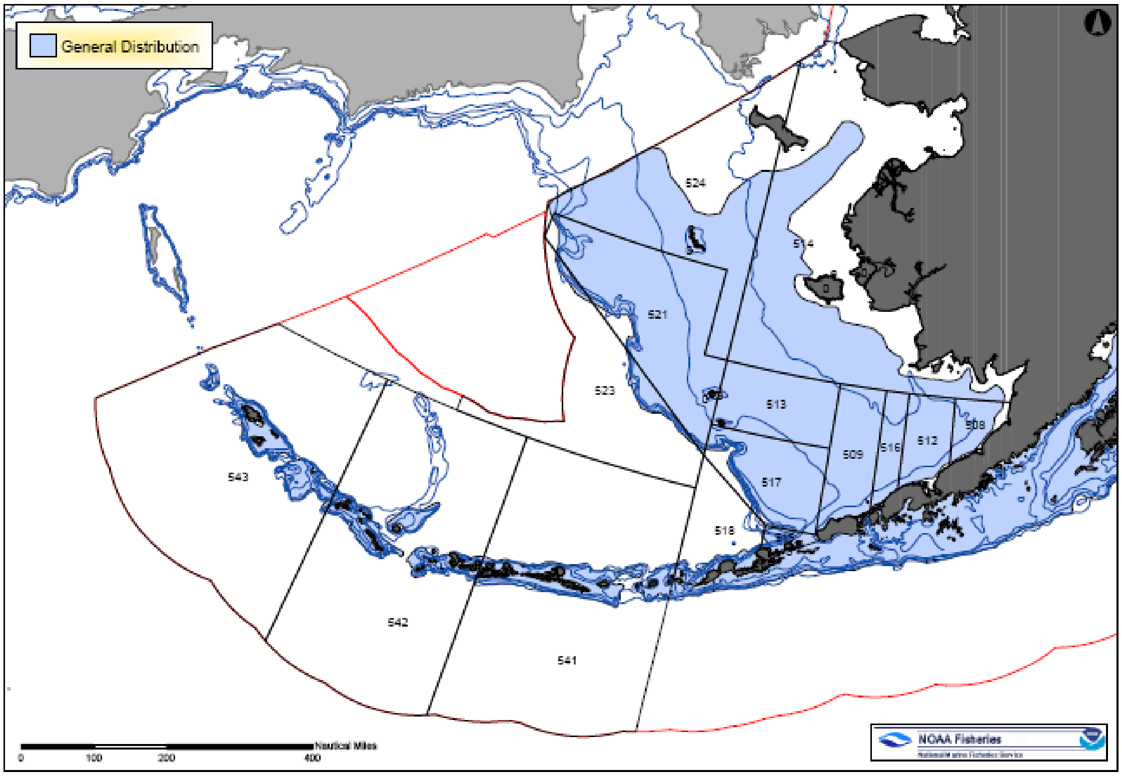


Figure E-6 EFH Distribution - BSAI Yellowfin Sole (Late Juveniles/Adults)

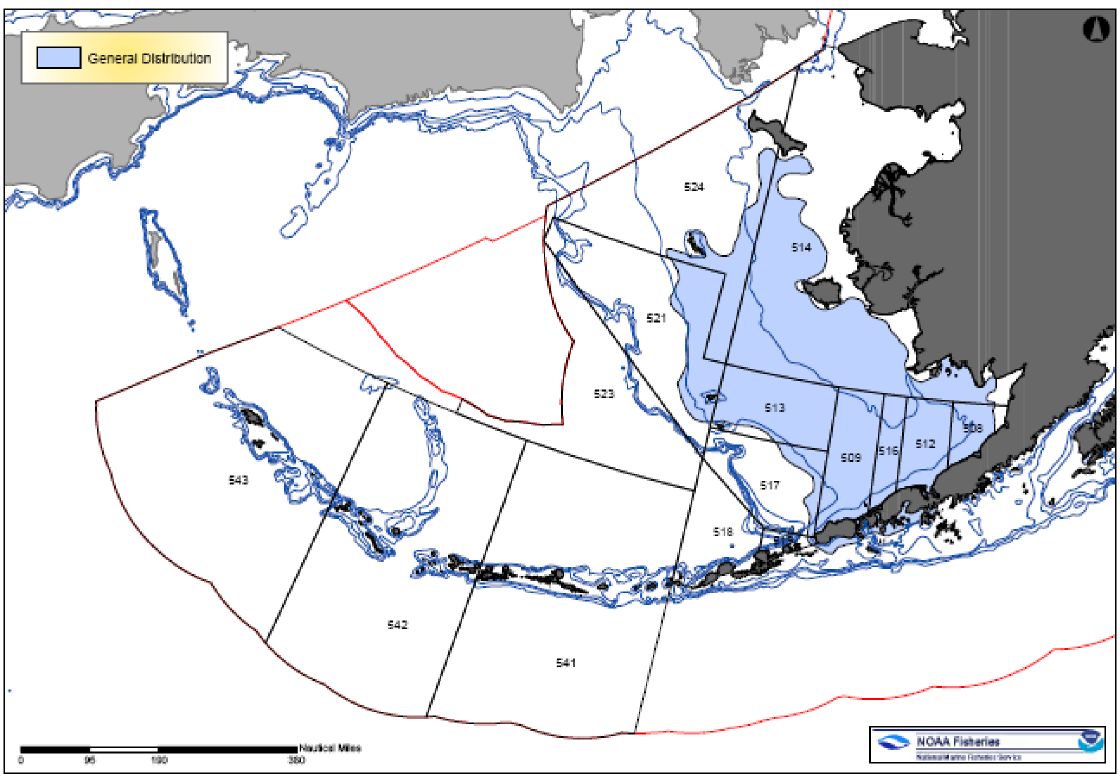


Figure E-7 EFH Distribution - BSAI Greenland Turbot (Eggs)

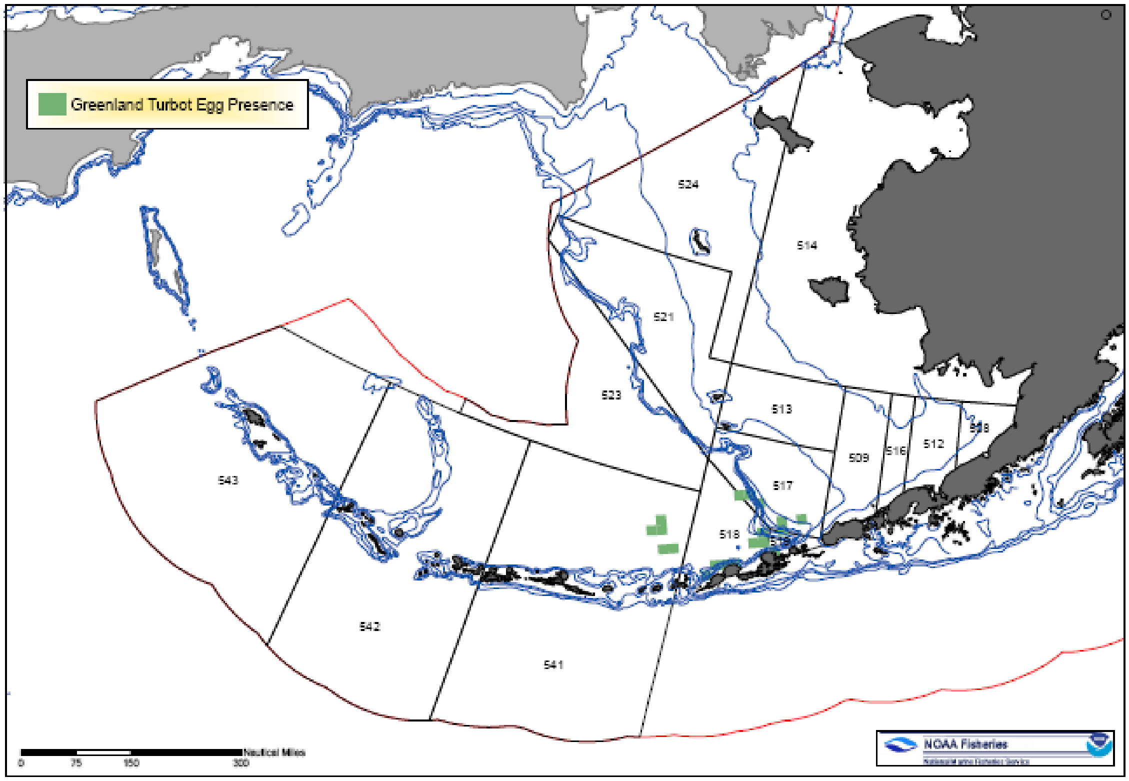


Figure E-8 EFH Distribution -BSAI Greenland Turbot (Larvae)

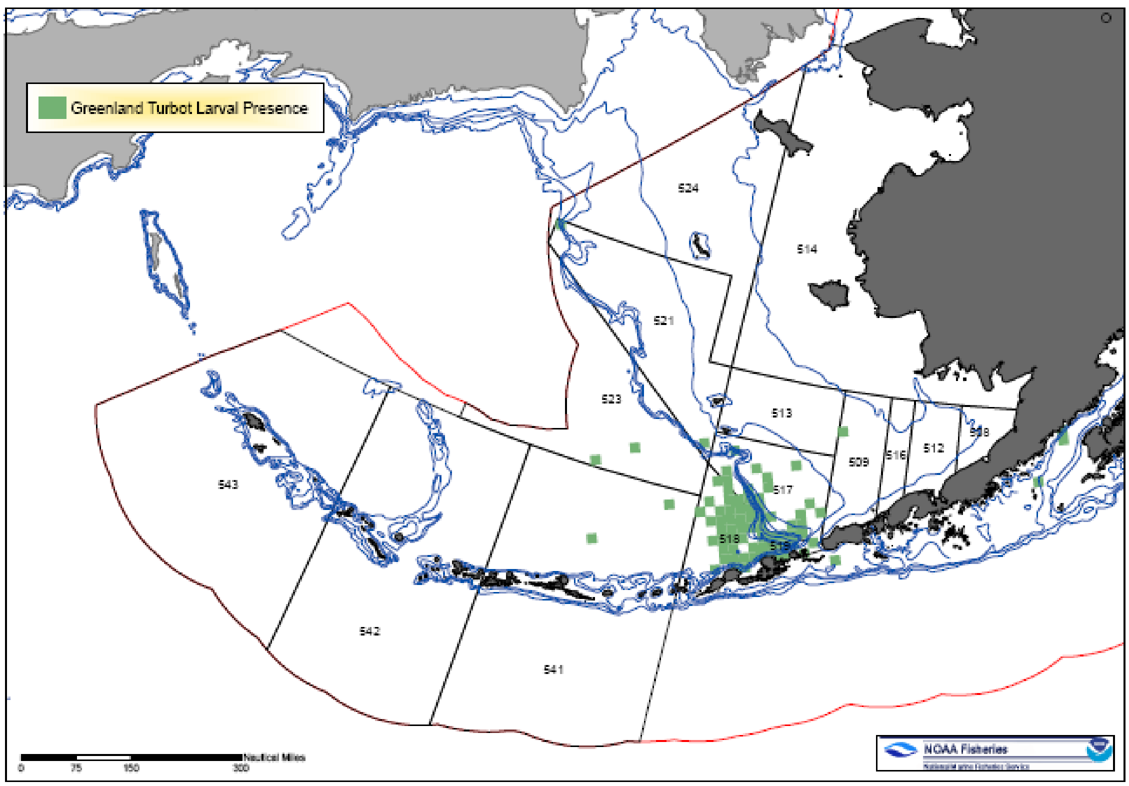


Figure E-9 EFH Distribution - BSAI Greenland Turbot (Late Juveniles/Adults)

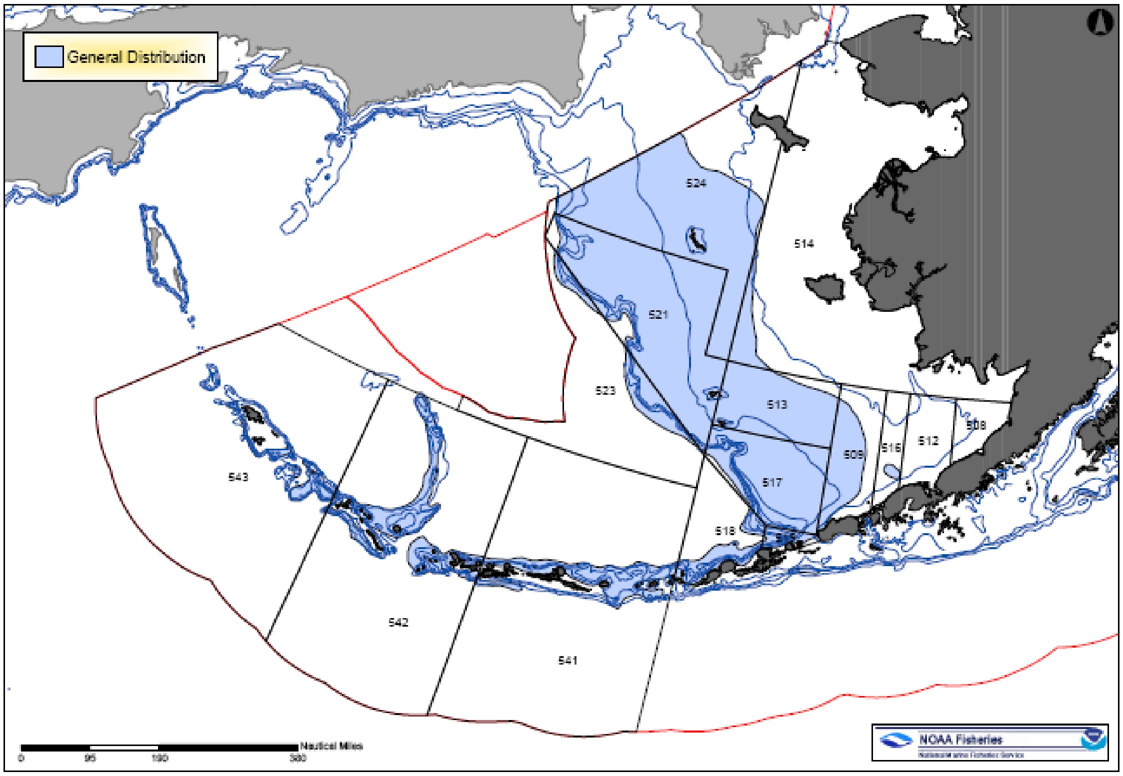


Figure E-10 EFH Distribution - BSAI Arrowtooth Flounder (Late Juveniles/Adults)

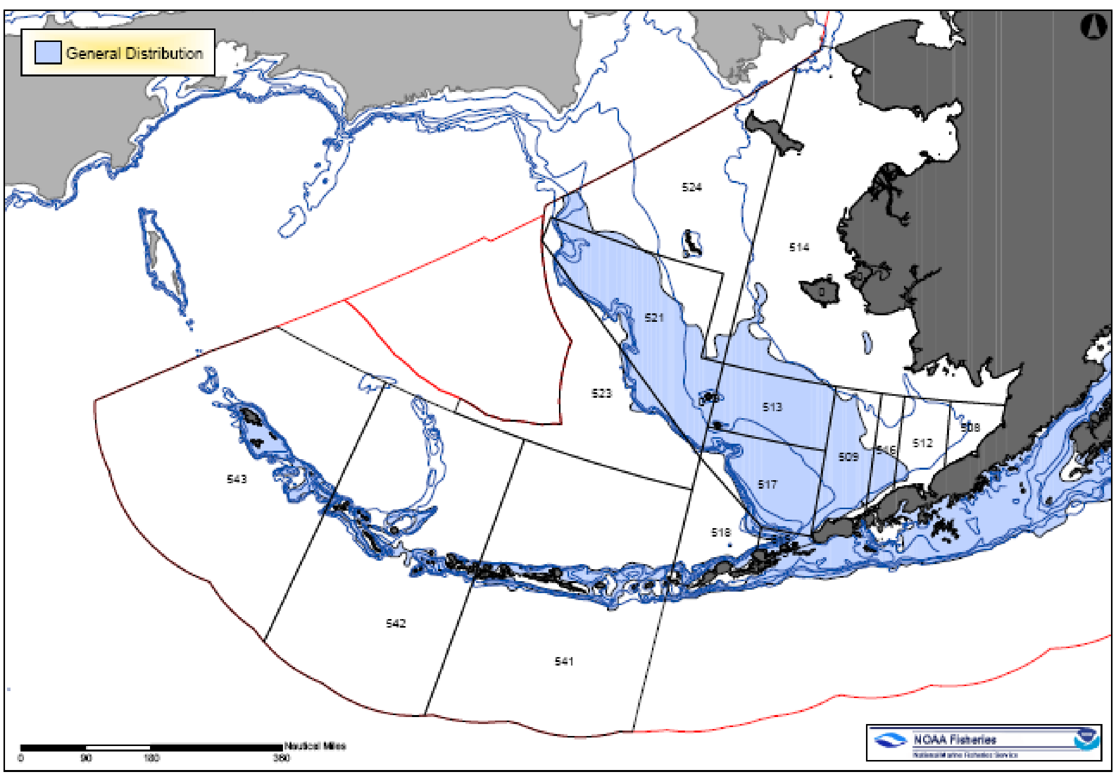


Figure E-11 EFH Distribution - BSAI Rock Sole (Larvae)

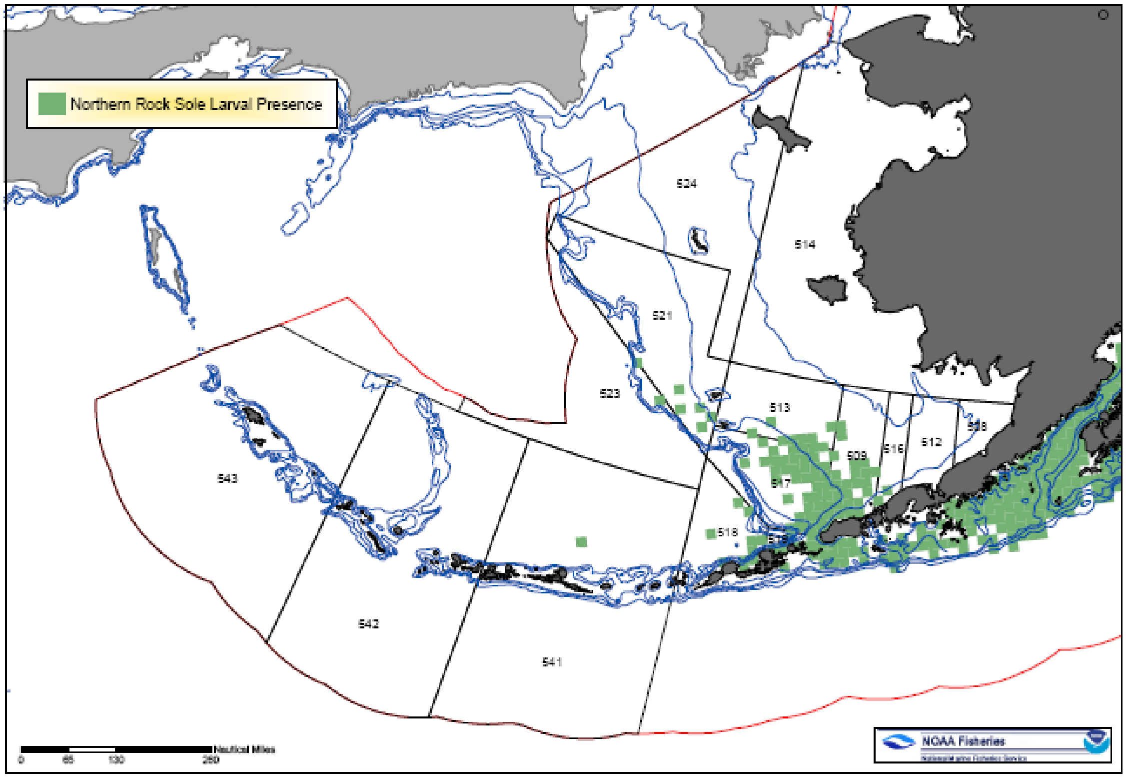


Figure E-12 EFH Distribution - BSAI Rock Sole (Late Juveniles/Adults)

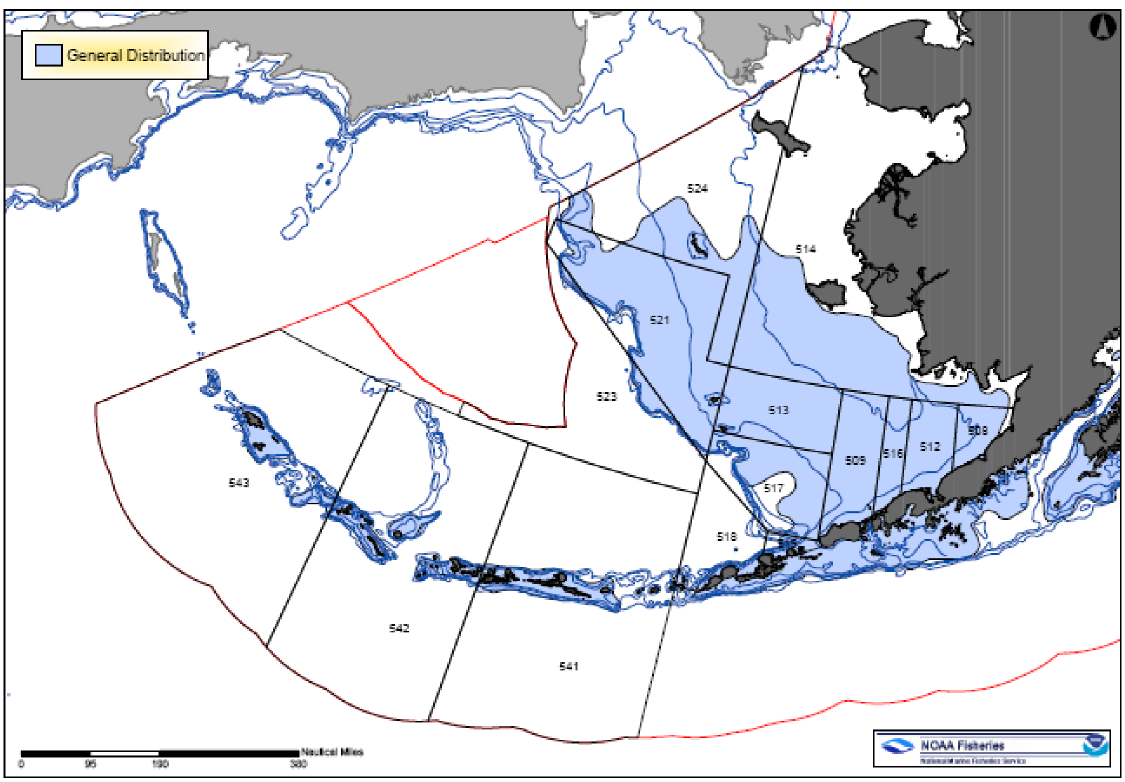


Figure E-13 EFH Distribution - BSAI Alaska Plaice (Eggs)

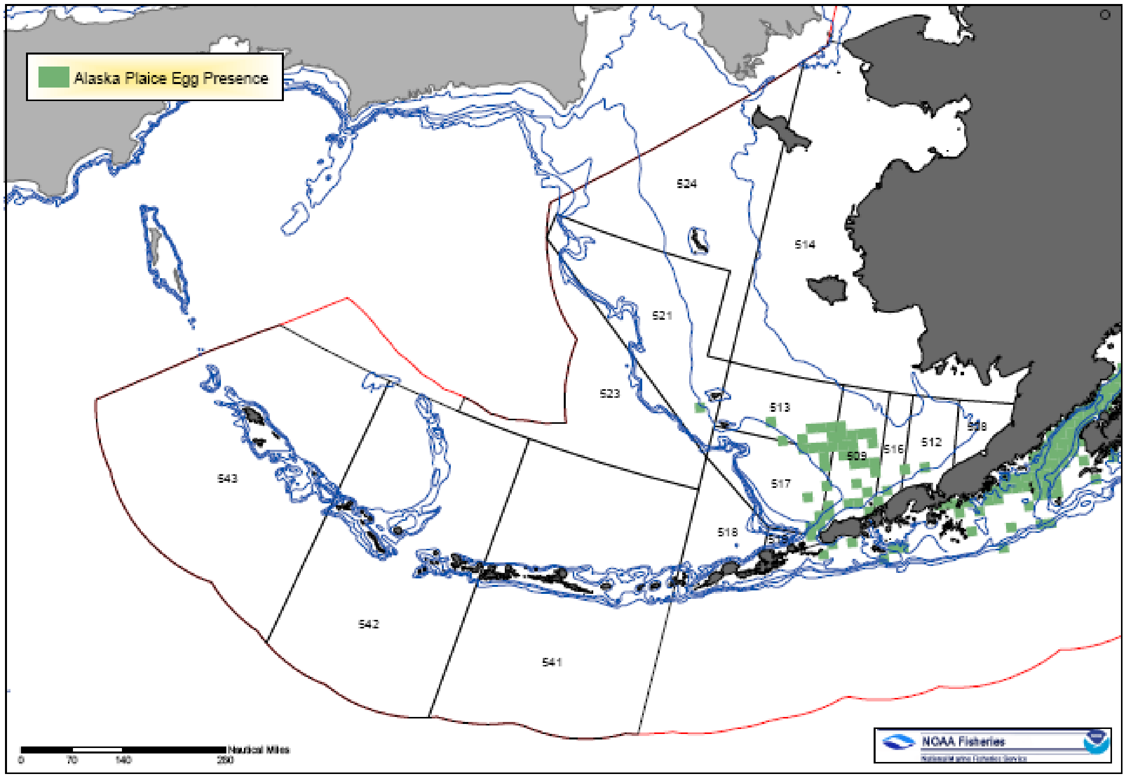


Figure E-14 EFH Distribution - BSAI Alaska Plaice (Late Juveniles/Adults)

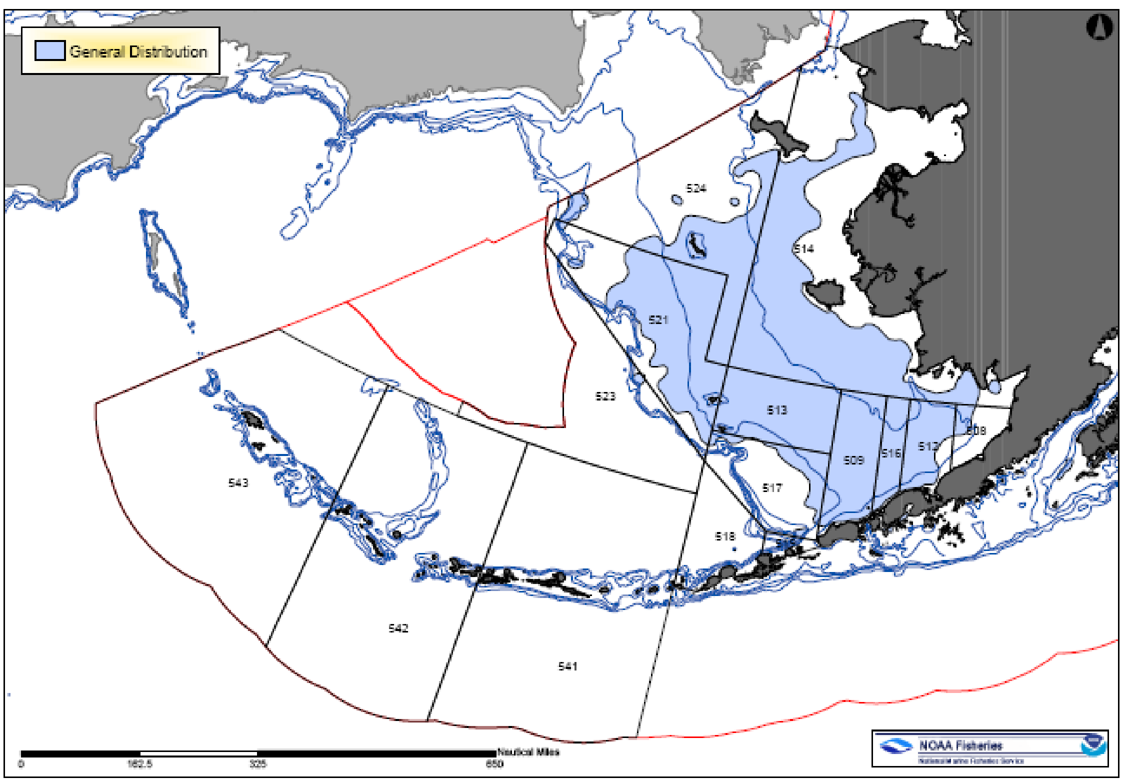


Figure E-15 EFH Distribution - BSAI Rex Sole (Late Juveniles/Adults)

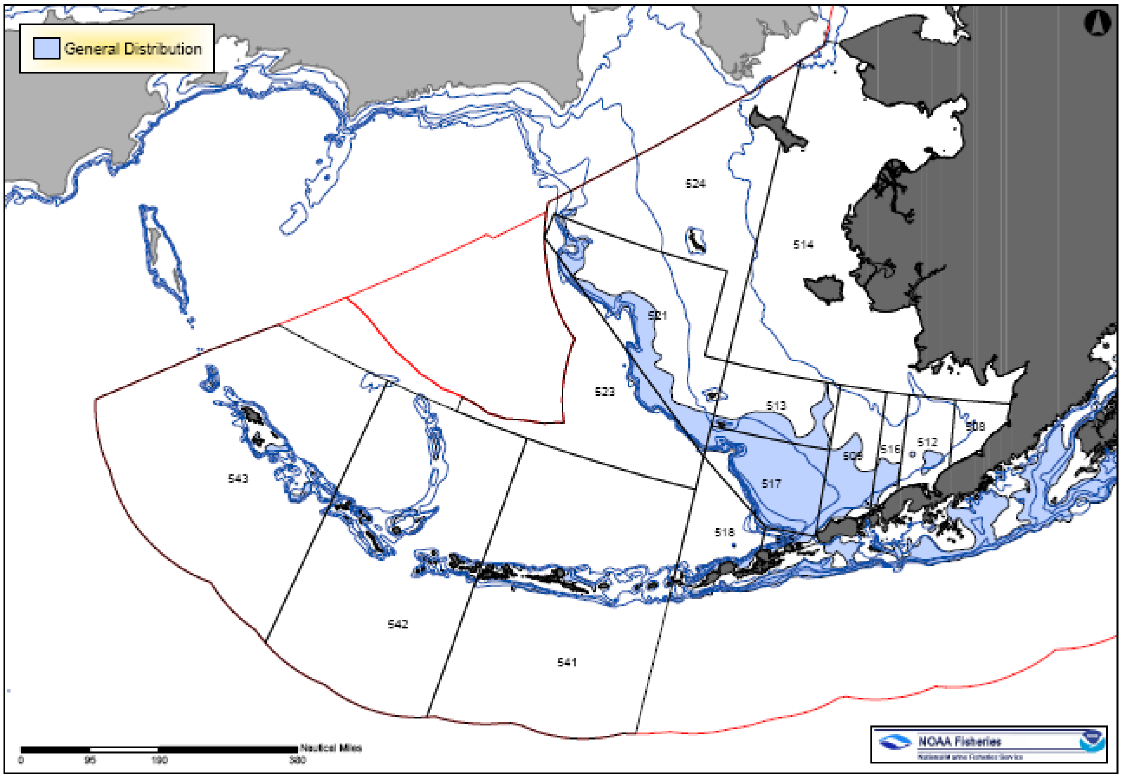


Figure E-16 EFH Distribution - BSAI Dover Sole (Late Juveniles/Adults)

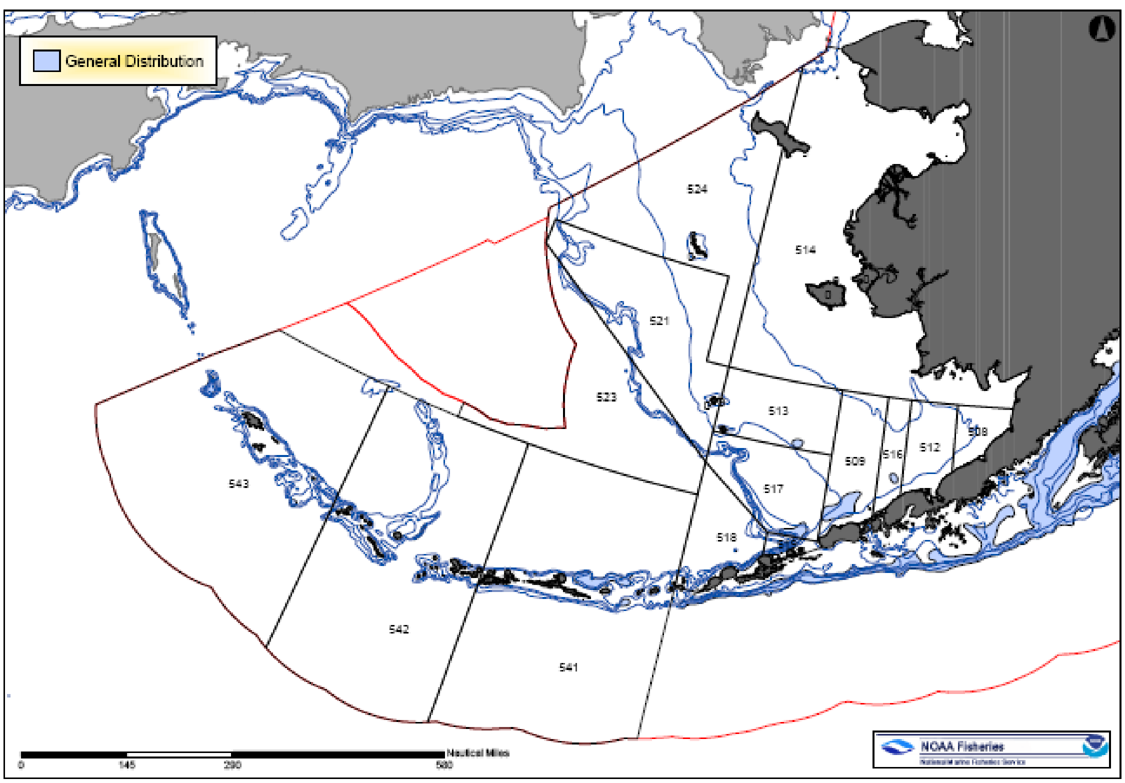


Figure E-17 EFH Distribution - BSAI Flathead Sole (Eggs)

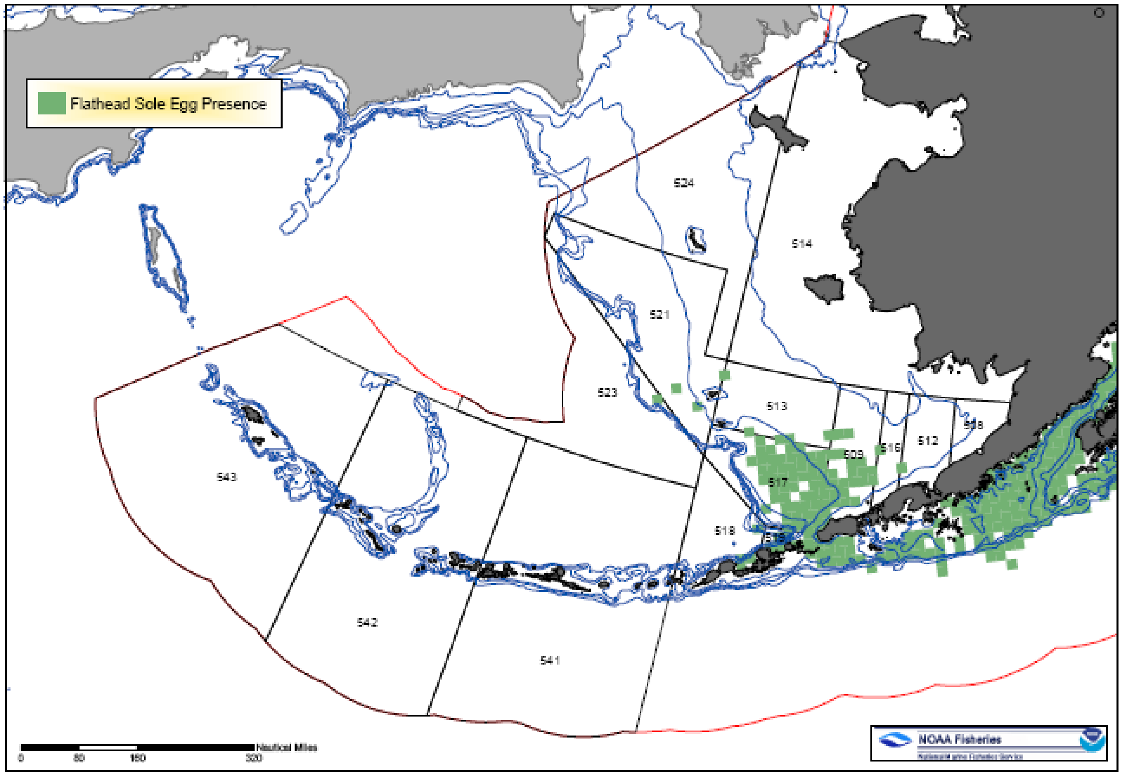


Figure E-18 EFH Distribution - BSAI Flathead Sole (Larvae)

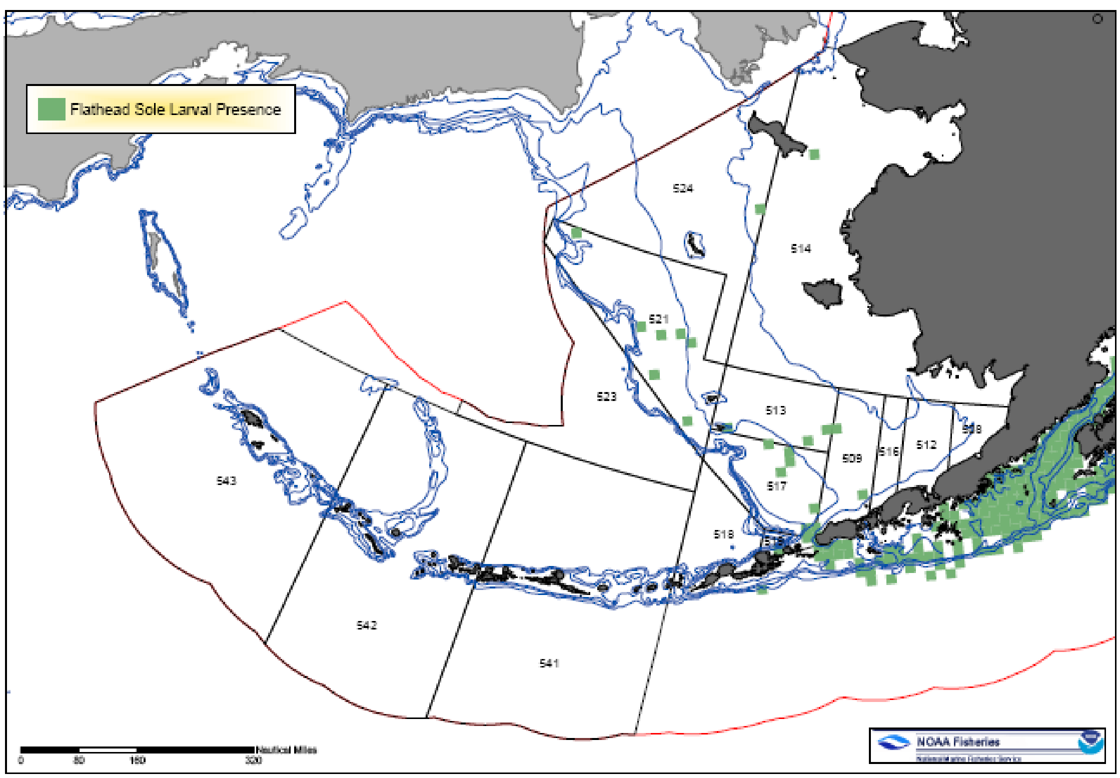


Figure E-19 EFH Distribution - BSAI Flathead Sole (Late Juveniles/Adults)

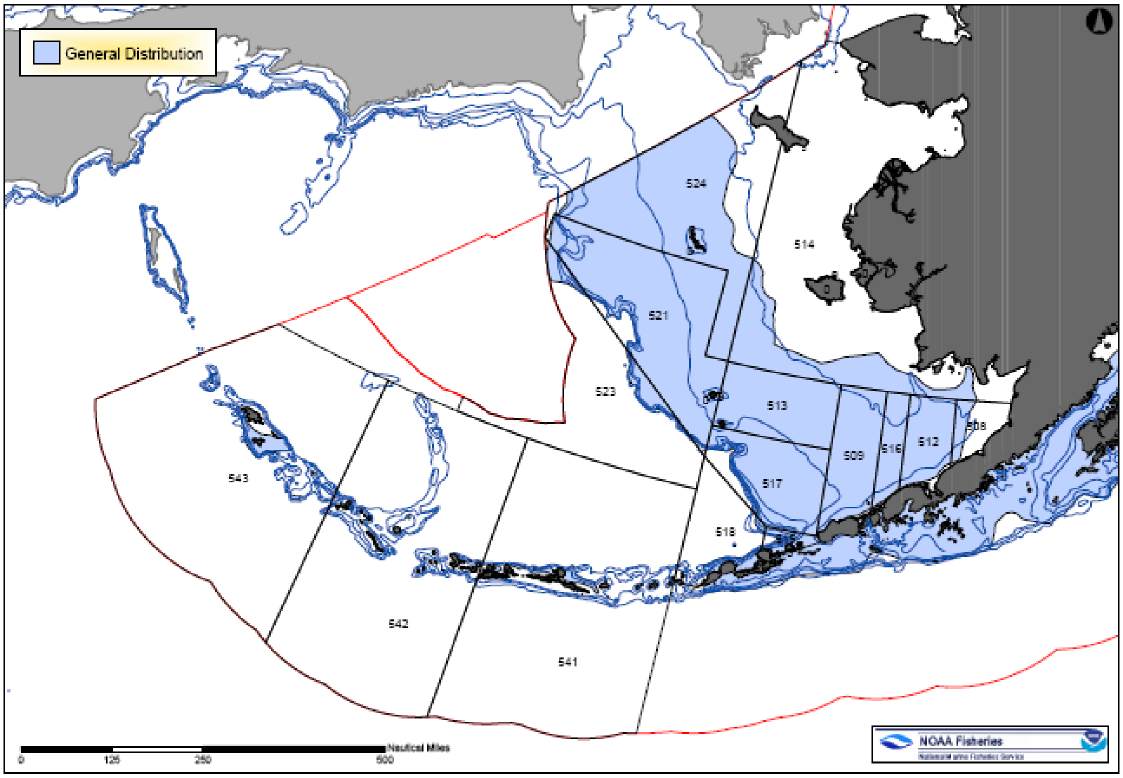


Figure E-20 EFH Distribution - BSAI Sablefish (Larvae)

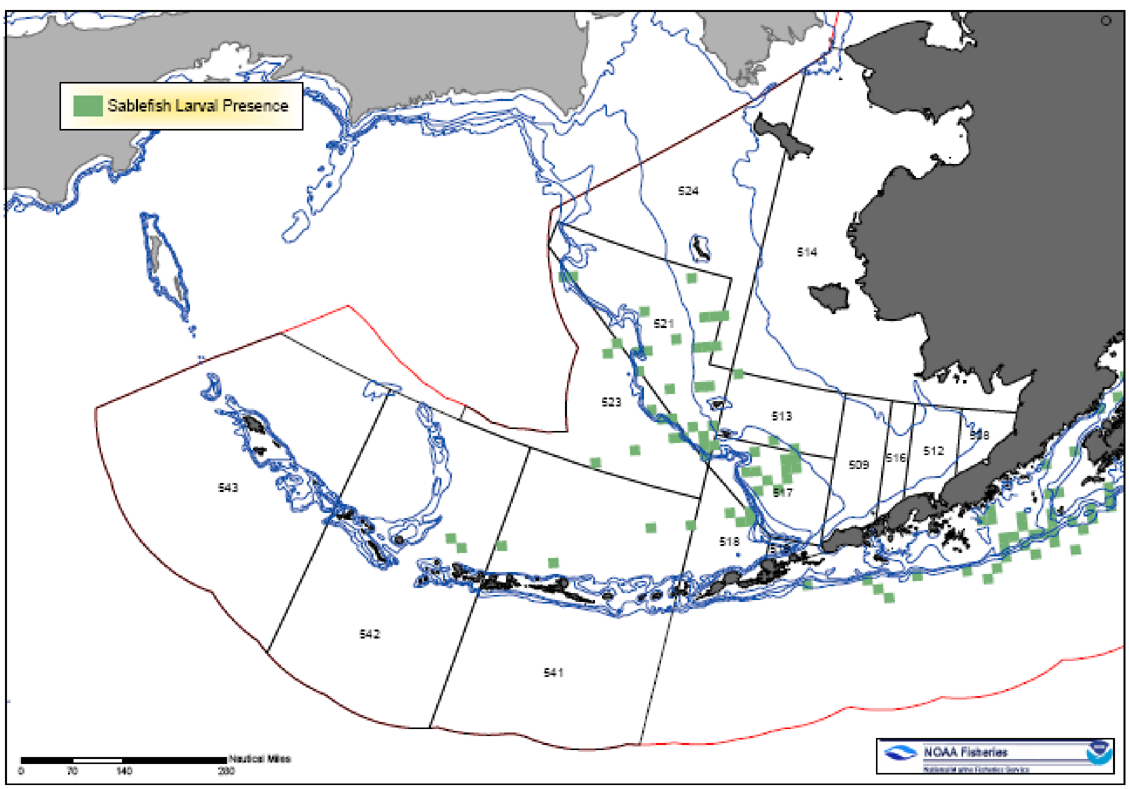


Figure E-21 EFH Distribution - BSAI Sablefish (Late Juvenile/Adults)

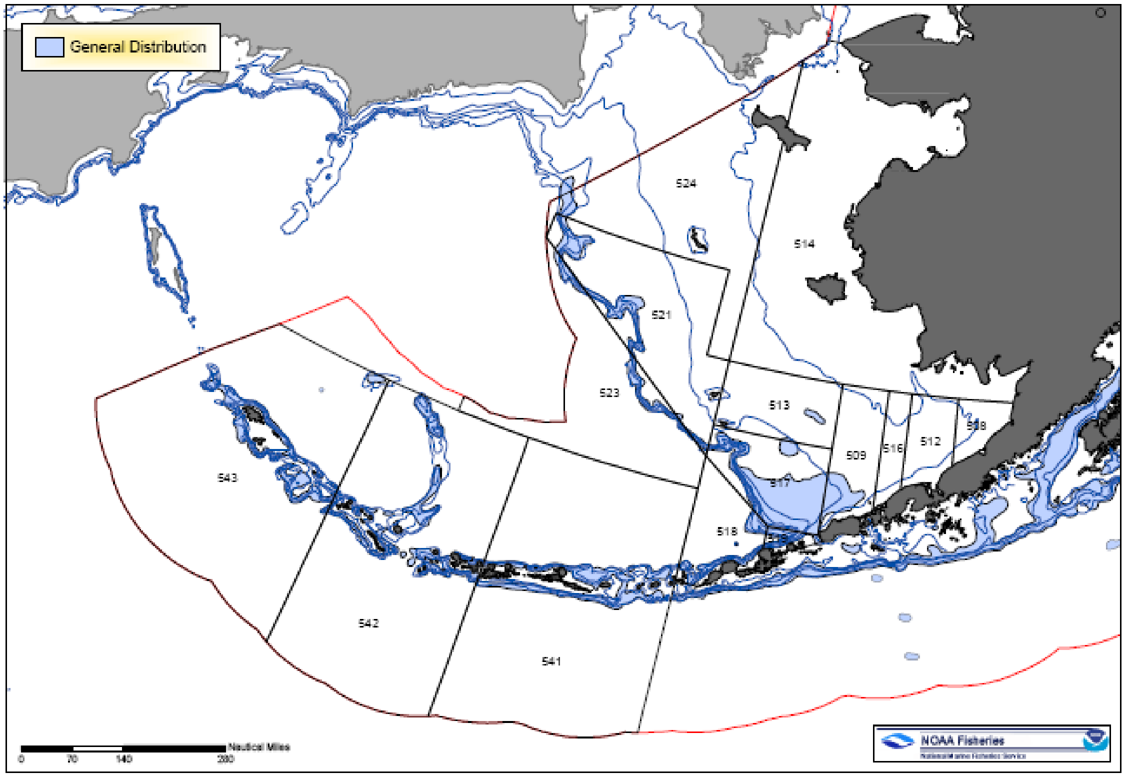


Figure E-22 EFH Distribution - BSAI Rockfish (Larvae)

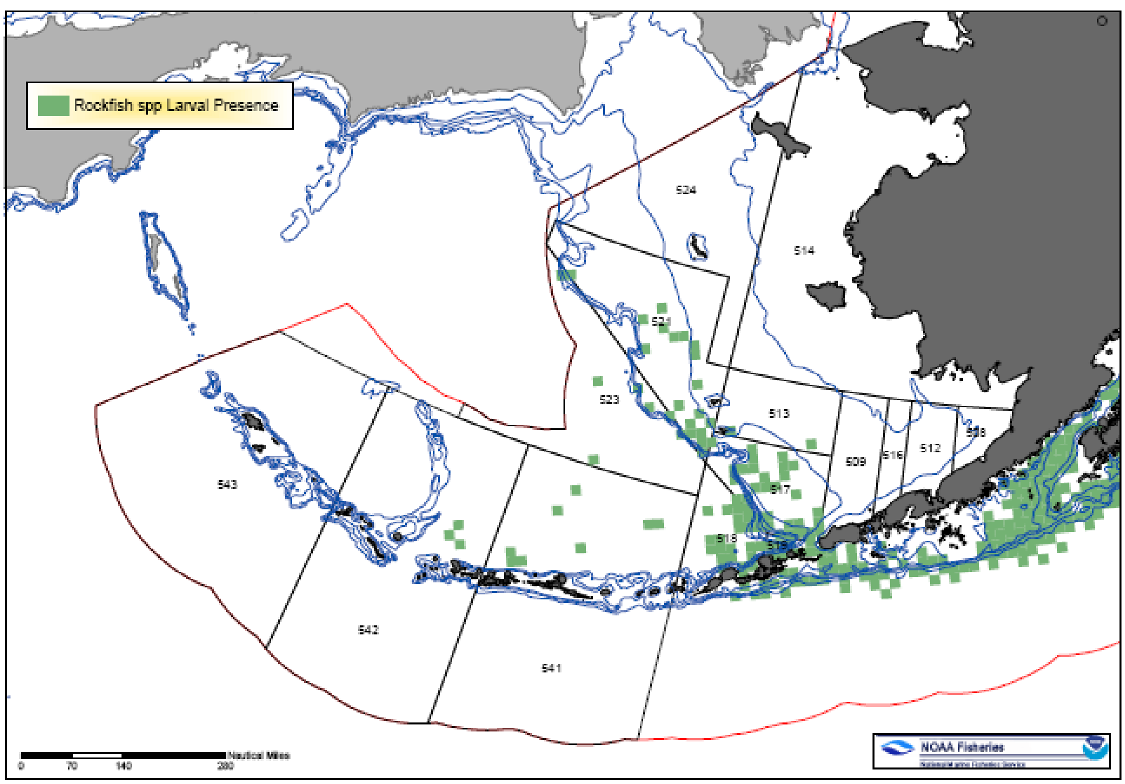


Figure E-23 EFH Distribution - BSAI Pacific Ocean Perch (Late Juveniles/Adults)

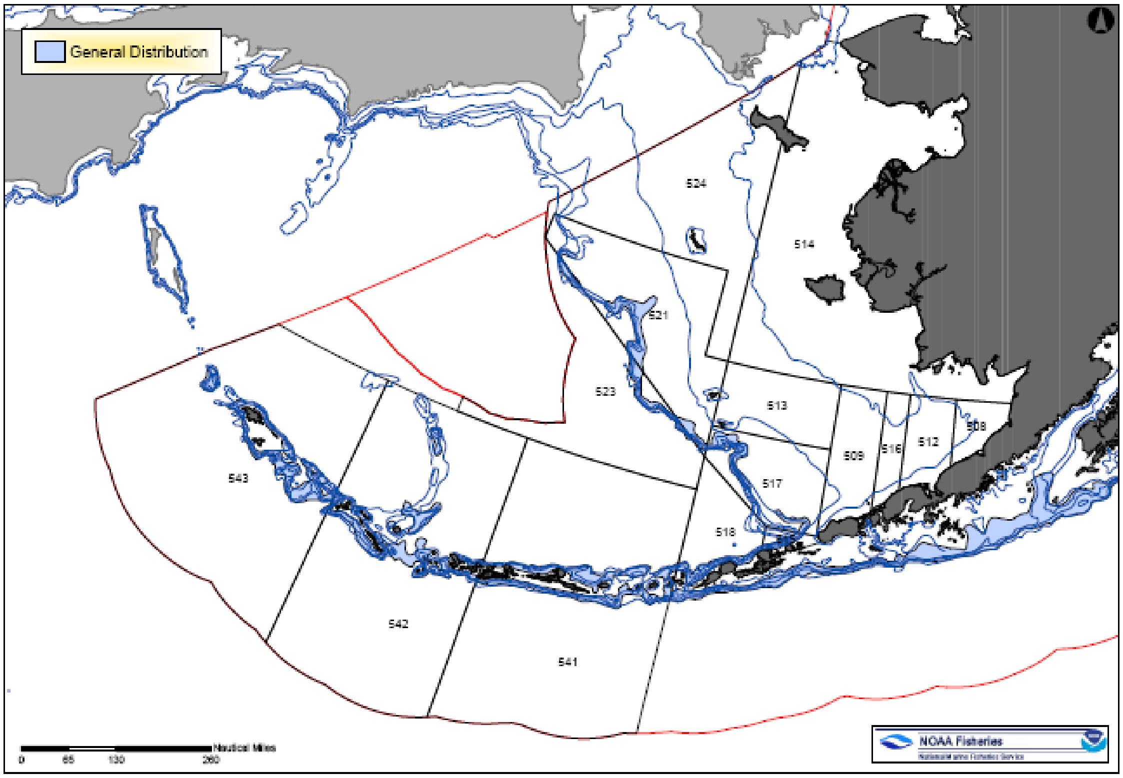


Figure E-24 EFH Distribution - BSAI Shortraker/Rougheye Rockfish (Adults)

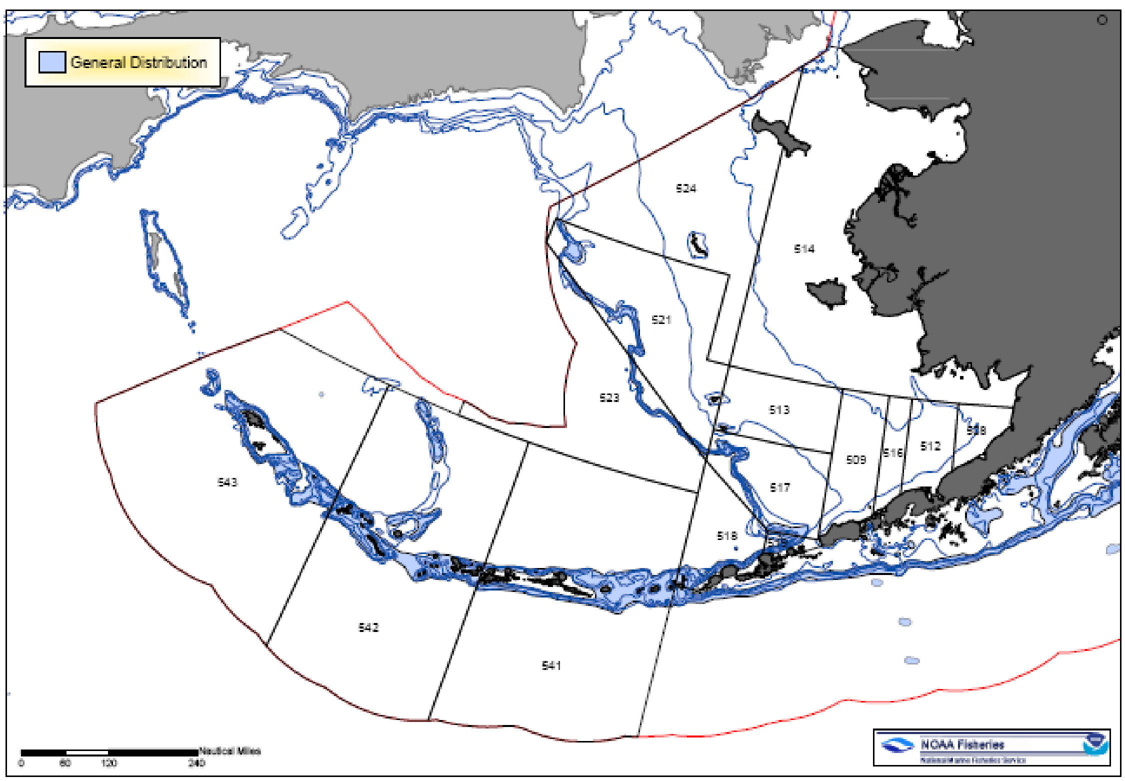


Figure E-25 EFH Distribution - BSAI Northern Rockfish (Adults)

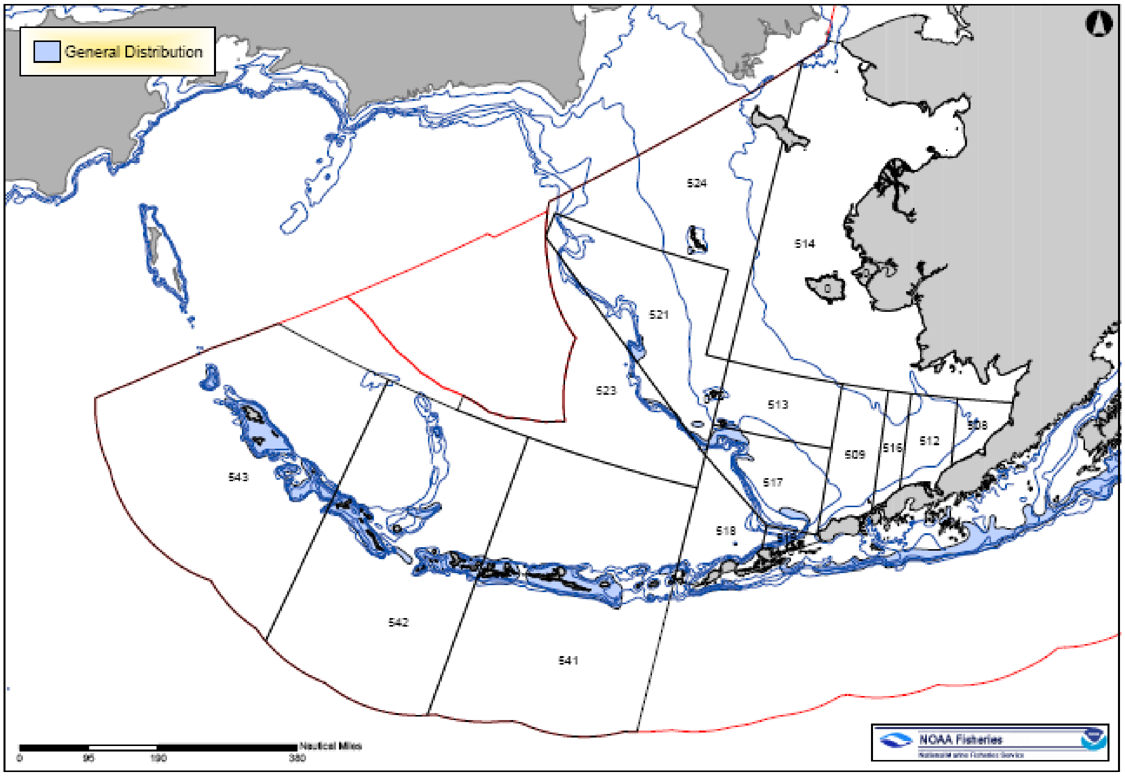


Figure E-26 EFH Distribution - BSAI Thornyhead Rockfish Late Juveniles/Adults)

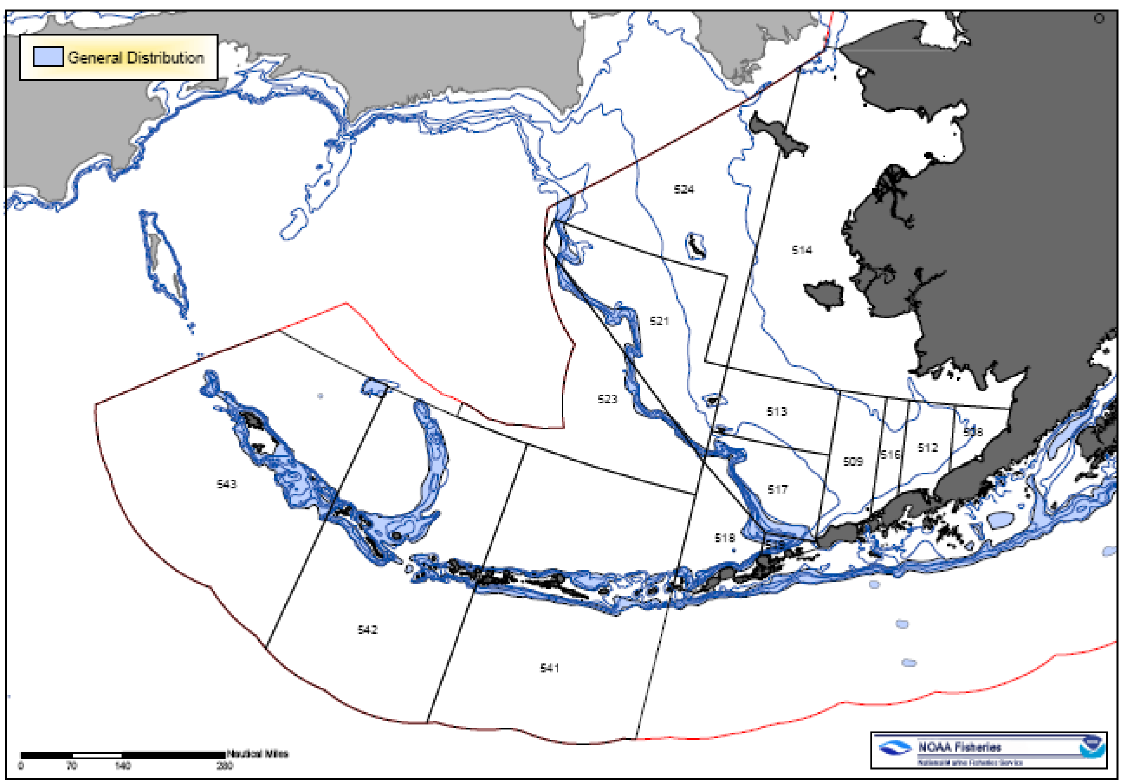


Figure E-27 EFH Distribution - BSAI Yelloweye Rockfish (Late Juveniles/Adults)

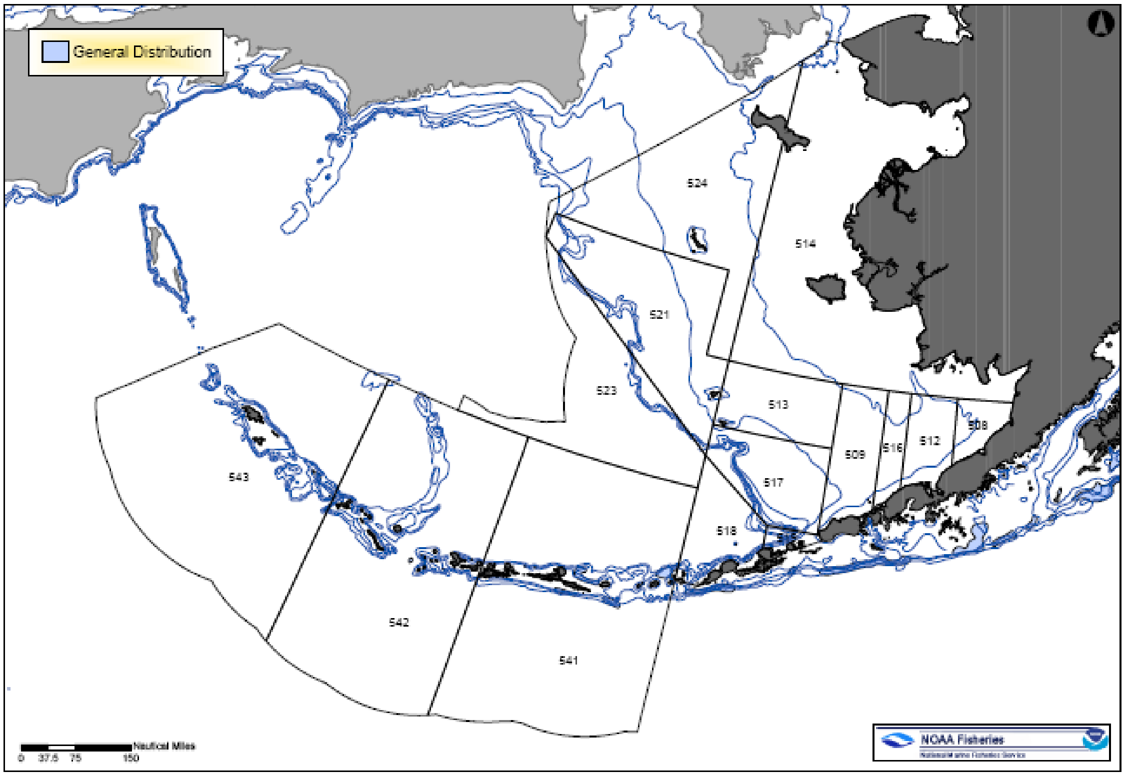


Figure E-28 EFH Distribution - BSAI Dusky Rockfish (Adults)

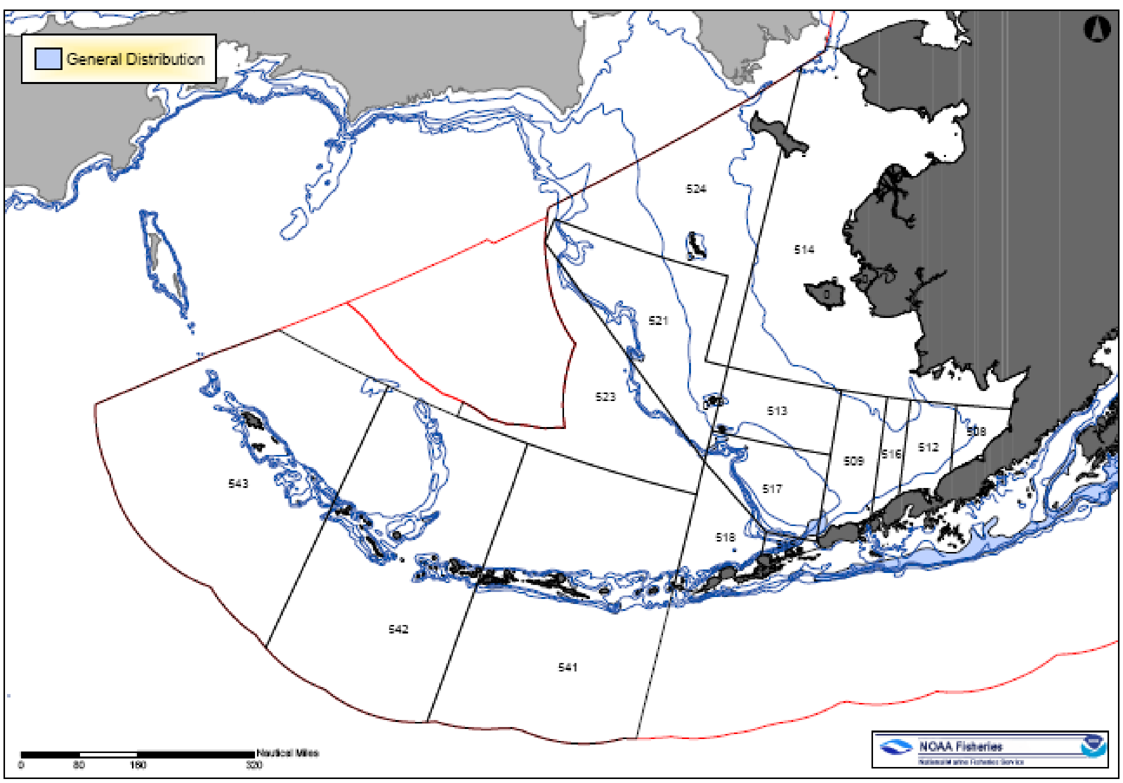


Figure E-29 EFH Distribution - BSAI Atka Mackerel (Larvae)

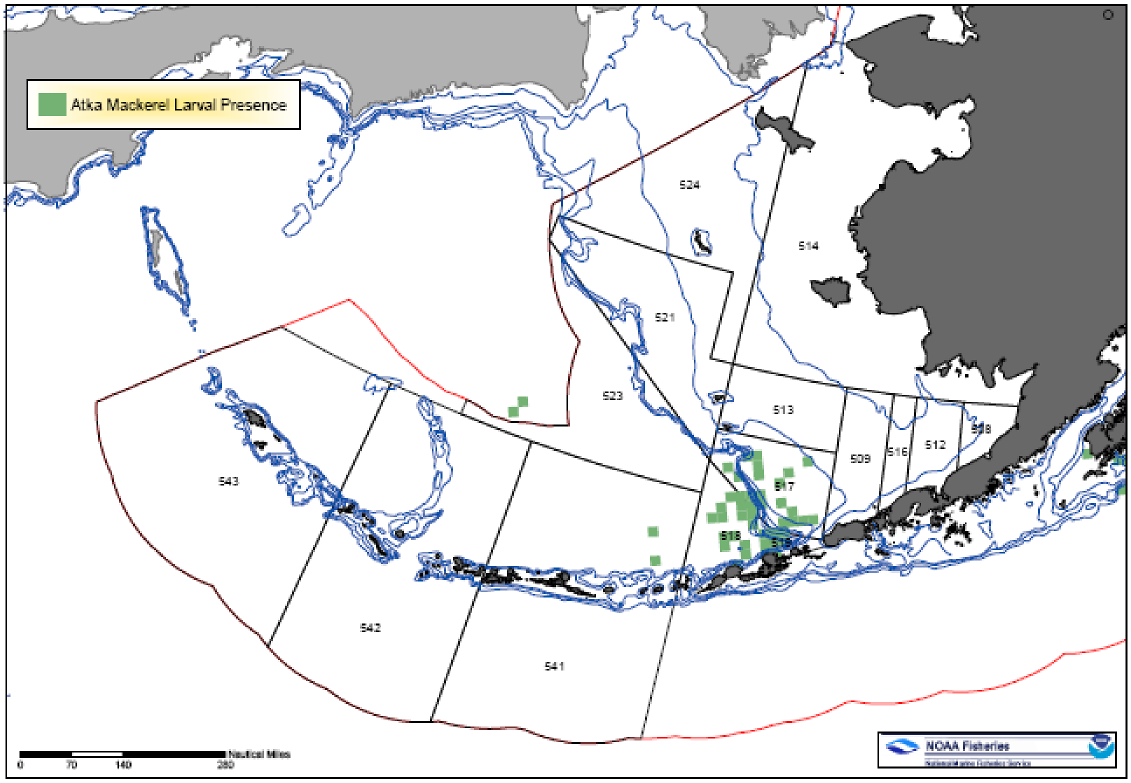


Figure E-30 EFH Distribution - BSAI Atka Mackerel (Adults)

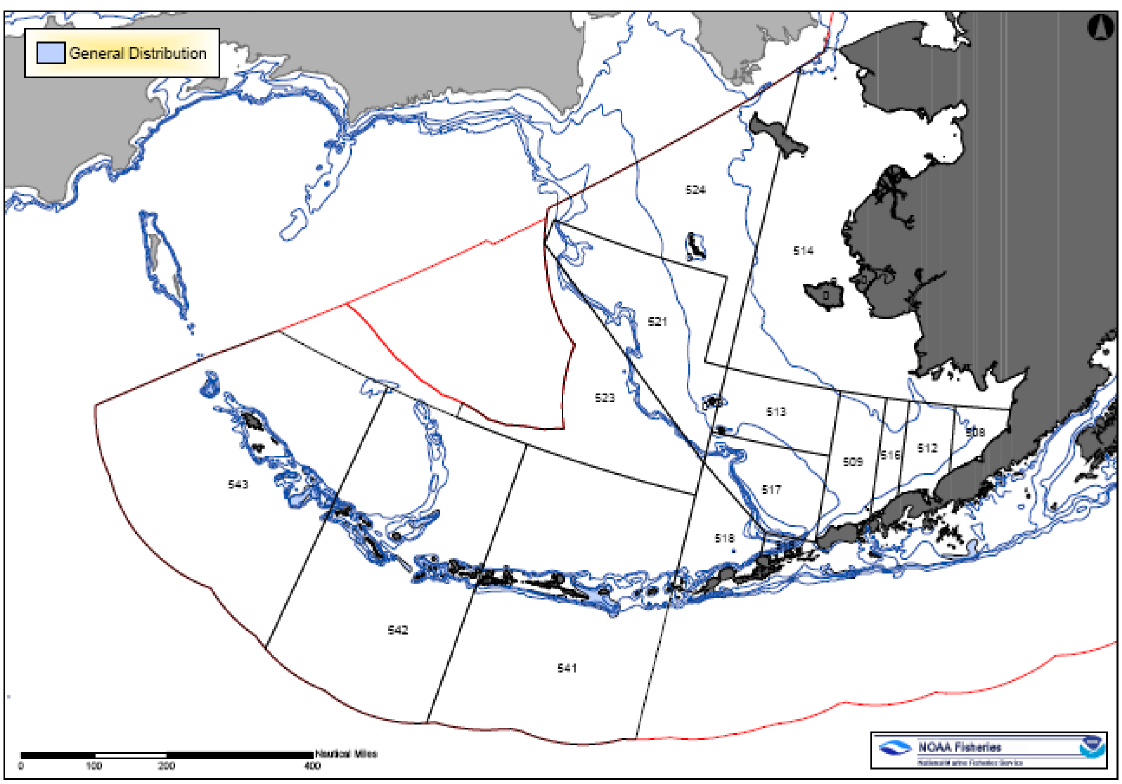


Figure E-31 EFH Distribution - BSAI Skate (Adults)

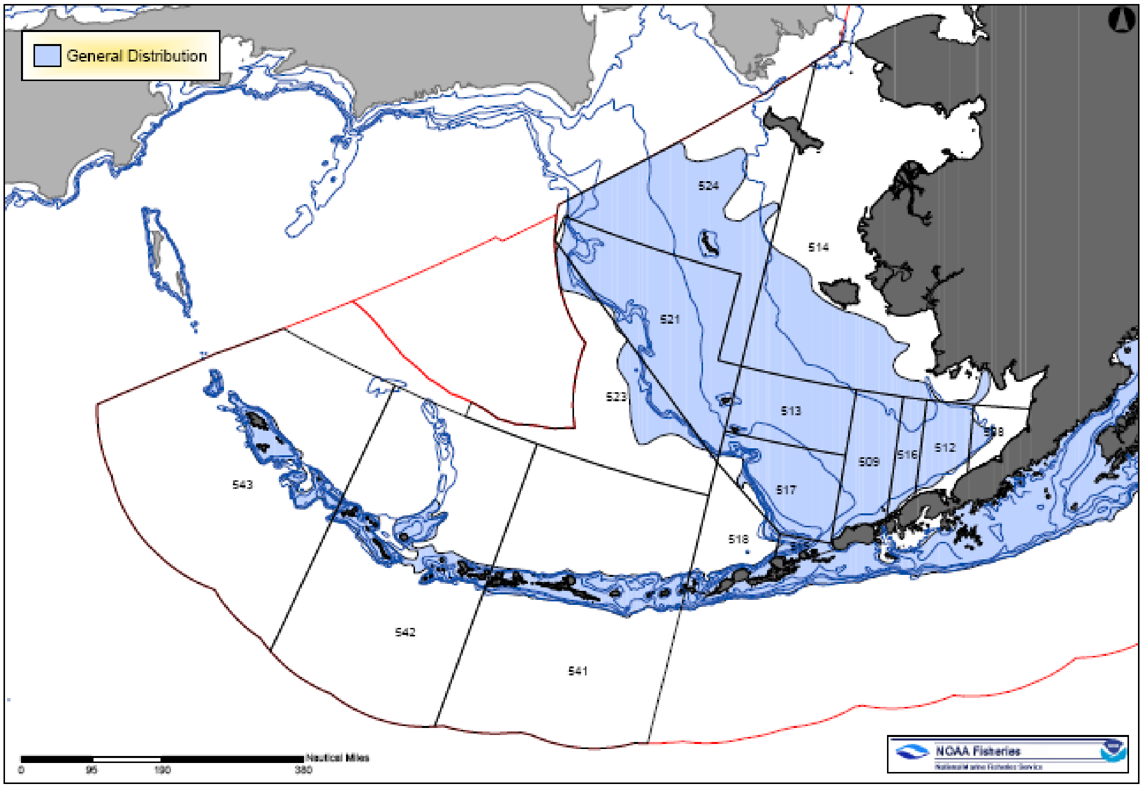


Figure E-32 EFH Distribution - BSAI Sculpin (Adults)

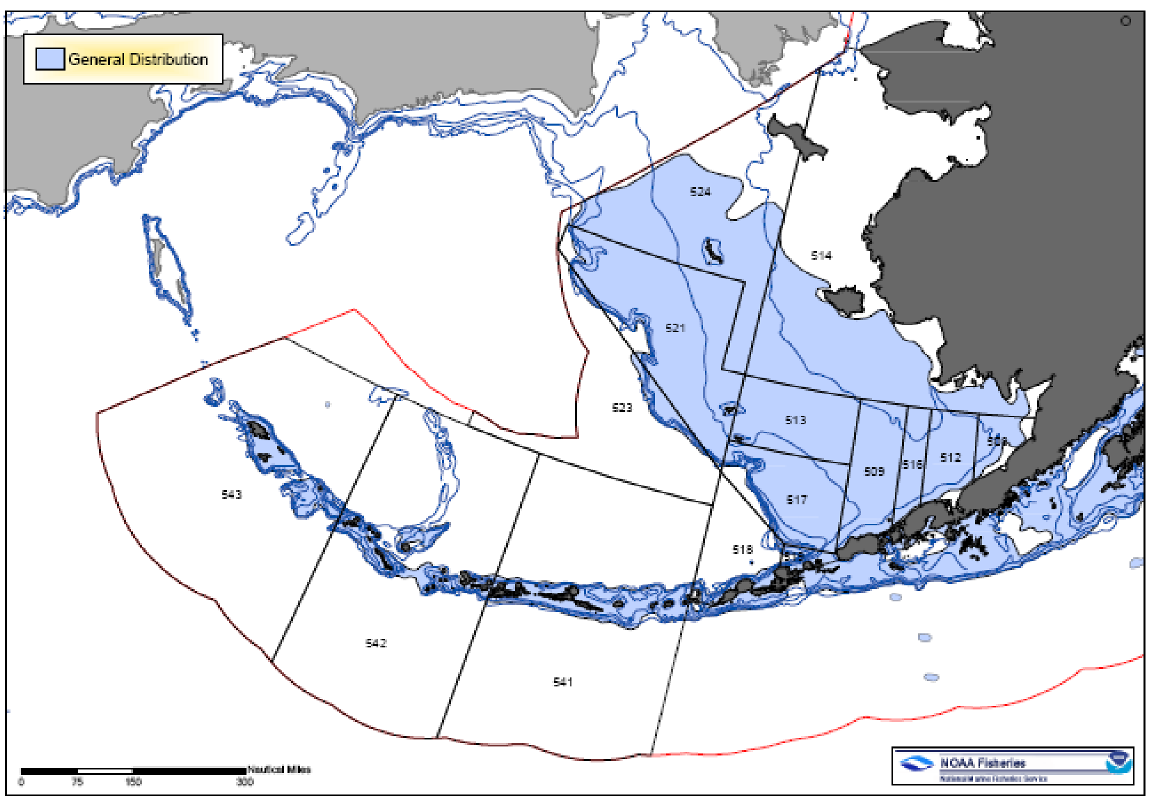
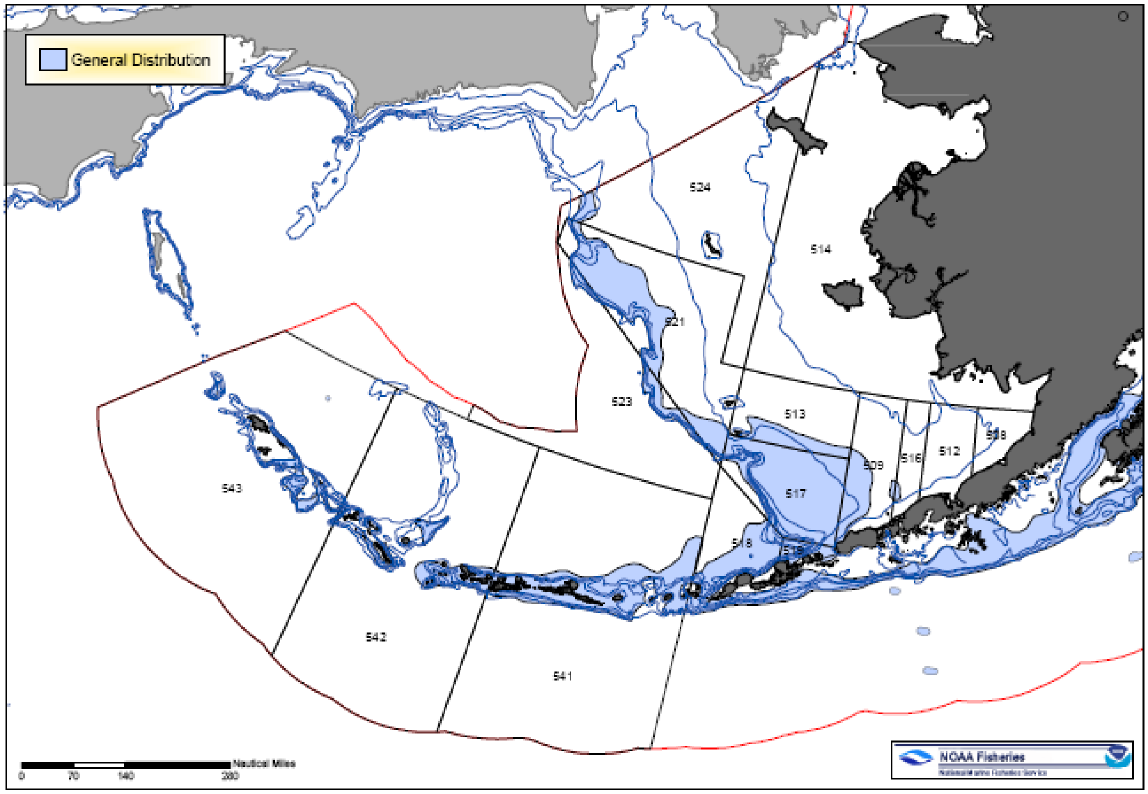


Figure E-33 EFH Distribution – BSAI Squid (Late Juveniles/Adults)



Appendix F Adverse Effects on Essential Fish Habitat

This appendix includes a discussion of fishing (Section F.1) and non-fishing (Section F.2) activities that may adversely affect essential fish habitat (EFH) for Bering Sea and Aleutian Islands (BSAI) groundfish, as well as a discussion of the potential impact of cumulative effects on EFH (Section F.3).

F.1 Fishing Activities that may Adversely Affect Essential Fish Habitat

F.1.1 Overview

This appendix addresses the requirement in Essential Fish Habitat (EFH) regulations (50 Code of Federal Regulations [CFR] 600.815(a)(2)(i)) that each FMP must contain an evaluation of the potential adverse effects of all regulated fishing activities on EFH. This evaluation must 1) describe each fishing activity, 2) review and discuss all available relevant information, and 3) provide conclusions regarding whether and how each fishing activity adversely affects EFH. Relevant information includes the intensity, extent, and frequency of any adverse effect on EFH; the type of habitat within EFH that may be affected adversely; and the habitat functions that may be disturbed.

In addition, the evaluation should 1) consider the cumulative effects of multiple fishing activities on EFH, 2) list and describe the benefits of any past management actions that minimize potential adverse effects on EFH, 3) give special attention to adverse effects on habitat areas of particular concern (HAPCs) and identify any EFH that is particularly vulnerable to fishing activities for possible designation as HAPCs, 4) consider the establishment of research closure areas or other measures to evaluate the impacts of fishing activities on EFH, 5) and use the best scientific information available, as well as other appropriate information sources.

This evaluation assesses whether fishing adversely affects EFH in a manner that is more than minimal and not temporary in nature (50 CFR 600.815(a)(2)(ii)). This standard determines whether Councils are required to act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable.

Much of the material supporting this evaluation is located in the following sections of the environmental impact statement (EIS) for EFH (NMFS 2005). These areas include:

- Descriptions of fishing activities (including gear, intensity, extent and frequency of effort) - Sections 3.4.1 and 3.4.2.
- Effects of fishing activities on fish habitat - Section 3.4.3.
- Past management actions that minimize potential adverse effects on EFH - Sections 2.2 and 4.3.
- Habitat requirements of managed species - Sections 3.2.1, 3.2.2, and Appendices D and F.
- Features of the habitat - Sections 3.1, 3.2.4 and 3.3.
- HAPCs - 2.2.2.7, 2.2.2.8, 2.3.2, and 4.2

Appendix B of the EFH EIS also contains a comprehensive, peer-reviewed analysis of fishing effects on EFH and detailed results for each managed species. This FMP incorporates by reference the complete analysis in Appendix B of the EFH EIS and summarizes the results for each managed species.

Section B.1 of Appendix B of the EFH EIS has a detailed discussion regarding the relevant rules and definitions that must be considered in developing the fishing effects on EFH analysis. The analysis is based on determining whether an effect on EFH is more than minimal and not temporary (50 CFR 600.815(a)(2)(ii)).

Fishing operations change the abundance or availability of certain habitat features (e.g., prey availability or the presence of living or non-living habitat structure) used by managed fish species to accomplish spawning, breeding, feeding, and growth to maturity. These changes can reduce or alter the abundance, distribution, or productivity of that species, which in turn can affect the species' ability to "support a sustainable fishery and the managed species' contribution to a healthy ecosystem" (50 CFR 600.10). The outcome of this chain of effects depends on characteristics of the fishing activities, the habitat, fish use of the habitat, and fish population dynamics. The duration and degree of fishing's effects on habitat features depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of habitat features.

A mathematical model was developed as a tool to structure the relationships among available sources of information that may influence the effects of fishing on habitat. This model was designed to estimate proportional effects on habitat features that would persist if current fishing levels were continued until affected habitat features reached an equilibrium with the fishing effects. Details on the limitations and uncertainties of the model and the process used by the analyst are in Section B.1 of Appendix B of the EFH EIS (NMFS 2005).

F.1.2 Effects of Fishing Analysis

Section B.2 of Appendix B of the EFH EIS (NMFS 2005) contains details on the fishing effects on EFH analysis. Fishing operations can adversely affect the availability of various habitat features for use by fish species. Habitat features are those parts of the habitat used by a fish species for the processes of spawning, breeding, feeding, or growth to maturity. A complex combination of factors influences the effects of fishing on habitat features, including the following:

(1) Intensity of fishing effort

(2) Sensitivity of habitat features to contact with fishing gear

(3) Recovery rates of habitat features

(4) Distribution of fishing effort relative to different types of habitat

The goal of this analysis was to combine available information on each of these factors into an index of the effects of fishing on features of fish habitat that is applicable to issues raised in the EFH regulations.

The effects of fishing on recovery for EFH is described by the long term effect index (LEI). Features that recover very quickly could achieve a small LEI under any fishing intensity. Features that recover very slowly may have a high LEI even with small rates of fishing effects. The LEI is used in the summaries to describe the fishing effects on EFH for managed species. The LEI scores represent the ability of fishing to reduce however much of each feature was present in an area as a proportional reduction. LEIs were calculated for all areas where fishing occurred, including some areas where the subject feature may never have existed.

Section B.2.4.3 of Appendix B of the EFH EIS contains information regarding recovery rates for various habitat types. Long and short recovery times were 3 to 4 months for sand, 6 to 12 months for sand/mud, and 6 to 18 months for mud habitats. In general, very little data are available on the recovery periods for living structure. Recovery rates of structure-forming invertebrates associated with the soft bottom, based on their life history characteristics, is estimated at 10 to 30 percent per year with a mean of 20 percent per year. Hard-bottom recovery rates are estimated to be slower, 1 to 9 percent per year, with a mean of 5 percent per year based on hard-bottom invertebrate life history characteristics. Recovery rates of gorgonian corals are potentially much longer, with rates of 50, 100, and 200 years estimated.

The habitat and regional boundaries were overlaid using geographic information systems (GIS) (ArcMap), resulting in the classification of each of the 5-by-5-km blocks by habitat type. Where a boundary passed through a block, the area within each habitat was calculated, and those areas were analyzed separately. For the GOA and AI habitats, the estimates of proportions of hard and soft substrate habitat types were entered into the classification matrix for each block. The total area of each benthic habitat was calculated through GIS based on coastlines, regional boundaries, habitat boundaries, and depth contours (Table B.2-7 of the EFH EIS).

Additional details on the quantity and quality of data and studies used to develop the analysis, how the analysis model was derived and applied, and considerations for the LEIs are contained in Section B.2 of Appendix B of the EFH EIS.

F.1.3 Fishing Gear Impacts

The following sections summarize pertinent research on the effects of fishing on seafloor habitats.

F.1.3.1 Bottom Trawls

The EFH EIS effects of fishing analysis evaluates the effects of bottom trawls on several categories of habitats: infaunal prey, epifaunal prey, living structure, hard corals, and nonliving structure.

Infaunal Prey

Infaunal organisms, such as polychaetes, other worms, and bivalves, are significant sources of prey for Alaska groundfish species. Because researchers were not able to determine which crustaceans cited in trawl effects studies were actually infauna, all crustaceans were categorized as epifaunal prey. Studies of the effects of representative trawl gear on infauna included Kenchington et al. (2001), Bergman and Santbrink (2000), Brown (2003), Brylinsky et al. (1994), and Gilkinson et al. (1998).

Kenchington et al. (2001) examined the effects on over 200 species of infauna from trawl gear that closely resembled the gear used off of Alaska. Three separate trawling events were conducted at intervals approximating 1 year. Each event included 12 tows through an experimental corridor, resulting in an average estimate of three to six contacts with the seafloor per event. Of the approximately 600 tests for species effects conducted, only 12 had statistically significant results. The statistical methods were biased toward a Type 1 error of incorrectly concluding an impact. Ten of the significant results are from a year when experimental trawling was more concentrated in the center of the corridors where the samples of infauna were taken. It is likely that more trawl contacts occurred at these sampled sites than the 4.5 estimate (average of three to six contacts) used to adjust the multiple contact results. As such, the results that were available from the study (non-significant values were not provided) represent a sample biased toward larger reductions when used to assess median reductions of infauna. The resulting median effect was 14 percent reduction in biomass.

Bergman and Santbrink (2000) studied effects on infauna (mostly bivalves) from an otter trawl equipped with 20-centimeter (cm) rollers in the North Sea. Because the study was conducted on fishing grounds with a long history of trawling, the infaunal community may already have been affected by fishing. Experimental trawling was conducted to achieve average coverage of 1.5 contacts within the experimental area over the course of the study. Results were provided for two substrate types: coarse sand with 1 to 5 percent of the area contacted, and silt and fine sand with 3 to 10 percent of the area contacted. The five infauna biomass reductions in the first area had a median of 8 percent. The ten infauna biomass reductions from the second area had a median of 5 percent.

In a recent master's thesis, Brown (2003) studied the effects of experimental trawling in an area of the nearshore EBS with sandy sediments. Trawling covered 57 percent of the experimental area. Several bivalves had lower abundance after trawling, while polychaetes were less affected. The median of the reduction in percentages for each species, after adjusting for coverage, was a 17 percent reduction in biomass per gear contact.

Brylinsky et al. (1994) investigated effects of trawling on infauna, mainly in trawl door tracks, at an intertidal estuary. Only three results were provided for infauna in roller gear tracks, but the results were so variable (-50 percent, +12 percent, +57 percent) that they were useless for the purpose of this analysis. Eight results on the effects of trawl doors on species biomass were available for polychaetes and nemerteans. These results had a median of 31 percent reduction in biomass and a 75th percentile of 42 percent reduction in biomass. Gilkinson et al. (1998) used a model trawl door on a prepared substrate to estimate that 64 percent of clams in the door's path were exposed after one pass, but only 5 percent were injured. Doors make up less than 4 percent of the area of the seafloor contacted by Alaska trawls.

The results of Kenchington et al. (2001), Bergman and Santbrink (2000), and Brown (2003) were combined for inclusion in the model, resulting in a median of 10 percent reduction in biomass per gear contact for infaunal species due to trawling, and 25th and 75th percentiles of 5 and 21 percent, respectively (Table B.2-5 of the EFH EIS).

Epifaunal Prey

Epifaunal organisms, such as crustaceans, echinoderms, and gastropods, are significant prey of Alaska groundfish species. However, one of the most common classes of echinoderms, asteroids, are rarely found in fish stomachs. While some crustaceans may be infauna, an inability to consistently identify these species resulted in all crustaceans being categorized as epifaunal prey. Studies of the effects of representative trawl gear on epifauna included Prena et al. (1999), Brown (2003), Freese et al. (1999), McConnaughey et al. (2000), and Bergman and Santbrink (2000).

Prena et al. (1999), as a component of the Kenchington et al. (2001) study, measured the effects of trawling on seven species of epifauna. The median of these results was a 4 percent biomass reduction per gear contact. There appeared to be in-migration of scavenging crabs and snails in this and other studies. Removing crab and snails left only two measurements, 6 and 7 percent reductions in biomass. Bergman and Santbrink (2000) measured effects on four epifaunal species in the experimental coarse sand area (median reduction in biomass was 12 percent) and five epifaunal species in the experimental fine sand area (median reduction in biomass was 16 percent). When crabs and snails were removed, the coarse sand area was unchanged, and the median value for the fine sand area was 15 percent biomass reduction. Brown (2003) studied six epifaunal species, resulting in a median reduction in biomass per gear contact of 5 percent. Combining results from Prena et al. (1999), Brown (2003), and Bergman and Santbrink (2000), and removing crabs and snails, gives a median reduction in biomass of epifaunal species of 10 percent, and 25th and 75th percentiles of 4 and 17 percent, respectively. These are the q values (proportion of the contacted elements that are made unavailable, due to damage, removal, or mortality) used for the analysis of the effects of full trawls on epifaunal prey, except for those fisheries using tire gear (see below).

The study of McConnaughey et al. (2000) compared the effects of fishing on an area that received heavy fishing pressure between 4 and 8 years previously, using an adjacent unfished area as a control. Therefore, results included a combination of species reductions and recovery, were not adjusted for multiple contacts, and were not directly comparable to the results of the studies above. However, for comparison with previously discussed studies, the resulting median and 75th percentile reductions in biomass for six species of epifauna (excluding snails and crabs) were 12 and 28 percent, respectively. The median result was within the same range as those from the more direct studies, and the 75th percentile result was not sufficiently higher as to indicate substantial error in the direct estimates.

Freese et al. (1999) studied the effects of tire gear on the epifauna of a pebble and boulder substrate. Eight epifaunal species gave a median response of 17 percent reduction in biomass and a 75th percentile of 43 percent reduction in biomass. Before snails were removed, the 25th percentile indicated an increase in biomass of 82 percent due to colonization by snails. The resulting values when two snail taxa were removed were 38 and 43 percent medians and a 5 percent reduction in epifaunal biomass for the 75th and 25th percentiles. The authors noted a strong transition to apparently smaller effects outside of the direct path of the tire gear. For fisheries in hard-bottom areas, where tire gear is most common, epifaunal effects were adjusted for this increased effect within the path of the tire gear. Typical tire gear covers about 25 percent of the full trawl path (i.e., 14 m out of 55 m total), so the resulting q values are 17 percent reduction in epifaunal biomass for the median (0.25 times 38 plus 0.75 times 10), 23 percent reduction for epifaunal biomass for the 75th percentile (0.25 times 43 plus 0.75 times17), and 5 percent reduction for the 25th percentile.

Living Structure

Organisms that create habitat structure in Alaska waters include sponges, bryozoans, sea pens, soft and stony corals, anemones, and stalked tunicates. Studies of the effects of representative trawls on these groups include Van Dolah et al. (1987), Freese et al. (1999), Moran and Stephenson (2000), Prena et al. (1999), and McConnaughey et al. (2000). The first three studies examined the effects on epifauna on substrates such as pebble, cobble, and rock that support attached erect organisms, while the last two studies were located on sandy substrates. Effect estimates were available for only one type of structure-providing organism, the soft coral *Gersemia*, from Prena et al. (1999). After adjustment for multiple contacts, *Gersemia* had a q of 10 percent reduction in biomass per gear contact.

Both the Van Dolah et al. (1987) and Freese et al. (1999) studies identified removal rates and rates of damage to organisms remaining after contact, raising the question of how damage incurred from contact with gear reduces the structural function of organisms. In Freese et al. (1999), sponges were indicated as damaged if they had more than 10 percent of the colony removed, or if tears were present through more than 10 percent of the colony length. Van Dolah et al. (1987) classified organisms as heavily damaged (more than 50 percent damage or loss) or lightly damaged (less than 50 percent damage or loss). Lacking better information, the damaged organisms from Freese et al. (1999) were assigned a 50 percent loss of structural function, and the heavily and lightly damaged organisms from VanDolah et al. (1987) were assigned 75 and 25 percent losses of their function respectively.

Adjustments to the Freese et al.(1999) results were based on observations of a further decrease in vase sponge densities 1 year post-study. Freese (2001) indicates that some of the damaged sponges had suffered necrotization (decay of dead tissues) to the extent that they were no longer identifiable. This percentage was added to the category of removed organisms, resulting in q estimates for epifauna structures in the path of tire gear of a 35 percent median reduction in biomass per contact and a 75th percentile of 55 percent reduction in biomass per contact. Summary results of the VanDolah data show a median of 17 percent reduction in biomass per gear contact and a 75th percentile of 22 percent reduction in biomass per gear contact. Moran and Stephenson (2000) combined all erect epifauna taller than 20 cm and studied their reductions subsequent to each of a series of trawl contacts. They estimated a per contact reduction in biomass (q) of 15 percent. Combining the non-tire gear studies gives a full gear q median per contact reduction estimate of 15 percent and a 75th percentile per contact reduction estimate of 21 percent. Using the same methods as applied to epifauna for combining non-tire gear data with the tire gear data produced effect estimates for trawls employing tire gear of a median per contact reduction of 20 percent and a 75th percentile per contact reduction of 30 percent.

Data from McConnaughey et al. (2000) combining initial effects of high-intensity trawling and recovery had a median value for structure-forming epifauna per contact reduction of 23 percent and a 75th percentile reduction of 44 percent. While these results show greater reductions than the single pass estimates from the other studies, the effects of multiple years of high-intensity trawling can reasonably account for such a difference; thus, the above values for q were not altered.

Hard Corals

While numerous studies have documented damage to hard corals from trawls (e.g., Fossa 2002, Clark and O'Driscoll 2003), only one (Krieger 2001) was found that related damage to a known number of trawl encounters. Fortunately, this study occurred in the GOA with a common species of gorgonian coral (*Primnoa rubi*) and with gear not unlike that used in Alaska commercial fisheries. Krieger used a submersible to observe a site where large amounts of *Primnoa* were caught during a survey trawl. An estimated 27 percent of the original volume of coral was removed by the single trawl effort. The site was in an area closed to commercial trawling, so other trawling effects were absent. This value was used for coral sensitivity in the analysis bracketed by low and high values of 22 and 35 percent.

Non-living Structure

A variety of forms of the physical substrates in Alaska waters can provide structure to managed species, particularly juveniles. These physical structures range from boulder piles that provide crevices for hiding to sand ripples that may provide a resting area for organisms swimming against currents. Unfortunately, few of these interactions are understood well enough to assess the effects of substrate changes on habitat functions. A number of studies describe changes to the physical substrates resulting from the passage of trawls. However, there is no consistent metric available to relate the use of such structures by managed species to their abundance or condition. This lack of relationship effectively precludes a quantitative description of the effects of trawling on non-living structure. The following discussion describes such effects qualitatively and proposes preliminary values of q for the analysis.

Sand and Silt Substrates:

Schwinghamer et al. (1998) described physical changes to the fine sand habitats caused by trawling as part of the same study that produced Prena et al. (1999) and Kenchington et al. (2001). Door tracks, approximately 1 m wide and 5 cm deep, were detected with sidescan sonar, adding to the surface relief of the relatively featureless seafloor. Finer scale observations, made with video cameras, indicated that trawling replaced small hummocky features a few cm tall with linear alignments of organisms and shell hash. A dark organic floc that was present before trawling was absent afterwards. While no changes in sediment composition were detected, measurements of the internal structure of the top 4.5 cm of sediment were interpreted to indicate loss of small biogenic sediment structures such as mounds, tubes, and burrows. Brylinsky et al. (1994) describe trawl tracks as the most apparent effect of trawls on a silty substrate and the tracks of rollers as resulting in much shallower lines of compressed sediment than tracks of trawls without rollers. A wide variety of papers describes trawl marks; these papers include Gilkinson et al. (1998), who describe the scouring process in detail as part of a model door study.

For effects on sedimentary forms, the action of roller gear trawls replaces one set of cm-scale forms, such as hummocks and sand ripples, with door and roller tracks of similar scales. In habitats with an abundance of such structures, this can represent a decrease in seabed complexity, while in relatively smooth areas, an increase in complexity will result (Smith et al. 2000). The effects on internal sediment structure are considered too small in scale to provide shelter directly to the juveniles of managed species. The extent to which they affect the availability of prey for managed species is better measured by directly considering the abundance or those prey species. This consideration was done by studies cited in the prey sections above. Since the observed effects of a single gear contact are relatively subtle, with ambiguous effects on function, the parameter selected for this analysis represents a small negative effect (-2 percent). This provides some effect size that can be scaled up or down if greater or lesser effects are hypothesized or measured.

Pebble to Boulder Substrates:

In substrates composed of larger particles (large pebbles to boulders), the interstitial structure of the substrate has a greater ability to provide shelter to juveniles and adults of managed species. The association of species aggregations with such substrates provides evidence of their function as structure (Krieger 1992, 1993). Freese et al. (1999) documented that the tire gear section of a trawl disturbed an average of 19 percent of the large boulders (more than 0.75-m longest axis) in its path. They noted that displaced boulders can still provide cover, while breaking up boulder piles can reduce the number and complexity of crevices.

In areas of smaller substrate particles (pebble to cobble), the track of the tire gear was distinguishable from the rest of the trawl path due to the removal of overlying silt from substrates with more cobble or the presence of a series of parallel furrows 1 to 8 cm deep from substrates with more pebble. Of the above effects, only breaking up boulder piles was hypothesized to decrease the amount of non-living functional structure for managed species. A key unknown is the proportional difference in functional structure between boulder piles and the same boulders, if separated. If that difference comprised 20 percent of the functional structure, and 19 percent of such piles were disturbed over one-third of the trawl paths (tire gear section), a single trawl pass would reduce non-living structure by only about 1 percent. Even if piles in the remaining trawl path were disturbed at half the rate of those in the path of the tire gear (likely an overestimate from descriptions in Freese et al. 1999), the effect would only increase to 2 percent. Lacking better information, this speculative value was applied in the analysis.

F.1.3.2 Pelagic Trawls

Studies using gear directly comparable to Alaska pelagic trawls, and thus identifying the resulting effect of such gear contact with the seafloor, are lacking. By regulation, these trawls must not use bobbins or other protective devices, so footropes are small in diameter (typically chain or sometimes cable or wrapped cable). Thus, their effects may be similar to other footropes with small diameters (i.e., shrimp or Nephrops trawls). However, these nets have a large enough mesh size in the forward sections that few, if any, benthic organisms that actively swim upward would be retained in the net. Thus, benthic animals that were found in other studies to be separated from the bottom and removed by trawls with small-diameter footropes would be returned to the seafloor immediately by the Alaska pelagic trawls. Pelagic trawls are fished with doors that do not contact the seafloor, so any door effects are eliminated. Finally, because the pelagic trawl's unprotected footrope effectively precludes the use of these nets on rough or hard substrates, they do not affect the more complex habitats that occur on those substrates.

Two studies of small footrope trawls were used to represent the effects of pelagic trawl footropes on infaunal prey. Since most infaunal prey are too small to be effectively retained by bottom trawls, the large mesh size of pelagic trawls was not considered a relevant difference for the feature. Ball et al. (2000) investigated the effects of two tows of a Nephrops trawl in the Irish Sea on a muddy sand bottom in two different years. Eighteen taxonomic groups were measured in each year, including bivalves, gastropods, crustaceans, and annelids. For the 27 abundance reductions cited, the median effect was a 19 percent reduction abundance per gear contact, and the 75th percentile was a 40 percent reduction in abundance per gear contact, with the adjustment for multiple tows. Sparks-McConkey and Wating (2001) used four passes of a whiting trawl on a clay-silt bottom in the Bay of Maine. The infauna responses measured included three bivalves and seven polychaetes and nemerteans. The median response was a 24 percent reduction in abundance per gear contact, and the 75th percentile was a 31 percent reduction in abundance per gear contact, with the adjustment for multiple tows. Combining the two studies gave a median per contract reduction of 21 percent and a 75th percentile per contact reduction of 36 percent. These values were higher than those for roller gear trawls since there is continuous contact across the footrope and a greater ability of smaller footropes to penetrate the substrate.

Sessile organisms that create structural habitat may be uprooted or pass under pelagic trawl footropes, while those that are more mobile or attached to light substrates may pass over the footrope, with less resulting damage. Non-living structures may be more affected by pelagic trawl footropes than by bottom trawl footropes because of the continuous contact and smaller, more concentrated, surfaces over which weight and towing force are applied. In contrast, bottom trawls may capture and remove more of the large organisms that provide structural habitat than pelagic trawls because of their smaller mesh sizes. The bottom trawl doors and footropes could add complexity to sedimentary bedforms as mentioned previously, while pelagic trawls have an almost entirely smoothing effect. Based on these considerations, values of 20 percent reduction per gear contact and 30 percent reduction per gear contact were selected for both living and non-living structure.

F.1.3.3 Longlines

Studies that quantitatively assess the effects of longlines on seafloor habitat features were not found. Due to the light weight of the lines used with longline gear, effects on either infaunal or epifaunal prey organisms are considered to be limited to anchors and weights. Since these components make up less than 1/500th of the length of the gear, their effects are considered very limited (0.05 percent reduction per contact was the value used). Similarly, effects on the non-living structure of soft bottoms are also likely to be very limited.

Organisms providing structure may be hooked or otherwise affected by contact with the line. Observers have recorded anemones, corals, sea pens, sea whips, and sponges being brought to the surface hooked on longline gear (Stellar sea lion protection measures SEIS, 2001), indicating that the lines move some distance across the seafloor and can affect some of the benthic organisms. The effects on non-living structure in hard-bottom areas due to hang-ups on smaller boulder piles and other emergent structures are limited to what may occur at forces below those necessary to break the line. Similar arguments to those used for bottom trawl effects on hard non-living structure would justify an even lower effect than the value generated for bottom-trawling (1 percent). Unfortunately, there are no data to indicate what proportion the retained organisms represent of those contacted on the seafloor or the level of damage to any of the affected organisms. Values for reduction of living structure equal to one-half of those for bottom trawls were used for the area contacted by longlines.

F.1.3.4 Pots

The only studies on pots (Eno et al. 2001) have examined gear much smaller and lighter than that used in Alaska waters and are, thus, not directly applicable in estimating effects of pots on habitat. Alaska pots are approximately 110 times as heavy and cover 19 times the area as those used by Eno et al. (2001) (2.6 kilograms [kg], 0.25 m^2). The Eno et al. (2001) study did show that most sea pens recovered after being pressed flat against the bottom by a pot. Most Alaska pots have their mesh bottoms suspended 2.5 to 5 cm above their weight rails (lower perimeter and cross pieces that contact the substrate first); hence, the spatial extent to which the greater weight of those pots is applied to organisms located underneath the pots is limited, but more intense.

The area of seafloor disturbed by the weight rails is of the greatest concern, particularly to the extent that the pot is dragged across the seafloor by bad weather, currents, or during hauling. Based on the estimated weight of the pots in water, and the surface area of the bottom of these rails, the average pressure applied to the seafloor along the weight rails (about 1 pound per square inch [lb/in^2] [0.7 kilogram per square centimeter (kg/cm^2)]) is sufficient to penetrate into most substrates during lateral movement. The effects of pots as they move across the bottom were speculated to be most similar to those of pelagic trawls with smaller contact diameter and more weight concentrated on the contact surface. Therefore, structure reduction values 5 percent greater than those determined for pelagic trawls were used.

F.1.3.5 Dinglebar

Dinglebar troll gear (Figure 3-9 of the HAPC EA) consists of a single line that is retrieved and set with a power or hand troll gurdy, with a terminally attached weight (cannon ball -12 lbs. or iron bar), from which one or more leaders with one or more lures or baited hooks are pulled through the water while a vessels is underway (NPFMC 2003). Dinglebar troll gear is essentially the same as power or hand troll gear, the difference lies in the species targeted and the permit required. For example, dinglebar troll gear can be used in the directed fisheries for groundfish (e.g. cod) or halibut. These species may only be taken incidentally while fishing for salmon with power or hand troll gear. There is a directed fishery for ling cod in Southeast Alaska using dinglebar troll gear. Trolling can occur over any bottom type and at almost any depths. Trollers work in shallower coastal waters, but may also fish off the coast, such as on the Fairweather Grounds. The dinglebar is usually made of a heavy metal, such as iron, is used in nearly continuous contact with the bottom, and therefore, is likely to disturb bottom habitat.

F.1.3.6 Dredge Gear

Dredging for scallops may affect groundfish habitat by causing unobserved mortality to marine life and modification of the benthic community and sediments. Similar to trawling, dredging places fine sediments into suspension, buries gravel below the surface and overturns large rocks that are embedded in the substrate (NEFMC 1982, Caddy 1973). Dredging can also result in dislodgement of buried shell material, burying of gravel under re-suspended sand, and overturning of larger rocks with an appreciable roughening of the sediment surface (Caddy 1968). A study of scallop dredging in Scotland showed that dredging caused significant physical disturbance to the sediments, as indicated by furrows and dislodgement of shell fragments and small stones (Eleftheriou and Robertson 1992). The authors note, however, that these changes in bottom topography did not change sediment disposition, sediment size, organic carbon content, or chlorophyll content. Observations of the Icelandic scallop fishery off Norway indicated that dredging changed the bottom substrate from shell-sand to clay with large stones within a 3-year period (Aschan 1991). Mayer et al. (1991), investigating the effects of a New Bedford scallop dredge on sedimentology at a site in coastal Maine, found that vertical redistribution of bottom sediments had greater implications than the horizontal translocation associated with scraping and plowing the bottom. The scallop dredge tended to bury surficial metabolizable organic matter below the surface, causing a shift in sediment metabolism away from aerobic respiration that occurred at the sediment-water interface and instead toward subsurface anaerobic respiration by bacteria (Mayer et al. 1991). Dredge marks on the sea floor tend to be short-lived in areas of strong bottom currents, but may persist in low energy environments (Messieh et al. 1991).

Two studies have indicated that intensive scallop dredging may have some direct effects on the benthic community. Eleftheriou and Robertson (1992), conducted an experimental scallop dredging in a small sandy bay in Scotland to assess the effects of scallop dredging on the benthic fauna. They concluded that while dredging on sandy bottom has a limited effect on the physical environment and the smaller infauna, large numbers of the larger infauna (molluscs) and some epifaunal organisms (echinoderms and crustaceans) were killed or damaged after only a few hauls of the dredge. Long-term and cumulative effects were not examined, however. Achan (1991) examined the effects of dredging for islandic scallops on macrobenthos off Norway. Achan found that the faunal biomass declined over a four-year period of heavy dredging. Several species, including urchins, shrimp, seastars, and polychaetes showed an increase in abundance over the time period. In summary, scallop gear, like other gear used to harvest living aquatic resources, may effect the benthic community and physical environment relative to the intensity of the fishery.

Adverse effects of scallop dredges on benthic communities in Alaska may be lower in intensity than trawl gear. Studies on effects of trawl and dredge gear have revealed that, in general, the heavier the gear in contact with the seabed, the greater the damage (Jones 1992). Scallop dredges generally weigh less than most trawl doors, and the relative width they occupy is significantly smaller. A 15 ft wide New Bedford style scallop dredge weighs about 1,900 lbs (Kodiak Fish Co. data). Because scallop vessels generally fish two dredges, the total weight of the gear is 3,800 lbs. Trawl gear can be significantly heavier. An 850 horsepower vessel pulling a trawl with a 150 ft sweep may require a pair of doors that weigh about 4,500 pounds. Total weight of all trawl gear, including net, footrope, and mud gear would weigh even more (T. Kandianis, personal communication). Hence, based on weight of gear alone, scallop fishing may have less effect than bottom trawling, however its effects may be more concentrated.

F.1.4 Results of the Analysis of Effects of Fishing on Habitat Features

No fishing occurred in blocks covering a large proportion of the seafloor area shallower than 1,000 m from 1998 to 2002 (Table B.2-8 of the EFH EIS), and even more blocks were unaffected by trawling. Most of the fished blocks experienced intensities less than 0.1, and only a small proportion of the area (2.5 percent BS, 0.8 percent AI, and 0.9 percent GOA) was in blocks with intensities above 1.0. These fishing intensities determined the spatial distribution of the indices of fishing effects estimated by the model.

The analysis estimated an LEI of the effects of fishing on infaunal prey, epifaunal prey, living structure (coral treated separately), and non-living structure across different habitats and between fisheries. The LEI estimated the percentage by which these habitat features would be reduced from a hypothetical unfished abundance if recent intensity and distribution of fishing effort were continued over a long enough term to achieve equilibrium. Equilibrium is defined as a point where the rate of loss of habitat features from fishing effects equal the gain from feature recovery. The spatial pattern of long-term effect indices largely reflects the distribution of fishing effort scaled by the sensitivity and recovery rates assigned to different features in different habitat types. Thus, patterns on the charts of LEI for each feature class were very similar, with higher overall LEIs for more sensitive or slower recovering features (Figures B.2-2 to B.2-5 of the EFH EIS). Prey LEIs were substantially lower than structure LEIs, reflecting their lower sensitivity and faster recovery rates.

All habitats included substantially unfished and lightly fished areas that have low LEIs (less than 1 percent) as well as some areas of high fishing that resulted in high LEIs (more than 50 percent or even more than 75 percent). In the AI, GOA, and EBS slope, substantial LEIs were primarily concentrated into many small, discrete pockets. On the EBS shelf, there were two larger areas where high LEIs were concentrated: (1) an area of sand/mud habitat between Bristol Bay and the Pribilof Islands and (2) an area of sand habitat north of Unimak Island and Unimak Pass, mostly inside of the 100-m contour.

Some of the patterns in fishing effects can be related to areas closed to bottom trawl fishing. In the GOA, no bottom trawling is allowed east of 140ºE longitude, and fishing effects are light there. Bottom trawling has been substantially restricted within specified radii (10 and 20 nm) of Steller sea lion rookeries and haulouts. The effects of these actions on LEI values are most clearly seen in the AI, where high LEI values are concentrated in small patches where the narrow shelf does not intersect these closures. Two large EBS areas around the Pribilof Islands and in and adjacent to Bristol Bay both mostly in sand substrates, are closed to bottom trawling to protect red king crab habitat. These closures concentrate fishing in the southern part of the EBS into the remaining sand, sand/mud, and slope habitats, which likely increases the predicted LEI in those areas.

Aggregate LEIs for each of the habitats are shown in Table B.2-9 of the EFH EIS. As discussed above, prey declined less than biostructure due to lower sensitivity and faster recovery rates. No prey feature was reduced by more than 3.5 percent (BS slope habitat). Biological structure features had LEIs between 7 and 9 percent in the hard substrate habitats where recovery rates were slow. LEIs above 10 percent were indicated for the biological structure of the sand/mud and slope habitats of the EBS where fishing effort is concentrated, and recovery rates are moderately slow.

Because of uncertainties in key input parameters, some evaluation was needed to determine how widely the resulting estimates might vary. In addition to the LEIs cited above, which were generated with median or central estimates for each input parameter (referred to below as central LEIs), LEI was estimated for both large and small values of sensitivity and recovery. High estimates of sensitivity were combined with low recovery rates to provide an upper LEI, and low estimates of sensitivity were combined with high recovery rates to produce a lower LEI. Lower LEIs for the habitat features (except for coral, which is discussed below) ranged from 8 to 50 percent of the original median estimates. Infaunal and epifaunal prey lower LEIs were all at or below 0.5 percent proportional reduction habitat, those for non-living structure were below 2 percent, and those for living structure were below 4 percent. The corresponding upper LEIs ranged from 1.5 to 3 times the original median estimate. The largest upper LEI values for infauna and epifauna prey were for the EBS sand/mud and slope habitats and ranged from 3.5 to 7 percent, with all other upper LEIs below 2 percent. Non-living structure upper LEIs were greatest on the GOA hard substrates, the AI shallow water habitat, and the EBS slope, ranging from 7 to 14 percent, with all other upper LEIs below 4 percent. In six habitats (the three GOA hard substrates, the AI shallow water habitats, and the EBS sand/mud and slope habitats), the upper LEI exceeded 10 percent, with the highest value (21 percent) on the GOA slope.

The analysis also calculated the proportion of each LEI attributable to each fishery. Fishery-specific LEI values for the habitat/feature combinations with the highest overall LEIs (all involving living structure) in each region are presented in Table B.2-10 of the EFH EIS. While the pollock pelagic trawl fishery was the largest single component (4.6 percent) of the total effects on living structure in the EBS sand/mud habitat, the combined effects of the bottom trawl fisheries made up all of the remaining 6.3 percent (total LEI of 10.9 percent). This was not true for living structure on the EBS slope, where nearly all (7.2 percent out of 10.9 percent) of the LEI was due to the pollock pelagic trawl fishery. Living structure on hard bottom substrates of the GOA slope was affected by bottom trawling for both deepwater flatfish and rockfish. While the LEIs of these two fisheries were nearly equal, it is likely that much more of the rockfish effort occurred on hard substrates as compared with trawling for deepwater flatfish. [Because the spatial distribution of hard and soft substrate was unknown, such differences are not explicitly accounted for in the fishing effects analysis.] Therefore, most of the effects on this feature were attributed to the rockfish trawl fishery. In the shallow, hard substrate habitat of the AI, most of the effects (4.2 out of 7.3 percent) on living structure were attributable to the trawl fishery for Pacific cod. The remainder was attributed to Atka mackerel trawling at 2.5 percent. Living structure was the only habitat feature in which the effect of a passive gear fishery, longlining for Pacific cod, had an LEI above 0.1 percent. This fishery accounts for the consistent light blue (less than 1 percent LEI) coverage in Figure B.2-3 (a, b, and c) of the EFH EIS of many shallow areas of the AI not open to trawling.

Results for ultra-slow recovering structures, represented by hard corals, were different from those of other living structure in several ways. Corals had the highest LEI values of the fishing effects analyses. Because the very slow recovery rate of these organisms results in very high (more than 75 percent LEI) eventual effects with more than the most minimal amount of trawl fishing (annual trawl effort less than one tenth the area of the block), the distribution of high LEI values directly reflects the distribution of blocks subject to more than minimal trawl effort (Figure B.2-6 [a, b, and c] of the EFH EIS). The LEI values by habitat range from 6 to 20 percent with the highest values in the shallow AI and GOA slopes. These results mostly reflect the proportion of blocks in each habitat type subject to more than minimal trawl effort. Even though fairly wide ranges of both sensitivity and recovery rates were used for the upper and lower LEI estimates for coral, the range between upper and lower LEI was not as wide as for the other living structure organisms, ranging from plus 40 to -33 percent of the central value.

This analysis combined available information to assess the effects of Alaska fisheries on marine fish habitat. It estimated the effects (as measured by LEIs) of fisheries on habitat features that may be used by fish for spawning, breeding, feeding, or growth to maturity. These LEIs represent the proportion of feature abundances (relative to an unfished state) that would be lost if recent fishing patterns were continued indefinitely (to equilibrium). Therefore, all LEIs represent effects that are not limited in duration and satisfy the EFH regulation's definition of "not temporary." The magnitude and distribution of feature LEIs can, thus, be compared with the distribution of the use of that feature by fish species to assess whether the effects are "more than minimal" relative to that species' EFH (Section B.3 of the EFH EIS). Effects meeting this second element would necessarily meet both elements (more than minimal and not temporary) due to the nature of the LEI estimates.

Additional information regarding the LEI analysis, including the comparison of results to groundfish surveys and literature, the quality of information used, and the limitations of the results are in Section B.2.6 of Appendix B of the EFH EIS.

F.1.5 Evaluation of Effects on EFH of Groundfish Species

The fishing effects analysis is performed to evaluate whether the fisheries, as they are currently conducted off Alaska, will affect habitat that is essential to the welfare of the managed fish populations in a way that is more than minimal and not temporary. The previous statement describes the standard set in the EFH regulations which, if met, requires Councils to act to minimize such effects. The above analysis has identified changes to habitat features that are not expected to be temporary. The habitat features were selected as those which a) can be affected by fishing and b) may be important to fish in spawning, breeding, feeding, and growth to maturity. This section evaluates the extent that these changes relate to the EFH of each managed species and whether they constitute an effect to EFH that is more than minimal.

Two conclusions are necessary for this evaluation: (1) the definition of EFH draws a distinction between the amount of habitat necessary for a species to "support a sustainable fishery and the managed species' contribution to a healthy ecosystem" (50 CFR 600.10) and all habitat features used by any individuals of a species; (2) this distinction applies to both the designation of EFH and the evaluation of fishing effects on EFH. If these conclusions are valid, the "more than minimal" standard relates to impacts that potentially affect the ability of the species to fulfill its fishery and ecosystem roles, not just impacts on a local scale. The forgoing analysis has indicated substantial effects to some habitat features in some locations, many of which are within the spatial boundaries of the EFH of a species that may use them in a life-history function. These habitat changes may or may not affect the welfare of that species (a term used to represent "the ability of a species to support a sustainable fishery and its role in a healthy ecosystem").

The evaluation method is detailed in Section B.3.1 of Appendix B of the EFH EIS.

The Effects of Fishing on EFH analysis in the EFH EIS was designed to answer the question: "Is there evidence that fishing adversely affects EFH in a manner that is more than minimal and not temporary in nature?" The following text summarizes the results of the analysis for each managed species. The details of the analysis for each species, including the habitat connections and the evaluation of effects, are contained in Section B.3.3 of Appendix B of the EFH EIS (NMFS 2005) and are incorporated by reference.

F.1.5.1 Walleye Pollock (BSAI and GOA)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—Pollock is a generalist species that occupies a broad geographic niche and can use a wide variety of different habitats (Bailey et al. 1999). The ability of pollock to invade and adapt to marginal habitats has been suggested as a possible reason for the rapid increases in abundance during the environmental changes that occurred in the North Pacific in the 1970s (Bailey 2000). Pollock's ecological plasticity may allow adaption to habitats that have been modified by fishing impacts. Fishing impacts might even be beneficial, particularly if there are significant adverse impacts on predators or competitors more dependent on seafloor habitat features.

The overall evaluation of fishing impacts on pollock EFH is based primarily on extensive life history information that shows that pollock eggs, larvae, juveniles, and adults are not associated with seafloor habitat features affected by fishing. Some pollock life history stages are more demersal (i.e., age-1 juveniles), but even here the association is more likely related to temperature tolerances and avoidance of predators higher up in the water column than any characteristic of the bottom that can be impacted by trawling. The rating for fishing impacts on spawning/breeding for BSAI/GOA pollock is MT because pollock are pelagic spawners, as are their eggs and larvae. The rating for fishing impacts on feeding for BSAI/GOA pollock is MT because adults feed mainly on pelagic euphausiids followed by calanoid copepods.

The primary concern for pollock is the reduction in living structure in areas that support high pollock densities and its potential importance to juvenile pollock in providing refuge from predation. Changes in predation (or cannibalism) on juveniles have been proposed as a mechanism for population control in both the BSAI (Hunt et al. 2002) and the GOA (Bailey 2000). An increase in juvenile mortality will reduce spawning output per individual and, if large enough, could impair the ability of the stock to produce MSY over the long term (Dorn 2004). In the GOA, there is evidence of an increase in pollock mortality due to increases in the abundance of the dominant piscivores (Bailey 2000, Hollowed et al. 2000). However, evidence is weak that living structure plays a significant role in mediating mortality risk for juvenile pollock in the BSAI and the GOA, and it appears more likely that juveniles avoid predation risk through behavioral mechanisms such as shoaling and position in the water column. In addition, the overall reduction in living substrate for pollock EFH is relatively small (7 percent). Therefore, the rating for fishing impacts on growth to maturity for BSAI/GOA pollock is MT.

F.1.5.2 Pacific Cod (BSAI and GOA)

Issue	Evaluation
Spawning/Breeding	MT (Minimal or temporary effect)
Growth to Maturity	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)

Summary of Effects—Fishing's effects on the habitat of Pacific cod in the BSAI and GOA do not appear to have impaired either stocks' ability to sustain itself at or near the MSY level. When weighted by the proportions of habitat types used by Pacific cod, the long-term effect indices are low, particularly those of the habitat features most likely to be important to Pacific cod (infaunal and epifaunal prey). The fishery appears to have had minimal effects on the distribution of adult Pacific cod. Effects of fishing on weight at length, while statistically significant in some cases, are uniformly small and sometimes positive. While the fishery may impose some habitat-mediated effects on recruitment, these fall below the standard necessary to justify a rating of anything other than minimal or temporary.

F.1.5.3 Sablefish (GOA and BSAI)

Issue	Evaluation
Spawning/Breeding	MT
Growth to Maturity	U (Unknown)
Feeding	U (Unknown)

Summary of Effects—The estimated productivity and sustainable yield of sablefish have declined steadily since the late 1970s. This is demonstrated by a decreasing trend in recruitment and subsequent estimates of biomass reference points and the inability of the stock to rebuild to target biomass levels despite of the decreasing level of the targets and fishing rates below the target fishing rate. While years of strong young-of-the-year survival have occurred in the 1980s and 1990s, the failure of strong recruitment to the mature stage suggests a decreased survival of juveniles during their residence as 2- to 4-year-olds on the continental shelf. While climate-related changes are a possible cause for reduced productivity, the observations noted above are consistent with possible effects of fishing on habitat and resulting changes in the juvenile ecology of sablefish, possibly through increased competition for food and space. Given the concern for the decline in the sustainable yield of sablefish, the possibility of the role of fishing effects on juvenile sablefish habitat, and the need for a better understanding of the possible causes, an MT rating is not merited, and sablefish growth to maturity and feeding is rated unknown.

F.1.5.4 Atka Mackerel (BSAI and GOA)

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of Atka mackerel are considered to be minimal and temporary or negligible. Affected habitat areas may impact Atka mackerel, but environmental conditions may be the dominant factor affecting the Atka mackerel population, given the moderate exploitation levels since 1977. Environmental conditions since 1977 may favor Atka mackerel and override impacts of fishing on habitat features important to the species. Some information, however, suggests that bottom trawling may have a negative effect on the benthic habitat, especially corals and sponges. The LEI analysis indicates that there is a potential for large reductions in hard coral habitats, which intersect with Atka mackerel habitat, and Atka mackerel have been observed in association with sponges and corals. The extent and nature of the associations between AI Atka mackerel and living and non-living substrate and hard corals are largely unknown. If these are desirable habitat features for Atka mackerel, however, and there is a significant dependence on these features, the potential large reduction (more than 50 percent) in hard corals in many areas of the AI could be of concern. Overall the Atka mackerel stock is in relatively good condition and is currently at a high abundance level. There are no indications that the affected habitat areas that overlap with the distribution of Atka mackerel would impair the ability of the stock to produce MSY over the long term.

There is some presumed overlap of the fishery with the distribution of Atka mackerel nesting sites, but the extent of the overlap with the spatial distribution of fishing impacted areas is likely to be low due a variety of factors. These factors include Steller Sea Lion protection measures, which likely afford protection to several Atka mackerel spawning grounds. Other spawning grounds that are not in closed areas, but that occur in untrawlable habitat, are also afforded protection. Summer resource assessment trawl surveys conducted biennially in the AI at the time of spawning provide a relative measure of abundance of the spawning biomass and have not detected a shift in the spatial distribution of biomass. To date, there is no evidence to suggest a link between habitat disturbance and the spawning/breeding success of AI Atka mackerel. There is also no evidence to suggest that habitat disturbance impairs the stock's ability to produce MSY over the long term through impacts on spawning/breeding success. Therefore, the impact of habitat disturbance on the spawning/breeding success of Atka mackerel is minimal and temporary.

There is no evidence to suggest a link between habitat disturbance and growth to maturity of AI Atka mackerel. There is also no evidence to suggest that habitat disturbance impairs the stock's ability to produce MSY over the long term through impacts on growth to maturity. Analyses of growth data do not indicate any detectable adverse impacts on the growth to maturity for Atka mackerel due to habitat disturbance.

Therefore, the impact of habitat disturbance on the growth to maturity of Atka mackerel is minimal and temporary.

The adults feed mainly on pelagic euphausiids followed by calanoid copepods, which are not one of the affected habitat features. As euphausiids and copepods are pelagic rather than benthic in their distribution and are too small to be retained by any fishing gear, fishing probably has a minimal and/or temporary effect on the availability of prey to Atka mackerel. There is no evidence to suggest that the diet or feeding distributions of Atka mackerel have changed. Overall, there is no evidence that habitat disturbance has affected feeding success of Atka mackerel. Therefore, the impact of habitat disturbance on the feeding success of Atka mackerel is minimal and temporary.

Stock assessment data do not show a negative trend in spawning biomass and recruitment or evidence of chronic low abundance and recruitment. There is no evidence that the cumulative effects of fishing activities on habitat have impaired the stock's ability to produce MSY since 1977. Spawning biomass is at a peak level. The stock has produced several years of above average recruitment since 1977, and recent recruitment has been strong.

F.1.5.5 Yellowfin Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas, where spawning occurs and where early juveniles reside, are mostly unaffected by past and current fishery activities. Adult and late juvenile yellowfin sole concentrations primarily overlap with the EBS sand (61 percent and sand/mud 39 percent) habitats on the inner- and mid-shelf areas (Table B.3-3 of the EFH EIS). Projected equilibrium reductions in epifauna and infaunal prey in those overlaps were less than 1 percent for sand and 3 percent for sand/mud. The reduction in living structure is estimated at a range of 5 (sand) to 18 (sand/mud) percent for the summer distribution (relevant because 10 percent of the yellowfin sole diet consists of tunicates). Given this level of disturbance, it is unlikely that late-juvenile and adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing impacts.

The yellowfin sole stock is currently at a high level of abundance (Wilderbuer and Nichol 2004) and has been consistently above the B_{MSY} and MSST for the past 20 years. No declines in weight and/or length at age have been documented in this stock for year classes observed over the past 22 years. Such declines might be expected if the quality of the benthic feeding habitat was degraded or essential habitat were reduced. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are either minimal or temporary for BS yellowfin sole.

F.1.5.6 Greenland Turbot (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)

Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by early juveniles of Greenland turbot are mostly unaffected by current fishery activities. Greenland turbot adult and late juvenile concentrations primarily overlap (65 percent with sand/mud habitats in the BSAI) (Table B.3-3 of the EFH EIS). Infaunal prey reductions would affect growth to maturity for late juvenile Greenland turbot. Infaunal prey reductions in the concentration areas in sand/mud habitats of the EBS are predicted to be 2 percent. This benthic disturbance is not thought to be relevant to adult Greenland turbot feeding success because fish species found in their diet are not directly associated with the seafloor.

The lack of overlap with shelf areas exhibiting effects from the reductions in habitat features from fishing indicate that their effect on Greenland turbot are minimal or temporary for the BSAI area.

F.1.5.7 Arrowtooth Flounder (BSAI and GOA)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by arrowtooth flounder early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile concentrations primarily overlap the EBS sand/mud habitat (34 percent) and the GOA deep shelf habitat (35 percent) (Table B.3-3 of the EFH EIS). Overall, epifaunal prey reduction in those overlaps is predicted to be 3 percent for EBS sand/mud and 1 percent for GOA deep shelf habitats. Given this level of disturbance, and the large percentage of the diet of arrowtooth flounder not including epifauna prey, it is unlikely that the adult feeding would be negatively impacted. The arrowtooth flounder stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s and 1990s (Turnock et al. 2002). No change in weight and length at age has been observed in this stock from bottom trawl surveys conducted from 1984 through 2003.

The BS arrowtooth flounder stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Wilderbuer and Sample 2004). The productivity of the stock is currently believed to correspond to favorable atmospheric forces in which larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). The GOA stock has increased steadily since the 1970s and is at a very high level. Therefore, the combined evidence from individual fish length-weight analysis, length at age analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are minimal or temporary for BSAI and GOA arrowtooth flounder.

F.1.5.8 Rock Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by rock sole early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile rock sole in the BSAI are primarily concentrated in sand/mud (41 percent) and sand (37 percent) habitats and are affected by levels of infaunal prey (Table B.3-3 of the EFH EIS). Predicted reductions of infaunal prey in those concentration overlaps are 3 percent (sand/mud) and less than 1 percent (sand). Given this level of disturbance, it is unlikely that adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis did not provide evidence of spatial shifts on the population level in response to areas of high fishing impacts.

The rock sole stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Wilderbuer and Walters 2004). The productivity of the stock is currently believed to correspond to favorable atmospheric forces in which larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). A decline in weight and length at age has been documented in this stock for year classes between 1979 and 1987 (Walters and Wilderbuer 2000), but was hypothesized to be a density dependent response to a rapid increase in an expanding population. Individual rock sole may have been displaced beyond favorable feeding habitat, rather than by a reduction in the quality of habitat. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are minimal or temporary for BS rock sole.

F.1.5.9 Flathead Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by flathead sole early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile flathead sole in the BSAI are primarily concentrated in sand/mud habitat (41 percent) and would be affected by reductions in infaunal and epifaunal prey (Table B.3-3 of the EFH EIS). The predicted reductions for infaunal and epifaunal prey in the concentration overlap for EBS sand/mud habitat are 3 and 2 percent, respectively. Given this level of disturbance, it is unlikely that the adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing effort impacts.

The flathead sole stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Spencer et al. 2002). The productivity of the stock is currently believed to correspond to favorable atmospheric forcing whereby larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). A decline in weight and length at age has not been documented in this stock during the 22-year time horizon of the trawl surveys (Spencer et al. 2002). Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that effects of the reductions in habitat features from fishing are either minimal or temporary for BS flathead sole.

F.1.5.10 Alaska Plaice (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)

Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by Alaska plaice early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile Alaska plaice concentrations in the BSAI primarily overlap with the EBS sand habitat (42 percent) and the EBS sand/mud habitat (52 percent) (Table B.3-3 of the EFH EIS). These fish would be affected by reductions in infaunal prey. However, the levels of reduction in those concentration overlaps are predicted to be less than 1 percent for EBS sand and 2 percent for EBS sand/mud habitat. Given this level of disturbance, it is unlikely that the adult feeding has been or would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing effort impacts.

The Alaska plaice stock is currently at a high level of abundance (Spencer et al. 2004) and well above the MSST. There have been no observations of a decline in length or weight at age for this stock over the 22 years of trawl survey sampling. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that effects of the reductions in habitat features from fishing are either minimal or temporary for BS Alaska plaice.

F.1.5.11 Pacific Ocean Perch (BSAI)

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	U (Unknown)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI Pacific ocean perch are rated as either unknown or minimal and temporary. The percent reduction in living and non-living substrates in the areas most commonly inhabited by BSAI Pacific ocean perch (the AI deep and AI shallow habitats) do not exceed 13 percent. Although larger percent reductions for hard corals are estimated, studies on habitat associations have not associated Pacific ocean perch with hard coral (Kreiger and Wing 2002). There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown for these processes for BSAI Pacific ocean perch.

Regarding growth to maturity, the available literature does indicate that juvenile red rockfish do use living (anemones) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI Pacific ocean perch stock is dependent upon these habitat features is not well known. Although the LEI percentages do not exceed 13 percent for the living and non-living substrates, these figures should be interpreted as rough guidelines that are estimated with some error and relate to entire BSAI stock. Examination of LEI maps indicates that finer scale impacts do occur and could be important for stocks such as Pacific ocean perch, which are thought to show population structure on small spatial scales (Withler et al. 2001). Similarly, although the current population level data do not indicate declining trends in spawning biomass or recruitment, it is not clear what effects may have occurred at finer spatial scales.

F.1.5.12 Shortraker and Rougheye Rockfish (BSAI)

Rougheye (*Sebastes aleutianus*) and shortraker (*Sebastes borealis*) rockfish are distributed from southern California, north to GOA and the EBS, and west to the Aleutian and Kuril Islands and the Okhotsk Sea (Love et al. 2002). In Alaskan waters, concentrations of abundance occur in the GOA and the AI, with smaller concentrations along the EBS slope. The mean depth at which shortraker and rougheye rockfish appear in recent AI summer trawl surveys is approximately 400 and 375 m, respectively.

Issue	Evaluation
Spawning/breeding	MT (Minimal, temporary, or no effect)
Growth to maturity	U (Unknown effect)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI rougheye and shortraker rockfish are rated as either unknown or minimal and temporary. There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown about these processes for BSAI shortraker and rougheye rockfish.

Regarding growth to maturity, the available literature indicates that juvenile red rockfish use living (corals) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. Although several of these studies did not specifically observe shortraker or rougheye rockfish, it is reasonable to assume that their juvenile habitat use would follow a similar pattern. Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI rougheye and shortraker stocks are related to these habitat features is not well known. The expected percent reduction in living and non-living habitat features does not exceed 7 percent in the AI deep and AI shallow habitats, suggesting that fishing impacts on these features are not likely to substantially affect BSAI rougheye and shortraker rockfish. However, larger percent reductions for hard corals are estimated, and studies on habitat associations have indicated that rougheye rockfish are associated with hard corals such as *Primnoa,* possibly due to the concentration of prey items in these habitats or for providing refuge for juveniles (Kreiger and Wing 2002). The extent to which habitat impacts occur at smaller scales and the importance of these impacts to the overall BSAI population are unknown.

F.1.5.13 Northern Rockfish (BSAI)

Northern rockfish (*Sebastes polyspinus*) are distributed from northern British Columbia north to the GOA and the EBS and west to the AI and the Kamchatka Peninsula (Love et al. 2002). Northern rockfish are poorly studied species, and little is known about their life history.

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	U (Unknown)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI northern rockfish are rated as either unknown or minimal and temporary. The percent reduction in living and non-living substrates in the areas most commonly inhabited by BSAI northern rockfish (the AI deep and AI shallow habitats) do not exceed 8 percent. Although larger percent reductions for hard corals are estimated, studies on habitat associations have not associated northern rockfish with hard coral (Kreiger and Wing 2002). Northern rockfish eat copepods and euphausiids which are not associated with benthic habitats and would not be expected to be impacted by fishing gear. There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown for these processes for BSAI northern rockfish.

Regarding growth to maturity, the available literature does indicate that juvenile red rockfish do use living (anemones) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. In particular, northern rockfish are associated with rough and rocky habitats (Clausen and Heifetz 2002). Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI northern rockfish stock is related to these habitat features is not well known. The LEI percentages of habitat reduction should be interpreted as rough guidelines that are estimated with some error and relate to the entire BSAI stock. Examination of LEI maps indicates that finer scale impacts do occur, and the extent to which these finer scale impacts may be important for northern rockfish is dependent upon the spatial scale of their population structure, which is currently unknown. Similarly, although the current population level data do not indicate declining trends in spawning biomass or recruitment, it is not clear what effects may have occurred at finer spatial scales.

F.1.5.14 Other Rockfish Species (BSAI)

The other rockfish complex includes all species of *Sebastes* and *Sebastolobus* spp. other than Pacific ocean perch (*Sebastes alutus*) and those species in the other red rockfish complex (northern rockfish, *S. polyspinis*; rougheye rockfish, *S. aleutianus*; and shortraker rockfish, *S. borealis*). This complex is one of the rockfish management groups in the BSAI regions. Eight out of 28 species of other rockfish have been confirmed or tentatively identified in catches from the EBS and AI region; thus, these are the only species managed in this complex (Reuter and Spencer 2001, NMFS 2003). The two most abundant species for this complex are dusky rockfish (*Sebastes variabilis*) and shortspine thornyheads (*Sebastolobus alascancus*).

Dusky Rockfish

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	MT (Minimal, temporary or no effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—In general the effects of fishing on the habitat of dusky rockfish are unknown or minimal. The main concern lies in the amount of habitat that has been estimated to be disturbed within the general distribution of dusky rockfish in the BSAI. If the loss of substrates, both living and non-living, is great due to the effects of fishing or as the result of a natural occurrence, then there is the potential that dusky rockfish growth to maturity may be affected. Many species of rockfish utilize rocky outcroppings and/or coral as a type of refugia during some or all of their life history stages. If this refugia is found to play an important role in the survival of this species, then loss of the substrate that makes up this refugia may decrease the survival rate of dusky rockfish.

BSAI Shortspine Thornyheads

Issue	Evaluation
Spawning/breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—In general, the relationship between habitat and SST survival rates has not been established. Given current information, however, impacts to habitat that may support various life stages of SST are minimal to no effect. The main concern is prey availability to SST. Because epifauna are the main prey items for SST, the impacts to those habitats that support their various life stages are also important. Unfortunately, there are no good data to determine which epifauna are the most important in SST diet along the large area of the BSAI.

F.1.5.15 Squid and Other Species

While there was considerable new information to evaluate habitat effects for the major target groundfish species in Alaska, there were some species where information was either too sparse to evaluate, or simply did not exist. For other species, especially nontarget species such as skates, sculpins, sharks, squids, and octopi, growth information has not been collected historically, and species-specific catch per unit effort information may be unreliable. Information on nontarget species is improving, but it is currently insufficient to evaluate habitat specific impacts. For these reasons, the original evaluations for the following species groups presented in the DEIS still represent the best available information, despite extensive inquiry to improve upon it.

F.1.5.15.1 BSAI Sharks (sleeper sharks and salmon sharks)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of sleeper sharks or salmon sharks. Sleeper sharks are thought to occur mainly in the middle and lower portions of the water column along the outer continental shelf and upper slope region; thus, any adverse effects to this habitat type may influence the health of the sleeper shark population. Salmon sharks are thought to occur in pelagic waters along the outer continental shelf and upper slope region of the EBS. Thus, any adverse effects to this habitat type, including disruption or removal of pelagic prey by fisheries, may influence the health of the salmon shark population.

F.1.5.15.2 BSAI Skates (between 8 and 15 species in the genus *Bathyraja*)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of skates. Skates are benthic dwellers. The Alaska skate dominates the skate complex biomass in the EBS and is distributed mainly on the upper continental shelf. The diversity of the group increases with depth along the outer continental shelf and slope, with several new species likely to be described in the near future. Therefore, any adverse affects to the shallow shelf habitat may influence the health of the Alaska skate populations, while any adverse affects to outer continental shelf and slope habitats may influence the health of multiple species of skates.

F.1.5.15.3 BSAI Sculpins (over 60 species identified in BSAI trawl surveys)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of sculpins. Sculpins are benthic dwellers. Some sculpin species guard their eggs, and at least one species, the bigmouth sculpin, lays its eggs in vase sponges in the AI, although it is not known whether a particular type of sponge, or sponges in general, are essential to reproductive success. There are so many diverse species in this category that almost all benthic areas in the EBS and AI are likely to be inhabited by at least one sculpin species. Therefore, any adverse affects to habitat may influence the health of species in the sculpin complex.

F.1.5.15.4 BSAI Squids (5 or more species)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of squid. Squid are thought to occur in pelagic waters along the outer continental shelf and upper slope region of the EBS and AI, and concentrate over submarine canyons; thus, any adverse effects to this habitat may influence the health of the squid populations.

F.1.5.15.5 BSAI octopi (5 or more species)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of octopi. Octopi occupy all types of benthic habitats, extending from very shallow subtidal areas to deep slope habitats; thus, any adverse effects to this habitat may influence the health of octopus populations. Knowledge of octopi distributions are insufficient to allow comparison with fishing effects.

F.1.5.16 Effects of Fishing on Essential Fish Habitat of Forage Species

The forage species category was created by Amendments 36 and 39 to the BSAI and GOA FMP. This category includes eight families of fish (Osmeridae, Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, and Gonostomatidae) and one order of crustaceans (Euphausiacea). The aforementioned amendments prohibit the directed fishery of any forage species. The species included in this category have diverse life histories and it is impractical to analyze the group as a whole. Therefore, for the purpose of this document, each family and order will be analyzed separately.

F.1.5.16.1 Family Osmeridae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Most of the Alaska species of smelt spawn on beaches, rivers, or in estuaries. Certain species of smelt, such as capelin, have been shown to have an affinity towards spawning grounds with specific substrate grain size (coarse sand or fine gravel). Therefore, non-living substrate is assumed to be very important for spawning/breeding. However, smelt spawning areas do not overlap with areas of intensive fishing. There is little to no fishing pressure in the nearshore environment needed by these species. Hence, the effects of fishing are anticipated to have little impact on the stock. The rating for the effects of fishing on spawning and breeding of smelt is MT.

Juvenile and adult smelt feed primarily on neritic plankton. There is little evidence that survival or prey availability of smelt is dependent on habitat that is disturbed by fishing. Therefore, the effects of fishing on the feeding and growth to maturity of smelt are rated MT.

F.1.5.16.2 Family Myctophidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Myctophids are pelagic throughout all life history stages. There is little evidence that Myctophid survival is dependent on habitat affected by fishing. Myctophids are broadcast spawners with pelagic eggs. Juvenile and adult Myctophids prey on neritic zooplankton and do not require physical structure for protection. Therefore, the effects of fishing on the spawning and breeding, feeding, and growth to maturity of Myctophids is rated MT.

F.1.5.16.3 Family Ammodytidae

Issue	Evaluation

Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—The sole member of family Ammodytidae found in Alaska is the Pacific sand lance (*Ammodytes hexapterus*). Sand lance have been shown to have an affinity towards spawning grounds with specific substrate grain size (coarse sand). Therefore, non-living substrate is assumed to be very important for spawning/breeding. However, smelt spawning areas do not overlap with known areas of intensive fishing. There is little to no fishing pressure in the nearshore habitat needed by these species. Hence, the effects of fishing on the EFH of sand lance is rated MT.

Juvenile and adult sand lance feed primarily on copepods. There is little evidence that survival or prey availability of sand lance is dependent on habitat disturbed by fishing. Therefore, the effects of fishing on the feeding and growth to maturity of smelt are rated MT.

F.1.5.16.4 Family Trichodontidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	U (Unknown)
Growth to maturity	U (Unknown)

Summary of Effects—Two members of the family Trichodontidae are found in the BSAI and GOA: the sailfin sandfish (*Arctoscopus japonicus*) and the Pacific sandfish (*Trichodon trichodon*). However, the sailfin sandfish is rarely encountered in Alaska waters. For the purposes of this document, attention will be focused on the Pacific sandfish.

Pacific sandfish lay demersal adhesive egg masses in rocky intertidal areas. The presence of the proper non-living substrate is important for the spawning/breeding of sandfish. However, there is little overlap of the spawning areas with known areas of intensive fishing. Hence, the effects of fishing on spawning/breeding of sandfish are rated MT.

Pacific sandfish are ambush predators that lay in wait for prey buried under the sand. They have been shown to consume some epifauna prey, but more than 95 percent of their diet consisted of small fish. It is unknown how the habitat for these prey species is affected by fishing.

Pacific sandfish larvae are pelagic, but juveniles and adults are demersal. Little is known about sandfish distribution in the BSAI and GOA. The effect of fishing on the survival of Pacific sandfish is unknown due to lack of data.

F.1.5.16.5 Family Pholidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—There are several species of Pholids (or gunnels) found in Alaska waters. Most species of gunnels reside, feed, and breed in the shallow, nearshore habitat, where there is little to no fishing effort. Due to the lack of fishing pressure in the environs used by Pholids, the effects of fishing on the habitat necessary for spawning/breeding, feeding, and growth to maturity are all rated MT.

F.1.5.16.6 Family Stichaeidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Due to the lack of fishing pressure in the environs used by pricklebacks, the effects of fishing on the spawning/breeding, feeding, and growth to maturity are all rated MT.

F.1.5.16.7 Family Gonostomatidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Bristlemouths are pelagic throughout all life history stages. There is little evidence that bristlemouths survival is dependent on habitat that is affected by fishing. Bristlemouths are broadcast spawners with pelagic eggs. Juvenile and adult bristlemouths prey on neritic zooplankton and do not require physical structure for protection. Therefore, the effects of fishing on the habitat necessary for spawning/breeding, feeding, and growth to maturity of bristlemouths are rated MT.

F.1.5.16.8 Order Euphausiacea

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Euphausiids (or krill) are small, shrimp-like crustaceans which, along with copepods, make up the base of the food web in the BSAI and GOA. Euphausiids are pelagic throughout their entire life cycle and do not have a strong link to habitat that is affected by fishing. Euphausiids do not require habitat that is disrupted by fishing for spawning/breeding, feeding, or growth to maturity. Therefore, the effects of fishing on habitat for euphausiids is MT.

F.1.6 Conclusions

F.1.6.1 Species Evaluations

Evaluations were completed for 26 managed species (or species groups) and 8 forage species (Table B.4-1 of the EFH EIS). See Sections B.3.2 to B.3.4 of the EFH EIS for more detailed information. Based on the available information, the analysis found no indication that continued fishing at the current rate and intensity would affect the capacity of EFH to support the life history processes of any species. In other words, the effects of fishing on EFH would not be more than minimal. Reasons for minimal ratings were predominantly either lack of a connection to affected habitat features, or findings from stock analyses that current fishing practices (including effects on habitat) do not jeopardize the ability of the stock to produce MSY over the long term. Other evaluations indicated that, even though a connection may exist between a habitat feature and a life-history process, the expected feature reductions were considered too small to make effects at the population level likely. There were also cases where the effects did not overlap significantly with the distribution of the species.

About one-third of the ratings were U (unknown effect). Most of unknown ratings were for species that have received relatively little study; hence, their life history needs and population status are poorly known. Most species with unknown ratings support small or no fisheries. Conversely, species that support significant fisheries have been studied more. In some cases, associations between the habitat features and life history processes were indicated, but the evaluator did not have enough information to assess whether the linkage and the amount of feature reduction would affect species welfare.

Even for well studied species, the knowledge to trace use of habitat features confidently for spawning, breeding, feeding, and growth to maturity to population level effects is not yet available. Several evaluators specifically cited uncertainty regarding the effect of particular noted linkages, and some urged caution. Most of these situations involved potential linkages between the growth-to-maturity of rockfish and Atka mackerel and habitat structure.

F.1.6.2 General Effects on Fish Habitat

While this evaluation identified no specific instances of adverse effects on EFH that were more than minimal and not temporary, the large number of unknown ratings and expressions of concern make it prudent to look for more general patterns across all of the species and habitat features (Table B.4-2 of the EFH EIS).

Specific areas with high fishing effort, and hence high LEIs, were identified in the effects-of-fishing analysis. These included two large areas of the EBS, one north of Unimak Island and Unimak Pass and the other between the Pribilof Islands and Bristol Bay. Both of these areas have continued to be highly productive fishing grounds through decades of intensive fishing. While that may initially seem at odds with the LEI results, it is consistent with the evaluation that the habitat features affected by fishing either are not those important to the species fished in those areas, or are not being affected in a way that limits species welfare.

Fishing concentrations in other areas were smaller, but made up higher proportions of the GOA and EBS slopes. The largest effect rates were on living structure, including coral. The high reliance on limited areas for fishing production and their high estimated LEIs make it prudent to obtain better knowledge of what processes occur in those locations.

Table B.3-1 of the EFH EIS shows the habitat connections identified for each life stage of managed species and species groups. Each row represents a species life stage and each column one of the habitat types from the fishing-effects analysis. At their intersections, evaluators entered letters representing each of the habitat features (prey or structure classes) used by that life stage in that habitat. Most species of groundfish have pelagic larval and egg stages. Only one species, Atka mackerel, had a connection with a benthic habitat feature for its egg or larval stages. A combined tally at the bottom of the table notes how many species/life-stages were identified for each habitat feature in each habitat. Prey features represented about twice as many connections as structure features. The habitat feature/type combinations that had LEIs above 5 percent, outlined in the table, tended to have few connections. The highest number of connections (six) were for living structures on the GOA deep shelf, which had the lowest LEI of the outlined habitat feature/type combinations (6.2 percent). Connections with the highlighted blocks mostly involved rockfish species, with a few connections from Atka mackerel and blue king crab.

Cropping and summing effects on habitat features by distributions of the adults of each species (Table B.3-3 of the EFH EIS) depicted how the fishing effects overlapped in the locations where each species is present. The general distribution values related to the broader areas occupied, while the concentration values related to areas of higher abundance. Concentration LEIs were generally higher than the estimates based on general distribution because adult species concentrations determine where fisheries operate. It is unfortunate that distributions were not available for juveniles because connections to the habitat feature with the highest LEIs (living structure) mostly involved the growth to maturity process. Characterizing juvenile distributions should be a high priority for future research.

Reductions across adult species distributions for the living structure were mostly between 10 and 17 percent. Higher values occurred for red king crab (29 percent for both coverages) and Atka mackerel (18 and 26 percent). The king crab evaluator noted that the distribution of juveniles was mostly outside of the affected areas. The evaluator for Atka mackerel emphasized use of non-living substrates by that species. Prey class effects by species distributions were all at or below 5 percent. In combination with negligible effects on habitat of forage species (Section B.3.5 of the EFH EIS), this indicates that effects on availability of prey were minimal.

While LEIs for hard corals are subject to the limitations mentioned in Section B.2.6 of the EFH EIS, they had the highest LEIs when considered by species distributions. Intersections where meaningful effects are most likely to occur are those between areas where hard corals are prevalent and species for which a significant portion of their distribution occurs in the same areas, including populations of golden king crab, Atka mackerel, sablefish, and the rockfish species. Coral LEIs at these points ranged from 23 to 59 percent. While few evaluators cited coral as specifically linked to life history functions, in some areas it may be an important component of the living structure that is potentially linked to growth to maturity for some of these species. Because of their very slow recovery, corals warrant particular consideration for protection and for the development of improved knowledge of their habitat functions and distribution.

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F.2 Non-fishing Impacts

The diversity, widespread distribution, and ecological linkages with other aquatic and terrestrial environments make the waters and substrates that comprise EFH susceptible to a wide array of human activities unrelated to fishing.

Non-fishing activities have the potential to adversely affect the quantity or quality of EFH in riverine, estuarine, and marine systems. Broad categories of such activities include, but are not limited to, mining, dredging, fill, impoundment, discharge, water diversions, thermal additions, actions that contribute to nonpoint source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH. For each activity, known and potential adverse impacts to EFH are described in the EFH EIS, Appendix G (NMFS 2005). The descriptions explain the mechanisms or processes that may cause the adverse effects and how these may affect habitat function. This FMP incorporates by reference the complete analysis of non-fishing impacts in Appendix G of the EFH EIS and summarizes the results for each type of non-fishing activity (NMFS 2005).

Non-fishing activities discussed in this document are subject to a variety of regulations and restrictions designed to limit environmental impacts under federal, state, and local laws. Many current requirements help to avoid or minimize adverse effects to aquatic habitats, including EFH. The conservation recommendations contained in this document are rather general and may overlap with certain existing standards for specific development activities. Nevertheless, the recommendations highlight practices that can help to avoid and minimize adverse effects to EFH. During EFH consultations between NMFS and other agencies, NMFS strives to provide reasonable and scientifically based recommendations that account for restrictions imposed under various state and federal laws by agencies with appropriate regulatory jurisdiction. Moreover, the coordination and consultation required by Section 305(b) of the Magnuson-Stevens Act do not supersede the regulations, rights, interests, or jurisdictions of other federal or state agencies. NMFS will not recommend that state or federal agencies take actions beyond their statutory authority, and NMFS' EFH conservation recommendations are not binding.

The conservation measures discussed in this document should be viewed as options to avoid, minimize, or compensate for adverse impacts and promote the conservation and enhancement of EFH. Ideally, non-water-dependent actions should not be located in EFH if such actions may have adverse impacts on EFH. Activities that may result in significant adverse effects on EFH should be avoided where less environmentally harmful alternatives are available. If there are no alternatives, the impacts of these actions should be minimized. Environmentally sound engineering and management practices should be employed for all actions that may adversely affect EFH. If avoidance or minimization is not practicable, or will not adequately protect EFH, compensatory mitigation (as defined for Section 404 of the Clean Water Act – the restoration, creation, enhancement, or in exceptional circumstances, preservation of wetlands and/or other aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved) should be considered to conserve and enhance EFH.

Section 303(a)(7) of the Magnuson-Stevens Act requires FMPs to identify activities other than fishing that may adversely affect EFH and define actions to encourage the conservation and enhancement of EFH, including recommended options to avoid, minimize, or compensate for the adverse effects identified. During consultation, agencies strive to consider all potential non-fishing impacts to EFH so that the appropriate recommendations can be made. Because impacts that may adversely affect EFH can be direct, indirect, and cumulative, the biologist must consider and analyze these interrelated impacts.

The conservation recommendations included with each activity present a series of site-specific measures the action agency can undertake to avoid, offset, or mitigate impacts to EFH. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect EFH. More specific or different measures based on the best and most current scientific information may be developed before or during EFH consultations and communicated to the appropriate agency. The conservation recommendations provided herein represent a short menu of actions that can contribute to the conservation, enhancement, and proper functioning of EFH.

While it is necessary to distinguish between activities to identify possible adverse impacts, it is equally important to consider and analyze these activities as they interrelate within habitats. This document is organized by activities that may potentially impact EFH occurring in four discrete ecosystems. The separation of these ecosystems is artificial, and many of the impacts and their related activities are not exclusive to one system.

The format for presenting the information in this document provides an introductory description of each activity, identification of potential adverse impacts, and suggested general conservation measures that would help minimize and avoid adverse effects of non-fishing activities on EFH. Table 3.4-36 in the EFH EIS identifies the categories from Appendix G and correlates them with possible changes in physical, chemical, and biological parameters, and Table 3.4-37 in the EFH EIS takes the same categories from Appendix G and broadly interprets whether the effects from the activities in Alaska have been positive, insignificant, negative, or unknown.

F.2.1 UPLAND ACTIVITIES

F.2.1.1 Nonpoint Source Pollution

Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification. Technically, the term nonpoint source means anything that does not meet the legal definition of point source in Section 502(14) of the Clean Water Act (CWA), which refers to discernable, confined, and discrete conveyance from which pollutants are or may be discharged. The major categories of nonpoint pollution are as follows:

- Agricultural runoff
- Urban runoff, including developed and developing areas (Section G.2.2 of the EFH EIS)
- Silvicultural (forestry) runoff (Section G.2.1.1 of the EFH EIS)
- Marinas and recreational boating
- Road construction
- Channel and streambank modifications, including channelization (Section G.4.7 of the EFH EIS)
- Streambank and shoreline erosion

Nonpoint source pollution is usually lower in intensity than an acute point source event, but it may be more damaging to fish habitat in the long term. Nonpoint source pollution is often difficult to detect. It may affect sensitive life stages and processes, and the impacts may go unnoticed for a long time. When severe pollution impacts are finally noticed, they may not be tied to any one event; hence, it may be difficult to correct, clean up, or mediate.

F.2.1.2 Silviculture/Timber Harvest

Recent revisions of Alaska's federal and state timber harvest regulations and best management practices (BMPs) have resulted in increased protection of EFH on federal, state, and private timber lands. Current forest management practices, when fully implemented and effective, avoid or minimize adverse effects to EFH that can result from the harvest and cultivation of timber and other forestry products. However, timber harvest can have both short- and long-term impacts throughout many coastal watersheds and estuaries if management practices are not fully implemented or effective. Past timber harvest in Alaska was not conducted under the current protective standards, and some effects from past harvesting continue to affect EFH.

If appropriate environmental standards are not followed, forest conditions after harvest may result in altered or impaired instream habitat structure and watershed function. In general, timber harvest can have a variety of effects such as removing the dominant vegetation; converting mature and old-growth upland and riparian forests to tree stands or forests of early seral stage; reducing permeability of soils and increasing the area of impervious surfaces; increasing sedimentation from surface runoff and mass wasting processes; altering hydrologic regimes; and impairing fish passage through inadequate design, construction, and/or maintenance of stream crossings (Northcote and Hartman 2004). Timber harvest may result in inadequate or excessive surface and stream flows, increased streambank and streambed erosion, loss of complex instream habitats, sedimentation of riparian habitat, and increased surface runoff with associated contaminants (e.g., herbicides, fertilizers, and fine sediments). Hydrologic characteristics (e.g., water temperature), annual hydrograph change, and greater variation in stream discharge can be associated with timber harvest. Alterations in the supply of large woody debris (LWD) and sediment can have negative effects on the formation and persistence of instream habitat features. Excess debris in the form of small pieces of wood and silt can cover benthic habitat and reduce dissolved oxygen levels.

Potential Adverse Impacts

There are many complex and important interactions, in both small and large watersheds, between fish and forests (Northcote and Hartman, 2004). Five major categories of activities can adversely affect EFH: 1) construction of logging roads, 2) creation of fish migration barriers, 3) removal of streamside vegetation, 4) hydrologic changes and sedimentation and 5) disturbance associated with log transfer facilities (LTFs) (Section G.4.9 of the EFH EIS). Potential impacts to EFH have been greatly reduced by the adoption of best management practices (BMPs) designed to protect fish habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. For timber operations near streams with EFH, adhere to modern forest management practices and BMPs, including the maintenance of vegetated buffers to reduce sedimentation and supply LWD.
2. Avoid timber operations to the extent practicable in wetlands contiguous with anadromous fish streams.
3. For timber operations near estuaries or beaches, maintain vegetated buffers as needed to protect EFH.
4. Maintain riparian buffers along all streams to the extent practicable. In Alaska, buffer width is site-specific and dependent on use by anadromous and resident fish and stream process type.
5. Incorporate watershed analysis into timber and silviculture projects whenever possible or practicable. Particular attention should be given to the cumulative effects of past, present, and future timber sales within the watershed.
6. For forest roads, see Section G.2.3 in the EFH EIS, Road Building and Maintenance.

F.2.1.3 Pesticide Application (includes insecticides, herbicides, fungicides)

Pesticides are frequently detected in freshwater and estuarine systems that provide EFH. Pesticides are substances intended to prevent, destroy, control, repel, or mitigate any pest. They include the following: insecticides, herbicides, fungicides, rodenticides, repellents, bactericides, sanitizers, disinfectants, and growth regulators. More than 800 different pesticides are currently registered for use in the U.S. Legal mandates covering pesticides are the CWA and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Water quality criteria for the protection of aquatic life have only been developed for a few of the currently used chemicals (EPA, Office of Pesticide Programs). The most common pesticides are insecticides, herbicides, and fungicides. These are used for pest control on forested lands, agricultural crops, tree farms and nurseries, highways and utility rights of way, parks and golf courses, and residences. Pesticides can enter the aquatic environment as single chemicals or as complex mixtures. Direct applications, surface runoff, spray drift, agricultural return flows, and groundwater intrusions are all examples of transport processes that deliver pesticides to aquatic ecosystems.

Habitat alteration from pesticides is different from more conventional water quality parameters, such as temperature, suspended solids, or dissolved oxygen, because, unlike temperature or dissolved oxygen, the presence of pesticides can be difficult to detect due to limitations in proven methodologies. This monitoring may also be expensive. As analytical methodologies have improved in recent years, however, the number of pesticides documented in fish and their habitats has increased.

Potential Adverse Impacts

There are three basic ways that pesticides can adversely affect EFH. These are (1) a direct toxicological impact on the health or performance of exposed fish, (2) an indirect impairment of the productivity of aquatic ecosystems, and (3) a loss of aquatic vegetation that provides physical shelter for fish.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Incorporate integrated pest management and BMPs as part of the authorization or permitting process to ensure the reduction of pesticide contamination in EFH (Scott et al. 1999).
2. Carefully review labels and ensure that application is consistent. Follow local, supplemental instructions such as state-use bulletins where they are available.
3. Avoid the use of pesticides in and near EFH.
4. Refrain from aerial spraying of pesticides on windy days.

F.2.1.4 Urban/Suburban Development

Urban development is most likely the greatest non-fishing threat to EFH. Urban growth and development in the U.S. continue to expand in coastal areas at a rate approximately four times greater than in other areas. Urban and suburban development and the corresponding infrastructure result in four broad categories of impacts to aquatic ecosystems: hydrological, physical, water quality, and biological indicators (Center for Watershed Protection [CWP] 2003). Runoff from impervious surfaces is the most widespread source of pollution into the nation’s waterways (EPA 1995). When a watershed’s impervious cover exceeds 10 percent, impacts to stream quality can be expected (CWP 2003).

Potential Adverse Impacts

Development activities within watersheds and in coastal marine areas often impact the EFH of managed species on both long- and short-term scales. The CWP made a comprehensive review of the impacts associated with impervious cover and urban development and found a negative relationship between watershed development and about 26 stream quality indicators (CWP 2003). Many of the impacts listed here are discussed in greater detail in other sections of this document. The primary impacts include (1) the loss of riparian and shoreline habitat and vegetation and (2) runoff. Upland and shoreline vegetation removal can increase stream water temperatures, reduce supplies of LWD, and reduce sources of prey and nutrients to the water system. An increase in impervious surfaces, such as the addition of new roads (see Section G.2.3 of the EFH EIS), roofs, bridges, and parking facilities, results in a decreased infiltration to groundwater and increased runoff volumes. This also has the potential to adversely affect water quality and water quantity/timing in downstream water bodies (i.e., estuaries and coastal waters).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Implement BMPs (EPA 1993) for sediment control during construction and maintenance operations.
2. Avoid using hard engineering structures for shoreline stabilization and channelization when possible.
3. Encourage comprehensive planning for watershed protection to avoid filling and building in floodplain areas affecting EFH.
4. Where feasible, remove impervious surfaces such as abandoned parking lots and buildings from riparian and shoreline areas, and reestablish wetlands and native vegetation.
5. Protect and restore vegetated buffer zones of appropriate width along all streams, lakes, and wetlands that include or influence EFH.
6. Manage stormwater to duplicate the natural hydrologic cycle, maintaining natural infiltration and runoff rates to the maximum extent practicable.
7. Where in-stream flows are insufficient to maintain water quality and quantity needed for EFH, establish conservation guidelines for water use permits and encourage the purchase or lease of water rights and the use of water to conserve or augment instream flows in accordance with state and federal water laws.
8. Encourage municipalities to use the best available technologies in upgrading their wastewater systems to avoid combined sewer overflow problems and chlorinated sewage discharges into rivers, estuaries, and the ocean.
9. Design and install proper on-site disposal systems.

F.2.1.5 Road Building and Maintenance

The building and maintenance of roads can affect aquatic habitats by increasing rates of natural processes such as debris slides or landslides and sedimentation, introducing exotic species, degrading water quality, and introducing chemical contamination (e.g., petroleum-based contaminants; Section G.2.2 of the EFH EIS). Paved and dirt roads introduce an impervious or semipervious surface into the landscape. This surface intercepts rain and creates runoff, carrying soil, sand and other sediments, and oil-based materials quickly downslope. If roads are built near streams, wetlands, or other sensitive areas, they may experience increased sedimentation that occurs from maintenance and use, as well as during storm and snowmelt events. Even carefully designed and constructed roads can become sources of sediment and pollutants if they are not properly maintained.

Potential Adverse Impacts

The effects of roads on aquatic habitat can be profound. They include (1) increased deposition of fine sediments, (2) changes in water temperature, (3) elimination or introduction of migration barriers such as culverts, (4) changes in streamflow, (5) introduction of non-native plant species, and (6) changes in channel configuration (see Section G.2.1.1 and the standards referenced in the EFH EIS).

Recommended Conservation Measures

The following conservation measures for road building and maintenance should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid locating roads near fish-bearing streams.
2. Incorporate appropriate erosion control and stabilization measures into road construction plans to reduce erosion potential.
3. Build bridges when possible.
4. Locate stream crossings in stable stream reaches.
5. Design bridge abutments to minimize disturbances to streambanks and place abutments outside of the floodplain whenever possible.
6. To the extent practicable, avoid road construction across alluvial floodplains, mass wastage areas, or braided stream bottom lands unless site-specific protection can be implemented to ensure protection of soils, water, and associated resources.
7. Avoid side-casting of road construction and maintenance materials on native surfaces and into streams.
8. To the extent practicable, use native vegetation in stabilization plantings.
9. Ensure that maintenance operations avoid adverse affects to EFH.

F.2.2 RIVERINE ACTIVITIES

F.2.2.1 Mining

Mining and mineral extraction activities take many forms, such as commercial dredging and recreational suction dredging, placer, area surface removal, and contour operations (Section G.5.6 of EIS EFH). Activities include gravel mining (NMFS 2004), exploration, site preparation, mining, milling, waste management, decommissioning or reclamation, and mine abandonment (American Fisheries Society [AFS] 2000). Mining and its associated activities have the potential to cause environmental impacts from exploration through post-closure. These impacts may include adverse effects to EFH. The operation of metal, coal, rock quarries, and gravel pit mining has caused varying degrees of environmental damage in urban, suburban, and rural areas. Some of the most severe damage, however, occurs in remote areas, where some of the most productive fish habitat is often located (Sengupta 1993). In Alaska, existing regulations, promulgated and enforced by other federal and state agencies, have been designed to control and manage these changes to the landscape to avoid and minimize impacts. These regulations are regularly updated as new technologies are developed to improve mineral extraction, reclaim mined lands, and limit environmental impacts. However, while environmental regulations may avoid, limit, control, or offset many of these potential impacts, mining will, to some degree, always alter landscapes and environmental resources (National Research Council [NRC] 1999).

Mineral Mining

Potential Adverse Impacts

The effects of mineral mining on EFH depend on the type, extent, and location of the activities. Potential impacts from mining include (1) adverse modification of hydrologic conditions so as to cause erosion of desirable habitats, (2) removal of substrates that serve as habitat for fish and invertebrates, (3) conversion of habitats,(4) release of harmful or toxic materials, and (5) creation of harmful turbidity levels.

Recommended Conservation Measures

The following conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid mineral mining in waters, riparian areas, and floodplains containing EFH.
2. Schedule necessary in-water activities when the fewest species/least vulnerable life stages of federally managed species will be present.
3. Use an integrated environmental assessment, management, and monitoring package in accordance with state and federal law and regulations.
4. Minimize spillage of dirt, fuel, oil, toxic materials, and other contaminants into EFH.
5. Treat and test wastewater (acid neutralization, sulfide precipitation, reverse osmosis, electrochemical, or biological treatments) and recycle on site to minimize discharge to streams.
6. Minimize opportunities for sediments to enter or affect EFH.
7. If possible, reclaim, rather than bury, mine waste that contains heavy metals, acid materials, or other toxic compounds if leachate can enter EFH through groundwater.
8. Restore natural contours and plant native vegetation on site after use to restore habitat function to the extent practicable.
9. Minimize the aerial extent of ground disturbance (e.g., through phasing of operations), and stabilize disturbed lands to reduce erosion.

Sand and Gravel Mining

Potential Adverse Impacts

Sand and gravel mining is extensive and occurs by several methods. These include wet-pit mining (i.e., removal of material from below the water table), dry-pit mining on beaches, exposed bars, and ephemeral streambeds, and subtidal mining. Sand and gravel mining in riverine, estuarine, and coastal environments can create EFH impacts, including (1) turbidity plumes and resuspension effects, (2) removal of spawning habitat, and (3) alteration of channel morphology.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

To the extent practicable, avoid sand/gravel mining in waters containing EFH.

1. Identify upland or off-channel (where the channel will not be captured) gravel extraction sites as alternatives to gravel mining in or adjacent to EFH, if possible.
2. Design, manage, and monitor sand and gravel mining operations to minimize potential direct and indirect impacts to EFH, if operations in EFH cannot be avoided.

3. Minimize the areal extent and depth of extraction.
4. Include restoration, mitigation, and monitoring plans, as appropriate in sand/gravel extraction plans.

F.2.2.2 Organic and Inorganic Debris

Natural occurring flotsam, such as LWD and macrophyte wrack (i.e., kelp), plays an important role in aquatic ecosystems, including EFH. LWD and wrack promote habitat complexity and provide structure to various aquatic and shoreline habitats. The natural deposition of LWD creates habitat complexity by altering local hydrologic conditions, nutrient availability, sediment deposition, turbidity, and other structural habitat conditions. Conversely, inorganic flotsam and jetsam debris can negatively impact EFH. Inorganic marine debris is a problem along much of the coastal U.S., where it litters shorelines, fouls estuaries, entangles fish and wildlife, and creates hazards in the open ocean. Marine debris consists of a wide variety of man-made materials, including general litter, plastics, hazardous wastes, and discarded or lost fishing gear. The debris enters waterbodies indirectly through rivers and storm drains, as well as directly via ocean dumping and accidental release. Although laws and regulatory programs exist to prevent or control the problem, marine debris continues to affect aquatic resources.

Organic Debris Removal

Natural occurring flotsam, such as LWD and macrophyte wrack (i.e., kelp), is sometimes intentionally removed from streams, estuaries, and coastal shores. This debris is removed for a variety of reasons, including dam operations, aesthetic concerns, and commercial and recreational uses. However, the presence of organic debris is important for maintaining aquatic habitat structure and function. Removal can alter the ecological conditions of riverine, estuarine, and coastal ecosystems and habitats.

Potential Adverse Impacts

The removal of organic debris from natural systems can reduce habitat function, adversely impacting habitat quality. Reductions in woody debris inputs to estuaries may also affect the ecological balance of estuarine systems by altering rates and patterns of nutrient transport, sediment deposition, and availability of in-water cover for larval and juvenile fish. Beach grooming and wrack removal can substantially alter the macrofaunal community structure of exposed sand beaches by reducing species richness, abundance, and biomass of macrofauna associated with beach wrack (e.g., sand crabs, isopods, amphipods, and polychaetes).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Leave LWD whenever possible, removing it only when it presents a threat to life or property.
2. Encourage appropriate federal, state, and local agencies to prohibit or minimize commercial removal of LWD from rivers, estuaries, and beaches.
3. Encourage appropriate federal, state, and local agencies to aid in the downstream movement of LWD around dams, culverts, and bridges wherever possible, rather than removing it from the system.
4. Educate landowners and recreationalists about the benefits of maintaining LWD.
5. Localize beach grooming practices, and minimize them whenever possible.

Inorganic Debris

Numerous national and international laws are intended to prevent the disposal of marine debris in ocean waters, including ocean dumping and land-based sources. Nationally, land-based sources of marine debris account for about 80 percent of the marine debris on beaches and in U.S. waters. Debris can originate from combined sewer overflows and storm drains, stormwater runoff, landfills, solid waste disposal, poorly maintained garbage bins, floating structures, and general littering of beaches, rivers, and open waters. Typical debris from these land-based sources includes raw or partially treated sewage, litter, hazardous materials, and discarded trash.

Potential Adverse Impacts

Land and ocean based marine debris is a very diverse problem, and adverse effects to EFH are likewise varied. Floating or suspended trash can directly affect fish that consume or are entangled in it. Toxic substances in plastics can kill or impair fish and invertebrates that use habitat polluted by these materials. The chemicals leach from plastics, persist in the environment, and can bioaccumulate through the food web.

Once floatable debris settles to the bottom of estuaries, coastal, and open ocean areas it may cover and suffocate immobile animals and plants, creating large spaces devoid of life. Currents can carry suspended debris to underwater reef habitats where the debris can become snagged, damaging these sensitive habitats. The typical floatable debris from combined sewer overflows includes street litter, sewage containing viral and bacterial pathogens, pharmaceutical by-products from human excretion, and pet wastes. Pathogens can also contaminate shellfish beds and reefs.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Encourage proper trash disposal in coastal and ocean settings.
2. Advocate and participate in coastal cleanup activities.
3. Encourage enforcement of regulations addressing marine debris pollution and proper disposal.
4. Provide resources and technical guidance for development of studies and solutions addressing the problem of marine debris.
5. Provide resources to the public explaining the impact of marine debris and giving guidance on how to reduce or eliminate the problem.

F.2.2.3 Dam Operation

Dams are constructed and operated to provide sources for hydropower, water storage, and flood control. Their operation, however, can affect water quality and quantity in riverine systems.

Potential Adverse Impacts

The effects of dam construction and operation on EFH can include (1) migratory impediments, (2) water flow and current pattern shifts, (3) thermal impacts, and (4) limits on sediment and woody debris transport.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Operate facilities to create flow conditions that provide for passage, water quality, proper timing of life history stages, and properly functioning channel conditions to avoid strandings and redd dewatering.

2. Develop water and energy conservation guidelines for integration into dam operation plans and into regional and watershed-based water resource plans.
3. Provide mitigation (including monitoring and evaluation) for nonavoidable adverse effects on EFH.

F.2.2.4 Commercial and Domestic Water Use

Commercial and domestic water use demands to support the needs of homes, farms, and industries require a constant supply of water. Freshwater is diverted directly from lakes, streams, and rivers by means of pumping facilities, or is stored in impoundments. Because human populations are expected to continue increasing in Alaska, it is reasonable to assume that water uses, including water impoundments and diversion, will similarly increase (Gregory and Bisson 1997).

Potential Adverse Impacts

Water diversions can involve either withdrawals (reducing flow) or discharges (increasing flow). The withdrawal of water can affect EFH by (1) altering natural flows and the process associated with flow rates, (2) affecting shoreline riparian habitats, (3) affecting prey bases, (4) affecting water quality, and (5) entrapping fishes. Problems associated with return flows include increased water temperature, increased salinity, introduction of pathogens, decreased dissolved oxygen, increased toxic contaminants from pesticides and fertilizers, and increased sedimentation (Northwest Power Planning Council [NPPC] 1986). Diversions can also physically divert or entrap EFH-managed species (Section G.5.3 of the EFH EIS).

Recommended Conservation Measures

The recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Design projects to create flow conditions that provide for adequate passage, water quality, proper timing of life history stages, and properly functioning channels to avoid juvenile stranding and redd dewatering, as well as to maintain and restore proper channel, floodplain, riparian, and estuarine conditions.
2. Establish adequate instream flow conditions for anadromous fish.
3. Screen water diversions on fish-bearing streams, as needed.
4. Incorporate juvenile and adult fish passage facilities on all water diversion projects (e.g., fish bypass systems).
5. Where practicable, ensure that mitigation is provided for nonavoidable impacts.

F.2.3 ESTUARINE ACTIVITIES

F.2.3.1 Dredging

Dredging navigable waters creates a continuous impact primarily affecting benthic and water-column habitats in the course of constructing and operating marinas, harbors, and ports. Routine dredging (i.e., the excavation of soft-bottom substrates) is used to create deepwater navigable channels or to maintain existing channels that periodically fill with sediments. In addition, port expansion has become an almost continuous process due to economic growth, competition between ports, and significant increases in vessel size (Section G.4.3 of the EFH EIS). Elimination or degradation of aquatic and upland habitats is commonplace because port expansion almost always affects open water, submerged bottoms, and, possibly, riparian zones.

Potential Adverse Impacts

The environmental effects of dredging on EFH can include (1) direct removal/burial of organisms; (2) turbidity/siltation effects, including light attenuation from turbidity; (3) contaminant release and uptake, including nutrients, metals, and organics; (4) release of oxygen consuming substances; (5) entrainment; (6) noise disturbances; and (6) alteration to hydrodynamic regimes and physical habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Avoid new dredging to the maximum extent practicable.
2. Where possible, minimize dredging by using natural and existing channels.
3. Site activities that would likely require dredging (such as placement of piers, docks, marinas, etc.) in deep-water areas or design such structures to alleviate the need for maintenance dredging.
4. Incorporate adequate control measures by using BMPs to minimize turbidity and dispersal of dredged material in areas where the dredging equipment would cause such effects.
5. For new dredging projects, undertake multi-season, pre-, and post-dredging biological surveys to assess the cumulative impacts to EFH and allow for implementation of adaptive management techniques.
6. Provide appropriate compensation for significant impacts (short-term, long-term, and cumulative) to benthic environments resulting from dredging.
7. Perform dredging at times when impacts to federally managed species or their prey are least likely. Avoid dredging in areas with submerged aquatic vegetation.
8. Reference all dredging latitude-longitude coordinates at the site so that information can be incorporated into a geographical information system format.
9. Test sediments for contaminants as per EPA and USACE requirements.
10. Identify excess sedimentation in the watershed that prompts excessive maintenance dredging activities, and implement appropriate management actions, if possible, to ensure that actions are taken to curtail those causes.
11. Ensure that bankward slopes of the dredged area are slanted to acceptable side slopes (e.g., 3:1) to prevent sloughing.
12. Avoid placing pipelines and accessory equipment used in conjunction with dredging operations to the maximum extent possible close to kelp beds, eelgrass beds, estuarine/salt marshes, and other high value habitat areas.

F.2.3.2 Material Disposal/Fill

The discharge of dredged materials subsequent to dredging operations or the use of fill material in aquatic habitats can result in sediments (e.g., dirt, sand, mud) covering or smothering existing submerged substrates, loss of habitat function, and adverse effects on benthic communities.

Disposal of Dredged Material

Potential Adverse Impacts

The disposal of dredged material can adversely affect EFH by (1) altering or destroying benthic communities, (2) altering adjacent habitats, and (3) creating turbidity plumes and introducing contaminants and/or nutrients.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Study all options for disposal of dredged materials, including upland disposal sites, and select disposal sites that minimize adverse effects to EFH.
2. Where long-term maintenance dredging is anticipated, acquire and maintain disposal sites for the entire project life.
3. Encourage beneficial uses of dredged materials.
4. State and federal agencies should identify the direct and indirect impacts open-water disposal permits for dredged material may have on EFH during proposed project reviews.
5. Minimize the areal extent of any disposal site in EFH, or avoid the site entirely. Mitigate all non-avoidable adverse impacts as appropriate.

Fill Material

Potential Adverse Impacts

Adverse impacts to EFH from the introduction of fill material include (1) loss of habitat function and (2) changes in hydrologic patterns.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH:

1. Federal, state, and local resource management and permitting agencies should address the cumulative impacts of past and current fill operations on EFH and consider them in the permitting process for individual projects.
2. Minimize the areal extent of any fill in EFH, or avoid it entirely. Mitigate all non-avoidable adverse impacts as appropriate.
3. Consider alternatives to the placement of fill into areas that support EFH.

F.2.3.3 Vessel Operations/Transportation/Navigation

The growth in Alaska coastal communities is putting demands on port districts to increase infrastructure capacity to accommodate additional vessel operations for cargo handling activities and marine transportation. Port expansion has become an almost continuous process due to economic growth, competition between ports, and significant increases in vessel size (Council 1999). In addition, increasing boat sales have put more pressure on improving and building new commercial fishing and small boat harbors.

Potential Adverse Impacts

Port facilities, vessel/ferry operations, and recreational marinas can impact to EFH, especially by filling productive shallow water habitats. Potential adverse impacts to EFH can occur during both the construction and operation phases. These include direct, indirect, and cumulative impacts on shallow subtidal, deep subtidal, eelgrass beds, mudflats, sand shoals, rock reefs, and salt marsh habitats. There is considerable evidence that docks and piers block sunlight penetration, alter water flow, introduce chemicals, and restrict access and navigation (Section G.4.6 of the EFH EIS). The increase in hard surfaces close to the marine environment increases nonpoint surface discharges (Section G.2.2 of the EFH EIS), adds debris sources, and reduces buffers between land use and the aquatic ecosystem. Additional impacts include vessel groundings, modification of water circulation (breakwaters, channels, and fill), vessel wake generation, pier lighting, anchor and prop scour, discharge of contaminants and debris, and changing natural patterns of fish movement.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate marinas in areas of low biological abundance and diversity; if possible, for example, avoid the disturbance of eelgrass or other submerged aquatic vegetation including macroalgae, mudflats, and wetlands as part of the project design.
2. If practicable, excavate uplands to create marina basins rather than converting intertidal or shallow subtidal areas to deeper subtidal areas for basin creation.
3. Leave riparian buffers in place to help maintain water quality and nutrient input.
4. Should mitigation be required, include a monitoring plan to gauge the success of mitigation efforts.
5. Include low-wake vessel technology, appropriate routes, and BMPs for wave attenuation structures as part of the design and permit process.
6. Incorporate BMPs to prevent or minimize contamination from ship bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging and disposal, and nonpoint source contaminants from upland facilities related to vessel operations and navigation.
7. Locate mooring buoys in water deep enough to avoid grounding and to minimize the effects of prop wash.
8. Use catchment basins for collecting and storing surface runoff from upland repair facilities.
9. Locate facilities in areas with enough water velocity to maintain water quality levels within acceptable ranges.
10. Locate marinas where they do not interfere with drift sectors determining the structure and function of adjacent habitats.
11. To facilitate the movement of fish around breakwaters, provide a shallow shelf or “fish bench” on the outside of the breakwater.
12. Harbor facilities should be designed to include practical measures for reducing, containing, and cleaning up petroleum spills.
13. Use appropriate timing windows for construction and dredging activities to avoid potential impacts on EFH.

F.2.3.4 Introduction of Exotic Species

Introductions of exotic species into estuarine, riverine, and marine habitats have been well documented and can be intentional (e.g., for the purpose of stock or pest control) or unintentional (e.g., fouling organisms).

Exotic fish, shellfish, pathogens, and plants can enter the environment from industrial shipping (e.g., as ballast), recreational boating, aquaculture (Section G.4.10 of the EFH EIS), biotechnology, and aquariums. The transportation of nonindigenous organisms to new environments can have many severe impacts on habitat (Omori et al. 1994).

Potential Adverse Impacts

Long-term impacts from the introduction of nonindigenous and reared species can change the natural community structure and dynamics, lower the overall fitness and genetic diversity of natural stocks, and pass and/or introduce exotic lethal disease. Overall, exotic species introductions create five types of negative effects: (1) habitat alteration, (2) trophic alteration, (3) gene pool alteration, (4) spatial alteration, and (5) introduction of diseases.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Uphold fish and game regulations of the Alaska Board of Fisheries (AS 16.05.251) and Board of Game (AS 16.05.255), which prohibit and regulate the live capture, possession, transport, or release of native or exotic fish or their eggs.
2. Adhere to regulations and use best management practices outlined in the State of Alaska Aquatic Nuisance Species Management Plan (Fay 2002).
3. Encourage vessels to perform a ballast water exchange in marine waters (in accordance with the U.S. Coast Guard’s voluntary regulations) to minimize the possibility of introducing exotic estuarine species into similar habitats.
4. Discourage vessels that have not performed a ballast water exchange from discharging their ballast water into estuarine receiving waters.
5. Require vessels brought from other areas over land via trailer to clean any surfaces that may harbor non-native plant or animal species (propellers, hulls, anchors, fenders, etc.).
6. Treat effluent from public aquaria displays and laboratories and educational institutes using exotic species before discharge to prevent the introduction of viable animals, plants, reproductive material, pathogens, or parasites into the environment.
7. Prevent introduction of non-native plant species into aquatic and riparian ecosystems by avoiding use of non-native seed mixes or invasive, non-native landscaping materials near waterways and shorelines.
8. Encourage proper disposal of seaweeds and other plant materials used for packing purposes when shipping fish or other animals.

F.2.3.5 Pile Installation and Removal

Pilings are an integral component of many overwater and in-water structures. They provide support for the decking of piers and docks, function as fenders and dolphins to protect structures, support navigation markers, and help in the construction of breakwaters and bulkheads. Materials used in pilings include steel, concrete, wood (both treated and untreated), plastic, or a combination thereof. Piles are usually driven into the substrate by using either impact hammers or vibratory hammers. Impact hammers consist of a heavy weight that is repeatedly dropped onto the top of the pile, driving it into the substrate. Vibratory hammers use a combination of a stationary, heavy weight and vibration, in the plane perpendicular to the long axis of the pile, to force the pile into the substrate. Impact hammers are able to drive piles into most substrates (including hardpan, glacial till, etc.), vibratory hammers are limited to softer, unconsolidated substrates (e.g., sand, mud, and gravel).

Piles can be removed using a variety of methods, including vibratory hammer, direct pull, clam shell grab, or cutting/breaking the pile below the mudline, leaving the buried section in place.

Pile Driving

Potential Adverse Impacts

Pile driving can generate intense underwater sound pressure waves that may adversely affect EFH. These pressure waves have been shown to injure and kill fish (CalTrans 2001, Longmuir and Lively 2001, Stotz and Colby 2001, Stadler, pers. obs. 2002). Injuries associated directly with pile driving are poorly studied, but include rupture of the swimbladder and internal hemorrhaging (CalTrans 2001; Abbott and Bing-Sawyer 2002; Stadler, pers. obs. 2002). The type and intensity of the sounds produced during pile driving depend on a variety of factors, including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer. Driving large hollow-steel piles with impact hammers produces intense, sharp spikes of sound that can easily reach levels injurious to fish. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate.

Systems successfully designed to reduce the adverse effects of underwater sounds on fish have included the use of air bubbles. Both confined (i.e., metal or fabric sleeve) and unconfined air bubble systems have been shown to attenuate underwater sound pressures (Longmuir and Lively 2001, Christopherson and Wilson 2002, Reyff and Donovan 2003).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Install hollow-steel piles with an impact hammer at a time of year when larval and juvenile stages of fish species with designated EFH are not present.
2. Drive piles during low tide when they are located in intertidal and shallow subtidal areas.
3. Use a vibratory hammer when driving hollow-steel piles.
4. Implement measures to attenuate the sound should it exceed threshold levels. If sound pressure levels are anticipated to exceed acceptable limits, implement appropriate mitigation measures when practicable. Methods to reduce the sound pressure levels include, but are not limited to, the following:
   a) Surround the pile with an air bubble curtain system or air-filled coffer dam.
   b) Because the sound produced has a direct relationship to the force used to drive the pile, use a smaller hammer to reduce the sound pressures.
   c) Use a hydraulic hammer if impact driving cannot be avoided. The force of the hammer blow can be controlled with hydraulic hammers; reducing the impact force will reduce the intensity of the resulting sound.
5. Drive piles when the current is reduced (i.e., centered around slack current) in areas of strong current to minimize the number of fish exposed to adverse levels of underwater sound.

Pile Removal

Potential Adverse Impacts

The primary adverse effect of removing piles is the suspension of sediments, which may result in harmful levels of turbidity and release of contaminants contained in those sediments. Vibratory pile removal tends to cause the sediments to slough off at the mudline, resulting in relatively low levels of suspended sediments and contaminants. Breaking or cutting the pile below the mudline may suspend only small amounts of sediment, providing that the stub is left in place, and little digging is required to access the pile. Direct pull or use of a clamshell to remove broken piles may, however, suspend large amounts of sediment and contaminants. When the piling is pulled from the substrate using these two methods, sediments clinging to the piling will slough off as it is raised through the water column, producing a potentially harmful plume of turbidity and/or contaminants. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling.

While there is a potential to adversely affect EFH during the removal of piles, many of the piles removed are old creosote-treated timber piles. In some cases, the long-term benefits to EFH obtained by removing a chronic source of contamination may outweigh the temporary adverse effects of turbidity.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Remove piles completely rather than cutting or breaking them off, if they are structurally sound.
2. Minimize the suspension of sediments and disturbance of the substrate when removing piles. Measures to help accomplish this include, but are not limited to, the following:
    a) When practicable, remove piles with a vibratory hammer, rather than using the direct pull or clamshell method.
    b) Remove the pile slowly to allow sediment to slough off at, or near, the mudline.
    c) The operator should first hit or vibrate the pile to break the bond between the sediment and the pile to minimize the potential for the pile to break, as well as to reduce the amount of sediment sloughing off the pile during removal.
    d) Encircle the pile, or piles, with a silt curtain that extends from the surface of the water to the substrate.
3. Complete each pass of the clamshell to minimize suspension of sediment if pile stubs are removed with a clamshell.
4. Place piles on a barge equipped with a basin to contain all attached sediment and runoff water after removal.
5. Using a pile driver, drive broken/cut stubs far enough below the mudline to prevent release of contaminants into the water column as an alternative to their removal.

F.2.3.6 Overwater Structures

Overwater structures include commercial and residential piers and docks, floating breakwaters, barges, rafts, booms, and mooring buoys. These structures typically are located in intertidal areas out to about 49 feet (15 meters) below the area exposed by the mean lower low tide (i.e., the shallow subtidal zone). Light, wave energy, substrate type, depth, and water quality are the primary factors controlling the plant and animal assemblages found at a particular site. Overwater structures and associated activities can alter these factors and interfere with key ecological functions such as spawning, rearing, and refugia. Site-specific factors (e.g., water clarity, current, depth, etc.) and the type and use of a given overwater structure determine the occurrence and magnitude of these impacts.

Potential Adverse Impacts

Overwater structures and associated developments may adversely affect EFH in a variety of ways, primarily by (1) changes in ambient light conditions, (2) alteration of the wave and current energy regime, and (3) activities associated with the use and operation of the facilities (Nightingale and Simenstad 2001).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Use upland boat storage whenever possible to minimize need for overwater structures.
2. Locate overwater structures in deep enough waters to avoid intertidal and shade impacts, minimize or preclude dredging, minimize groundings, and avoid displacement of submerged aquatic vegetation, as determined by a preconstruction survey.
3. Design piers, docks, and floats to be multiuse facilities to reduce the overall number of such structures and to limit impacted nearshore habitat.
4. Incorporate measures that increase the ambient light transmission under piers and docks. These measures include, but are not limited to, the following:
   a) Maximize the height of the structure, and minimize the width of the structure to decrease the shade footprint and using grated decking material.
   b) Use reflective materials (e.g., concrete or steel instead of materials that absorb light such as wood) on the underside of the dock to reflect ambient light.
   c) Use the fewest number of pilings necessary to support the structures to allow light into under-pier areas and minimize impacts to the substrate.
   d) Align piers, docks, and floats in a north-south orientation to allow the arc of the sun to cross perpendicular to the structure and to reduce the duration of light limitation.
5. Use floating rather than fixed breakwaters whenever possible, and remove them during periods of low dock use. Encourage seasonal use of docks and off-season haul-out.
6. Locate floats in deep water to avoid light limitation and grounding impacts to the intertidal or shallow subtidal zone.
7. Maintain at least 1 foot (0.30 meter) of water between the substrate and the bottom of the float at extreme low tide.
8. Conduct in-water work when managed species and prey species are least likely to be impacted.
9. To the extent practicable, avoid the use of treated wood timbers or pilings and use alternative materials such as untreated wood, concrete, or steel.
10. Mitigate for unavoidable impacts to benthic habitats. Mitigation should be adequate, monitored, and adaptively managed.

F.2.3.7 Flood Control/Shoreline Protection

Protecting riverine and estuarine communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. The use of dikes and berms can also have long-term adverse effects on tidal marsh and estuarine habitats. Tidal marshes are highly variable, but typically have freshwater vegetation at the landward side, saltwater vegetation at the seaward side, and gradients of species in between that are in equilibrium with the prevailing climatic, hydrographic, geological, and biological features of the coast. These systems normally drain through highly dendritic tidal creeks that empty into the bay or estuary. Freshwater entering along the upper edges of the marsh drains across the surface and enters the tidal creeks. Structures placed for coastal shoreline protection include, but are not limited to, concrete or wood seawalls, rip-rap revetments (sloping piles of rock placed against the toe of the dune or bluff in danger of erosion from wave action), dynamic cobble revetments (natural cobble placed on an eroding beach to dissipate wave energy and prevent sand loss), vegetative plantings, and sandbags.

Potential Adverse Impacts

Dikes, levees, ditches, or other water controls at the upper end of a tidal marsh can cut off all tributaries feeding the marsh, preventing freshwater flushing and annual flushing, annual renewal of sediments and nutrients, and the formation of new marshes. Water controls within the marsh proper intercept and carry away freshwater drainage, block freshwater from flowing across seaward portions of the marsh, increase the speed of runoff of freshwater to the bay or estuary, lower the water table, permit saltwater intrusion into the marsh proper, and create migration barriers for aquatic species. In deeper channels where reducing conditions prevail, large quantities of hydrogen sulfide are produced. These quantities are toxic to marsh grasses and other aquatic life. Acid conditions of these channels can also result in release of heavy metals from the sediments.

Long-term effects on the tidal marsh include land subsidence (sometimes even submergence), soil compaction, conversion to terrestrial vegetation, greatly reduced invertebrate populations, and general loss of productive wetland characteristics. Loss of these low-salinity environments reduces estuarine fertility, restricts suitable habitat for aquatic species, and creates abnormally high salinity during drought years. Low-salinity environments form a barrier that prevents the entrance of many marine species, including competitors, predators, parasites, and pathogens.

Armoring of shorelines to prevent erosion and to maintain or create shoreline real estate simplifies habitats, reduces the amount of intertidal habitat, and affects nearshore processes and the ecology of numerous species (Williams and Thom 2001). Hydraulic effects on the shoreline include increased energy seaward of the armoring, reflected wave energy, dry beach narrowing, substrate coarsening, beach steepening, changes in sediment storage capacity, loss of organic debris, and downdrift sediment starvation (Williams and Thom 2001). Installation of breakwaters and jetties can result in community changes from burial or removal of resident biota, changes in cover and preferred prey species, and predator attraction (Williams and Thom 2001). As with armoring, breakwaters and jetties modify hydrology and nearshore sediment transport, as well as movement of larval forms of many species (Williams and Thom 2001).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Minimize the loss of riparian habitats as much as possible.
2. Do not undertake diking and draining of tidal marshlands and estuaries.
3. Wherever possible, use soft approaches (such as beach nourishment, vegetative plantings, and placement of LWD) to shoreline modifications.
4. Include efforts to preserve and enhance EFH by providing new gravel for spawning areas, removing barriers to natural fish passage, and using weirs, grade control structures, and low-flow channels to provide the proper depth and velocity for fish.
5. Construct a low-flow channel to facilitate fish passage and help maintain water temperature in reaches where water velocities require armoring of the riverbed.
6. Offset unavoidable impacts to in-stream fish habitat by providing rootwads, deflector logs, boulders, and rock weirs and by planting shaded riverine aquatic cover vegetation.

7. Use an adaptive management plan with ecological indicators to oversee monitoring and to ensure that mitigation objectives are met. Take corrective action as needed.

F.2.3.8 Log Transfer Facilities/In-water Log Storage

Rivers, estuaries, and bays were historically the primary ways to transport and store logs in the Pacific Northwest. Log storage within the bays and estuaries remains an issue in several Pacific Northwest bays. Using estuaries and bays and nearby uplands for storage of logs is common in Alaska, with most LTFs found in Southeast Alaska and a few located in Prince William Sound.

Potential Adverse Impacts

Log handling and storage in the estuary and intertidal zones of rivers can result in modification of benthic habitat and water quality degradation within the area of bark deposition (Levings and Northcote 2004). EFH may also be physically impacted by activities associated with facilities, constructed in the water, that are used to transfer commercially harvested logs to or from a vessel or log raft, including log rafts. Bark and wood debris may accumulate as a result of the abrasion of log surfaces from transfer equipment and impact EFH. After the logs have entered the water, they usually are bundled into rafts and hooked to a tug for shipment. In the process, bark and other wood debris can pile up on the ocean floor. The piles can smother clams, mussels, some seaweed, kelp, and grasses, with the bark sometimes remaining for decades. Accumulation of bark debris in shallow and deep-water environments has resulted in locally decreased epifaunal macrobenthos richness and abundance (Kirkpatrick et al. 1998, Jackson 1986). Log storage may also result in a release of soluble organic compounds within the bark pile. The physical, chemical, and biological impacts of log operations can be substantially reduced by adherence to appropriate siting and operational constraints. Adherence operational and siting guidelines will reduce (1) the amount of bark and wood debris that enters the marine and coastal environment, (2) the potential for displacement or harm to aquatic species, and (3) the accumulation of bark and wood debris on the ocean floor.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Restrict or eliminate storage and handling of logs from waters where state and federal water quality standards cannot be met at all times outside of the authorized zone of deposition.
2. Minimize potential impacts of log storage by employing effective bark and wood debris control, collection, and disposal methods at log dumps, raft building areas, and mill-side handling zones; avoiding free-fall dumping of logs; using easy let-down devices for placing logs in the water; and bundling logs before water storage (bundles should not be broken except on land and at millside).
3. Do not store logs in the water if they will ground at any time or shade sensitive aquatic vegetation such as eelgrass.
4. Avoid siting log-storage areas and LTFs in sensitive habitat and areas important for specified species, as required by the ATTF guidelines.
5. Site log storage areas and LTFs in areas with good currents and tidal exchanges.
6. Use land-based storage sites where possible, with the goal of eliminating in-water storage of logs.

F.2.3.9 Utility Line/Cables/Pipeline Installation

With the continued development of coastal regions comes greater demand for the installation of cables, utility lines for power and other services, and pipelines for water, sewage, etc. The installation of pipelines, utility lines, and cables can have direct and indirect impacts on the offshore, nearshore, estuarine, wetland, beach, and rocky shore coastal zone habitats. Many of the primary and direct impacts occur during the construction phase of installation, such as ground disturbance in the clearing of the right-of-way, access roads, and equipment staging areas. Indirect impacts can include increased turbidity, saltwater intrusion, accelerated erosion, and introduction of urban and industrial pollutants.

Potential Adverse Impacts

Adverse effects on EFH from the installation of pipelines, utility lines, and cables can occur through (1) destruction of organisms and habitat, (2) turbidity impacts, (3) resuspension of contaminants, and (4) changes in hydrology.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Align crossings along the least environmentally damaging route. Avoid sensitive habitats such as hard-bottom (e.g., rocky reefs), cold-water corals, submerged aquatic vegetation, oyster reefs, emergent marsh, and mud flats.
2. Use horizontal directional drilling where cables or pipelines would cross anadromous fish streams, salt marsh, vegetated inter-tidal zones, or steep erodible bluff areas adjacent to the inter-tidal zone to avoid surface disturbances.
3. Avoid construction of permanent access channels since they disrupt natural drainage patterns and destroy wetlands through excavation, filling, and bank erosion.
4. Store and contain excavated material on uplands.
5. Backfill excavated wetlands with either the same or comparable material capable of supporting similar wetland vegetation and at original marsh elevations.
6. Use existing rights-of-way whenever possible to lessen overall encroachment and disturbance of wetlands.
7. Bury pipelines and submerged cables where possible.
8. Remove inactive pipelines and submerged cables unless they are located in sensitive areas (e.g., marsh, reefs, sea grass, etc.) or in areas that present no safety hazard.
9. Use silt curtains or other type barriers to reduce turbidity and sedimentation whenever possible near the project site.
10. Limit access for equipment to the immediate project area.
11. Limit construction equipment to the minimum size necessary to complete the work.
12. Conduct construction during the time of year when it will have the least impact on sensitive habitats and species.
13. Suspend transmission lines beneath existing bridges or conduct directional boring under streams to reduce the environmental impact.
14. For activities on the Continental Shelf, shunt drill cuttings through a conduit and either discharge the cuttings near the sea floor, or transport them ashore.
15. For activities on the Continental Shelf, and to the extent practicable, locate drilling and production structures, including pipelines, at least 1 mile (1.6 kilometers) from the base of a hard-bottom habitat.
16. For activities on the Continental Shelf, and to avoid and minimize adverse impacts to managed species, implement the following to the extent practicable:

a) Bury pipelines at least 3 feet (0.9 meter) beneath the sea floor, whenever possible. Particular considerations (i.e., currents, ice scour) may require deeper burial or weighting to maintain adequate cover. Buried pipeline and cables should be examined periodically for maintenance of adequate earthen cover.

b) Where burial is not possible, such as in hard-bottomed areas, attach pipelines and cables to substrate to minimize conflicts with fishing gear.

c) Locate alignments along routes that will minimize damage to marine and estuarine habitat.

d) Where user conflicts are likely, consult and coordinate with fishing stakeholder groups during the route-planning process to minimize conflict.

F.2.3.10 Commercial Utilization of Habitat

Productive embayments are often used for commercial culturing and harvesting operations. These locations provide protected waters which serve as sites for oyster and mussel culturing. These operations may occur in areas of productive eelgrass beds. In 1988, Alaska passed the Alaska Aquatic Farming Act which is designed to encourage establishment and growth of an aquatic farming industry in the state. The Act establishes four criteria for issuance of an aquatic farm permit, including the requirement that the farm may not significantly affect fisheries, wildlife, or other habitats in an adverse manner.

Potential Adverse Impacts

Adverse impacts to EFH by operations that directly or indirectly use habitat include (1) discharge of organic waste, (2) shading and direct impacts to the seafloor, (3) risk of introducing undesirable species, and (4) impacts on estuarine food webs.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Site mariculture operations away from existing kelp or eelgrass beds. If mariculture operations are to be located adjacent to existing kelp or eelgrass beds, monitor these beds on an annual basis and resite the mariculture facility if monitoring reveals adverse effects.
2. Do not enclose or impound tidally influenced wetlands for mariculture. Take into account the size of the facility, migratory patterns, competing uses, hydrographic conditions, and upstream uses when siting facilities.
3. Undertake a thorough scientific review and risk assessment before any non-native species are introduced.
4. Encourage development of harvesting methods to minimize impacts on plant communities and the loss of food and/or habitat to fish populations during harvesting operations.
5. Provide appropriate mitigation for the unavoidable, extensive, or permanent loss of plant communities.

F.2.4 COASTAL/MARINE ACTIVITIES

F.2.4.1 Point-source Discharges

Point-source discharges from municipal sewage treatment facilities or storm water discharges are controlled through EPA's regulations under the CWA and by state water regulations. The primary concerns associated with municipal point-source discharges involve treatment levels needed to attain acceptable nutrient inputs and overloading of treatment systems due to rapid development of the coastal zone. Storm drains are contaminated from communities using settling and storage ponds, street runoff, harbor activities, and honey buckets. Annually, wastewater facilities introduce large volumes of untreated excrement and chlorine through sewage outfall lines, as well as releasing treated freshwater into the nation's waters. This can significantly alter pH levels of marine waters (Council 1999).

Potential Adverse Impacts

There are many potential impacts from point-source discharge, but point-source discharges and resulting altered water quality in aquatic environments do not necessarily result in adverse impacts, either to marine resources or EFH. Because most point-source discharges are regulated by the state or EPA, effects to receiving waters are generally considered on a case-by-case basis. Point-source discharges can adversely affect EFH by (1) reducing habitat functions necessary for growth to maturity, (2) modifying community structure, (3) bioaccumulation, and (4) modifying habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate discharge points in coastal waters well away from shellfish beds, sea grass beds, coral reefs, and other similar fragile and productive habitats.
2. Reduce potentially high velocities by diffusing effluent to acceptable velocities.
3. Determine benthic productivity by sampling before any construction activity related to installation of new or modified facilities. Develop outfall design (e.g., modeling concentrations within the predicted plume or likely extent of deposition along a productive nearshore) with input from appropriate resource and Tribal agencies.
4. Provide for mitigation when degradation or loss of habitat occurs from placement and operation of the outfall structure and pipeline.
5. Institute source-control programs that effectively reduce noxious materials to avoid introducing these materials into the waste stream.
6. Ensure compliance with pollutant discharges regulated through discharge permits which set effluent discharge limitations and/or specify operation procedures, performance standards, or BMPs. These efforts rely on the implementation of BMPs to control polluted runoff (EPA 1993).
7. Treat discharges to the maximum extent practicable, including implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances.
8. Use land-treatment and upland disposal/storage techniques where possible. Limit the use of vegetated wetlands as natural filters and pollutant assimilators for large-scale discharges to those instances where other less damaging alternatives are not available, and the overall environmental and ecological suitability of such actions has been demonstrated.
9. Avoid siting pipelines and treatment facilities in wetlands and streams. Since pipelines and treatment facilities are not water-dependent with regard to positioning, it is not essential that they be placed in wetlands or other fragile coastal habitats. Avoiding placement of pipelines within streambeds and wetlands will also reduce inadvertent infiltration into conveyance systems and retain natural hydrology of local streams and wetlands.

F.2.4.2 Fish Processing Waste—Shoreside and Vessel Operation

Seafood processing facilities are either shore-based facilities discharging through stationary outfalls or mobile vessels engaged in the processing of fresh or frozen seafood (Science Applications International

Corporation 2001). Discharge of fish waste from shoreside and vessel processing has occurred in marine waters since the 1800s (Council 1999). With the exception of fresh market fish, some form of processing involving butchering, evisceration, precooking, or cooking is necessary to bring the catch to market. Precooking or blanching facilitates the removal of skin, bone, shell, gills, and other materials. Depending on the species, the cleaning operation may be manual, mechanical, or a combination of both (EPA 1974). Seafood processing facilities generally consist of mechanisms to offload the harvest from fishing boats; tanks to hold the seafood until the processing lines are ready to accept them; processing lines, process water, and waste collection systems; treatment and discharge facilities; processed seafood storage areas; and necessary support facilities such as electrical generators, boilers, retorts, water desalinators, offices, and living quarters. In addition, marinas that cater to patrons who fish a large amount can produce an equally large quantity of fish waste at the marina from fish cleaning.

Potential Adverse Impacts

Generally, seafood processing wastes consist of biodegradable materials that contain high concentrations of soluble organic material. Seafood processing operations have the potential to adversely affect EFH through (1) direct and/or nonpoint source discharge, (2) particle suspension, and (3) increased turbidity and surface plumes.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the maximum extent practicable, base effluent limitations on site-specific water quality concerns.
2. To the maximum extent practicable, avoid the practice of discharging untreated solid and liquid waste directly into the environment.
3. Do not allow designation of new ZODs. Explore options to eliminate or reduce ZODs at existing facilities.
4. Control stickwater by physical or chemical methods.
5. Promote sound fish waste management through a combination of fish-cleaning restrictions, public education, and proper disposal of fish waste.
6. Encourage the alternative use of fish processing wastes (e.g., fertilizer for agriculture and animal feed).
7. Explore options for additional research.
8. Locate new plants outside rearing and nursery habitat. Monitor both biological and chemical changes to the site.

F.2.4.3 Water Intake Structures/Discharge Plumes

The withdrawal of riverine, estuarine, and marine waters by water intake structures is a common aquatic activity. Water may be withdrawn and used, for example, to cool power-generating stations and create temporary ice roads and ice ponds. In the case of power plants, the subsequent discharge of heated and/or chemically treated discharge water can also occur.

Potential Adverse Impacts

Water intake structures and effluent discharges can interfere with or disrupt EFH functions in the source or receiving waters by (1) entrainment, (2) impingement, (3) discharge, (4) operation and maintenance, and (5) construction-related impacts.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate facilities that rely on surface waters for cooling in areas other than estuaries, inlets, heads of submarine canyons, rock reefs, or small coastal embayments where managed species or their prey concentrate.
2. Design intake structures to minimize entrainment or impingement.
3. Design power plant cooling structures to meet the best technology available requirements as developed pursuant to Section 316(b) of the CWA.
4. Regulate discharge temperatures (both heated and cooled effluent) so they do not appreciably alter the temperature to an extent that could cause a change in species assemblages and ecosystem function in the receiving waters.
5. Avoid the use of biocides (e.g., chlorine) to prevent fouling where possible. Implement the least damaging antifouling alternatives.
6. Mitigate for impacts related to power plants and other industries requiring cooling water.
7. Treat all discharge water from outfall structures to meet state water quality standards at the terminus of the pipe.

F.2.4.4 Oil/Gas Exploration/Development/Production

Offshore exploration, development, and production of natural gas and oil reserves have been, and continue to be, an important aspect of the U.S. economy. As demand for energy resources grows, the debate over trying to balance the development of oil and gas resources and the protection of the environment will also continue. Projections indicate that U.S. demand for oil will increase by 1.3 percent per year between 1995 and 2020. Gas consumption is projected to increase by an average of 1.6 percent during the same time frame (Waisley 1998). Much of the 1.9 billion acres within the offshore jurisdiction of the U.S. remains unexplored (Oil and Gas Technologies for the Arctic and Deepwater 1985). Some of the older oil and gas platforms in operation will probably reach the end of their productive life in the near future, and decommissioning them is also an issue.

Potential Adverse Impacts

Offshore oil and gas operations can be classified into exploration, development, and production activities (which includes transportation). These activities occur at different depths in a variety of habitats. Not all of the potential disturbances in this list apply to every type of activity. These areas are subject to an assortment of physical, chemical, and biological disturbances, including the following (Council 1999, Helvey 2002):

- Noise from seismic surveys, vessel traffic, and construction of drilling platforms or islands
- Physical alterations to habitat from the construction, presence, and eventual decommissioning and removal of facilities such as islands or platforms, storage and production facilities, and pipelines to onshore common carrier pipelines, storage facilities, or refineries
- Waste discharges, including well drilling fluids, produced waters, surface runoff and deck drainage, domestic waste waters generated from the offshore facility, solid waste from wells (drilling muds and cuttings), and other trash and debris from human activities associated with the facility
- Oil spills
- Platform storage and pipeline decommissioning

The potential disturbances and associated adverse impacts on the marine environment have been reduced through operating procedures required by regulatory agencies and, in many cases, self-imposed by facilities operators. Most of the activities associated with oil and gas operations are conducted under permits and regulations that require companies to minimize impacts or avoid construction in sensitive marine habitats. New technological advances in operating procedures also reduce the potential for impacts.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH:

1. As part of pre-project planning, identify all species of concern regulated under federal or state fishery management plans that inhabit, spawn, or migrate through areas slated for exploration, development, or production.
2. Avoid the discharge of produced waters into marine waters and estuaries. Reinject produced waters into the oil formation whenever possible.
3. Avoid discharge of muds and cuttings into the marine and estuarine environment.
4. To the extent practicable, avoid the placement of fill to support construction of causeways or structures in the nearshore marine environment.
5. As required by federal and state regulatory agencies, encourage the use of geographic response strategies that identify EFH and environmentally sensitive areas.
6. To the extent practicable, use methods to transport oil and gas that limit the need for handling in environmentally sensitive areas, including EFH.
7. Ensure that appropriate safeguards have been considered before drilling the first development well into the targeted hydrocarbon formations whenever critical life history stages of federally managed species are present.
8. Ensure that appropriate safeguards have been considered before drilling exploration wells into untested formations whenever critical life stages of federally managed species are present.
9. Oil and gas transportation and production facilities should be designed, constructed, and operated in accordance with applicable regulatory and engineering standards.
10. Evaluate and minimize impacts to EFH during the decommissioning phase of oil and gas facilities, including possible impacts during the demolition phase.

F.2.4.5 Habitat Restoration/Enhancement

Habitat loss and degradation are major, long-term threats to the sustainability of fishery resources (NMFS 2002). Viable coastal and estuarine habitats are important to maintaining healthy fish stocks. Good water quality and quantity, appropriate substrate, ample food sources, and substantial hiding places are needed to sustain fisheries. Restoration and/or enhancement of coastal and riverine habitat that supports managed fisheries and their prey will assist in sustaining and rebuilding fisheries stocks and recovering certain threatened or endangered species by increasing or improving ecological structure and functions. Habitat restoration/enhancement may include, but is not limited to, improvement of coastal wetland tidal exchange or reestablishment of historic hydrology, dam or berm removal, fish passage barrier removal/ modification, road-related sediment source reduction, natural or artificial reef/substrate/habitat creation, establishment or repair of riparian buffer zones, improvement of freshwater habitats that support anadromous fishes, planting of native coastal wetland and submerged aquatic vegetation, creation of oyster reefs, and improvements to feeding, shade or refuge, spawning, and rearing areas that are essential to fisheries.

Potential Adverse Impacts

The implementation of restoration/enhancement activities may have localized and temporary adverse impacts on EFH. Possible impacts can include (1) localized nonpoint source pollution such as influx of sediment or nutrients, (2) interference with spawning and migration periods, (3) temporary or permanent removal feeding opportunities, and (4) indirect effects from actual construction portions of the activity.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Use BMPs to minimize and avoid potential impacts to EFH during restoration activities. BMPs should include, but are not limited to, the following:
    a) Use turbidity curtains, haybales, and erosion mats to protect the water column.
    b) Plan staging areas in advance, and keep them to a minimum size.
    c) Establish buffer areas around sensitive resources; flag and avoid rare plants, archeological sites, etc.
    d) Remove invasive plant and animal species from the proposed action area before starting work. Plant only native plant species. Identify and implement measures to ensure native vegetation or revegetation success (Section G.4.4 of the EFH EIS).
    e) Establish temporary access pathways before restoration activities to minimize adverse impacts from project implementation.
2. Avoid restoration work during critical life stages for fish such as spawning, nursery, and migration. Determine these periods before project implementation to reduce or avoid any potential impacts.
3. Provide adequate training and education for volunteers and project contractors to ensure minimal impact to the restoration site. Train volunteers in the use of low-impact techniques for planting, equipment handling, and any other activities associated with the restoration.
4. Conduct monitoring before, during, and after project implementation to ensure compliance with project design and restoration criteria. If immediate post-construction monitoring reveals that unavoidable impacts to EFH have occurred, ensure that appropriate coordination with NMFS occurs to determine appropriate response measures, possibly including mitigation.
5. To the extent practicable, mitigate any unavoidable damage to EFH within a reasonable time after the impacts occur.
6. Remove and, if necessary, restore any temporary access pathways and staging areas used in the restoration effort.
7. Determine benthic productivity by sampling before any construction activity in the case of subtidal enhancement (e.g., artificial reefs). Avoid areas of high productivity to the maximum extent possible. Develop a sampling design with input from state and federal resource agencies. Before construction, evaluate of the impact resulting from the change in habitat (sand bottom to rocky reef, etc.). During post-construction monitoring, examine the effectiveness of the structures for increasing habitat productivity.

F.2.4.6 Marine Mining

Mining activity, which is also described in Sections G.3.1.1 and G.3.1.2 of the EFH EIS, can lead to the direct loss of EFH for certain species. Offshore mining, such as the extraction of gravel and gold in the Bering Sea and the mining of gravel from beaches, can increase turbidity of water. Thus, the resuspension of organic materials could affect less motile organisms (i.e., eggs and recently hatched larvae) in the area.

Benthic habitats could be damaged or destroyed by these actions. Mining large quantities of beach gravel may significantly affect the removal, transport, and deposition of sand and gravel along the shore, both at the mining site and down-current (Council 1999). Neither the future extent of this activity nor the effects of such mortality on the abundance of marine species is known.

Potential Adverse Impacts

Mining practices that can affect EFH include physical impacts from intertidal dredging and chemical impacts from the use of additives such as flocculates (Council 1999). Impacts may include the removal of substrates that serve as habitat for fish and invertebrates; habitat creation or conversion in less productive or uninhabitable sites, such as anoxic holes or silt bottom; burial of productive habitats, such as in near-shore disposal sites (as in beach nourishment); release of harmful or toxic materials either in association with actual mining, or in connection with machinery and materials used for mining; creation of harmful turbidity levels; and adverse modification of hydrologic conditions so as to cause erosion of desirable habitats. Submarine disposal of mine tailings can also alter the behavior of marine organisms. Submarine mine tailings may not provide suitable habitat for some benthic organisms. In laboratory experiments, benthic dwelling flatfishes (Johnson et al. 1998a) and crabs (Johnson et al. 1998b) strongly avoided mine tailings.

During beach gravel mining, water turbidity increases and the resuspension of organic materials can affect less motile organisms (i.e., eggs and recently hatched larvae) in the area. Benthic habitats can be damaged or destroyed by these actions. Changes in bathymetry and bottom type may also alter population and migrations patterns (Hurme and Pullen 1988).

Recommended Conservation Measures

The following recommended conservation measures for marine mining should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid mining in waters containing sensitive marine benthic habitat including EFH (e.g., spawning, migrating, and feeding sites).
2. Minimize the areal extent and depth of extraction to reduce recolonization times.
3. Monitor turbidity during operations, and cease operations if turbidity exceeds predetermined threshold levels. Use sediment or turbidity curtains to limit the spread of suspended sediments and minimize the area affected.
4. Monitor individual mining operations to avoid and minimize cumulative impacts. For instance, three mining operations in an intertidal area could impact EFH, whereas one may not. Disturbance of previously contaminated mining areas may cause additional loss of EFH.
5. Use seasonal restrictions, as appropriate, to avoid and minimize impacts to EFH during critical life history stages of managed species (e.g., migration and spawning).

F.2.4.7 Persistent Organic Pollutants

The single biggest pollution threat to marine waters in Alaska is the deposition of persistent pollutants from remote sources. A large variety of contaminants can be found in Alaska’s marine environment, including persistent organic pollutants (POPs) and heavy metals. North Pacific and Alaska marine waters are perceived as pristine because most of Alaska’s 6,640 miles (10,686 kilometers) of coastline are devoid of point-source pollution, unlike much of North America. Effluents from pulp mills, marinas and boat harbors, municipal outfalls, and other industrial activities are generally considered to be the primary sources of contamination in Alaska waters, so most efforts at monitoring and mitigation have been focused on the local level. However, there is an increasing body of evidence suggesting that the greatest contaminant threat in Alaska comes from atmospheric and marine transport of contaminants from areas quite distant from Alaska.

The geography of Alaska makes it particularly vulnerable to contaminants volatilized from Asia. Pesticides applied to crops in Southeast Asia can be volatilized into the air, bound to suspended particulates, transported in the atmosphere to Alaska, and deposited in snow or rain directly into marine ecosystems or indirectly from freshwater flow to nearshore waters. Revolatilization of these compounds is inhibited by the cold temperatures associated with Alaska latitudes, resulting in a net accumulation of these compounds in northern habitats. This same distillation process also transfers volatilized contaminants from the atmosphere to the Pacific at lower latitudes, and ocean currents also deliver the contaminants to Alaska. Concentrations will be very low, but there will extensive geographical marine or land areas to act as cold deposit zones. The effect of these transport mechanisms has been the appearance of persistent organic contaminants in northern latitudes, despite the absence of local sources.

With over 100,000 chemicals on the market and an additional 1,000 to 2,000 new ones introduced annually, there are likely other toxic compounds in the environment whose concentrations are increasing. In addition, combustion and industrial processes result in the inadvertent production of unregulated chemicals (Arctic Monitoring and Assessment Programme [AMAP] 2002).

Potential Adverse Impacts

It is not clear if the levels of contaminants in Alaska waters are causing deleterious effects to populations, because research in this area is still in its infancy. Relatively small and spotty contaminant surveys have established that POPs are present in Alaska waters, forage, and predators. No comprehensive geographical and temporal studies have been done to date to examine trends or sources of variation. The potential for the problem has been exposed; the extent and significance remain to be determined.

The existence of organic contaminants in biological tissues means these contaminants are being transported within the food webs in Alaska fish habitats. The trophic structure of Alaska marine food webs, coupled with the tendency of contaminants to accumulate in Alaska habitats, causes apex predators to concentrate significant amounts of POPs in their tissues. Contamination is probably widespread among forage species at low levels, but apex predators are likely be the most affected as a result of their longevity, lipid storage, and the relatively high concentrations they bear. Contamination can cause immunological and reproductive impairment, acute toxic effects, and population declines. This issue is particularly relevant when the contaminant loads experienced by Alaska natives subsisting on foods derived from marine habitats are considered. Impacts may also occur at lower trophic levels, but there has been even less research in this area.

The impacts of persistent contaminants on populations in Alaska waters are not likely to be acute. The impacts are more likely be expressed as sublethal impacts in apparently healthy animals. These sublethal impacts ultimately lead to reduced reproductive fitness or decreased survival to maturity; therefore, they manifest themselves indirectly. Science is certain that the physical properties of these compounds couple with global climate patterns to ensure that they will be deposited in Alaska habitats, while maintaining their toxicity and perfusing through Alaska food webs, which include some of the most valuable fisheries on the planet. What is uncertain is how these compounds impact the health of organisms deriving sustenance from those food webs and how those impacts might feed back into the food web.

Recommended Conservation Measures

No mitigation strategies are proposed at this time relative to contaminants. There are too many unknowns. POP contaminants are present in Alaska waters and forage species and in predators up through apex predators, but the significance of the present loads is not known. Also, the relative concentrations in forage species (pollock for example) from the EBS, near Russia, or the northern GOA are not known. Comprehensive studies on a geographical, temporal, or widespread species scale to determine any relationship between contaminant loads and population changes have not been conducted. POP contaminants may contribute to poor recovery in some species, but mitigation strategies, whether they would be changes in fishing regulations or international regulation to curb contaminant releases, will likely need a better research foundation to support changes.

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F.3 Cumulative Effects of Fishing and Non-Fishing Activities on Essential Fish Habitat

This section discusses the cumulative effects of fishing and non-fishing activities on EFH. As identified in Section 4.4 of the EFH EIS (NMFS 2005), historical fishing practices may have had effects on EFH that have led to declining trends in some of the criteria examined (Table 4.4-1 of the EFH EIS). As described in earlier sections of F.1 above, the effects of current fishing activities on EFH are classified as minimal and temporary or unknown.

A review of the effects of non-fishing activities on EFH is found in Section F.2 above. There are 29 non-fishing activities for which potential effects are described above. However, the magnitude of these effects cannot currently be quantified with available information. Of the 29 activities, most are described as likely having less than substantial potential effects on EFH. Some of these activities such as urban/suburban development, road building and maintenance (including the placement of fill material), vessel operations/transportation/navigation, silviculture (including LTFs), and point source discharge may have potential cumulative impacts due to the additive and chronic nature of these activities. NMFS does not have regulatory authority over non-fishing activities, but frequently provides recommendations to other agencies to avoid, minimize, or otherwise mitigate the effects of these activities.

Fishing and each activity identified in the analysis of non-fishing activities may not significantly affect the function of EFH. However, the synergistic effect of the combination of all of these activities may be a cause for concern. Unfortunately, available information is not sufficient to assess how the cumulative effects of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale. The magnitude of the combined effect of all of these activities cannot be quantified, so the level of concern is not known at this point.

Appendix G Fishery Impact Statement

The Magnuson-Stevens Fishery and Conservation Management Act requires that a fishery management plan (FMP) include a fishery impact statement that assesses, specifies, and describes the likely effects of the FMP measures on participants in the fisheries and fishing communities affected by the FMP. A detailed analysis of the effects of the FMP on the human environment, including fishery participants and fishing communities, was conducted in the *Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement* (NMFS 2004). The following is a brief summary from this analysis.

The FMP has instituted privilege-based management programs in the some groundfish fisheries, and fishery managers, under the guidance of the FMP management policy, are moving towards extending privilege-based allocations to other groundfish fisheries.

1. The FMP promotes increased social and economic benefits through the promotion of privilege-based allocations to individuals, sectors and communities. For this reason, it is likely to increase the commercial value generated from the groundfish fisheries.
2. As the race-for-fish is eliminated, the FMP could result in positive effects in terms of producer net revenue, consumer benefits, and participant health and safety.
3. The elimination of the race-for-fish will likely result in a decrease in overall participation levels. In the long-run, communities are likely to see fewer persons employed in jobs related to the fishing industry (fishing, processing, or support sectors), but the jobs that remain could be more stable and provide higher pay.
4. The FMP's promotion of privilege-based allocations is also expected to increase consumer benefits and health and safety of participants.

The FMP has adopted a variety of management measures to promote the sustainability of the groundfish fisheries and dependent fishing communities.

- Management measures to account for uncertainty ensure the sustainability of the managed species by maintaining a spawning stock biomass for the target species with the potential to produce sustained yields.
- The transition to privilege-based management in the short-term could disrupt stability, however in the long-term, the stability of fisheries would be increased in comparison to a derby-style fishery.
- Communities would also tend to experience an increase in stability as a result of built-in community protections to the privilege-based management programs.

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Appendix H Research Needs

Although research needs are identified in this appendix to the Fishery Management Plan (FMP), ongoing research and research needs are constantly being updated. It may therefore be useful to the reader to access other sources in order to obtain the North Pacific Fishery Management Council (Council)'s most current description of research and research needs on the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. A complete discussion of up-to-date sources is included in Chapter 6 of the FMP. In particular, the Council's Science and Statistical Committee regularly updates the Council on its research needs, and these can be found on the Council's website. Additionally, ongoing research by National Marine Fisheries Service (NMFS)' Alaska Fisheries Science Center (AFSC) is also accessible through their website. Website addresses are in Chapter 6.

The FMP management policy identifies several research programs that the Council would like to encourage. These are listed in Section H.1. The Council relies on its Scientific and Statistical Committee (SSC) to assist the Council in interpreting biological, sociological, and economic information. The SSC also plays an important role in providing the Council with recommendations regarding research direction and priorities based on identified data gaps and research needs. The SSC and Council's research priorities are listed in Section H.2. Additionally, NMFS regularly develops a five-year strategy for fisheries research which is described in Section H.3. Research needs specific to essential fish habitat are described in Section H.4.

H.1 Management Policy Research Programs

The management objectives of the FMP (see Section 2.2.1) include several objectives that provide overarching guidance as to research programs that the Council would like to encourage.

- Encourage research programs to evaluate current population estimates for non-target species with a view to setting appropriate bycatch limits as information becomes available.
- Encourage programs to review status of endangered or threatened marine mammal stocks and fishing interactions and develop fishery management measures as appropriate.
- Encourage development of a research program to identify regional baseline habitat information and mapping, subject to funding and staff availability.
- Encourage a coordinated, long-term ecosystem monitoring program to collect baseline information and compile existing information from a variety of ongoing research initiatives, subject to funding and staff availability.

Other objectives in the management policy also contain research elements without which they cannot be achieved. Research initiatives that would support other FMP management objectives are discussed in Section H.1.2 below.

H.2 Council Research Priorities

At its March 2003 meeting, the SSC reviewed the list of research priorities as developed by the Council's BSAI and Gulf of Alaska (GOA) groundfish Plan Teams, and developed the following short list of research topics:

A. Critical Assessment Problems

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

- Supplement triennial trawl survey biomass estimates with estimates of biomass or indices of biomass obtained from alternative survey designs.
- Obtain age and length samples from the commercial fishery, especially for Pacific ocean perch, northern rockfish, and dusky rockfish.
- Increase capacity for production ageing of rockfish so that age information from surveys and the fishery can be included in stock assessments in a timely manner.
- Further research is needed on model performance in terms of bias and variability. In particular, computer simulations, sensitivity studies, and retrospective analyses are needed. As models become more complex in terms of parameters, error structure, and data sources, there is a greater need to understand how well they perform.

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

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

B. Stock Survey Concerns

- There is a need to explore ways for inaugurating or improving surveys to assess rockfish, including nearshore pelagics.
- There is a need to develop methods to measure fish density in habitats typically inaccessible to NMFS survey gear, i.e., untrawlable habitats.

C. Expanded Ecosystem Studies

- Research effort is required to develop methods for incorporating the influence of environmental and climate variability, and there influence on processes such as recruitment and growth into population models, especially for crab stocks.
- Forage fish are an important part of the ecosystem, yet little is known about these stocks. Effort is needed on stock status and distribution for forage fishes such as capelin, eulachon, and sand lance.
- Studies are needed to identify essential habitat for groundfish and forage fish. Mapping of nearshore and shelf habitat should be continued for FMP species.

D. Social and Economic Research

- Development of time series and cross-sectional databases on fixed and variable costs of fishing and fish processing.
- Pre- and post-implementation economic analyses of crab and GOA groundfish rationalization.

- Identification of data needed to support analyses of community level consequences of management actions.
- Development of integrated multispecies and multifishery models for use in analyses of large scale management actions, such as the Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement and the Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska.

E. Bycatch

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

F. Monitoring

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

G. Research Priorities Identified by the National Research Council's Steller Sea Lion Committee

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

H.3 National Marine Fisheries Service

NMFS is responsible for ensuring that management decisions are based on the best available scientific information relevant to the biological, social, and economic status of the fisheries. As required by the Magnuson-Stevens Fishery Management and Conservation Act, NMFS published the *NMFS Strategic Plan for Fisheries Research* in December 2001, outlining proposed research efforts for fiscal years 2001-2006. The Strategic Plan outlines the following broad goals and objectives for NMFS: 1) to improve scientific capability; 2) to increase science quality assurance; 3) to improve fishery research capability; 4) to improve data collection; 5) to increase outreach/information dissemination; and 6) to support international fishery science. The document also outlines the AFSC's research priorities for this time period. Summarized below are the AFSC's research priorities grouped into four major research areas: research to support fishery conservation and management; conservation engineering research; research on the fisheries themselves; and information management research.

1. Research to Support Fishery Conservation and Management

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

      - Conduct periodic (annual, biennial, triennial) bottom trawl, midwater trawl-acoustic, hydroacoustic bottom trawl, longline surveys on groundfish in the BSAI and GOA.
      - Conduct field operations to study marine mammal-fish interactions, with particular emphasis on sea lion and pollock, Pacific cod, and Atka mackerel interactions in the GOA and the BSAI management areas.

- Observer programs for groundfish fisheries that occur off Alaska.
- Assessments of the status of stocks, including their biological production potentials (maximum sustainable yield, acceptable biological catch, overfishing levels), bycatch requirements, and other parameters required for their management.
- Assessments of the population dynamics, ecosystem interactions, and abundance of marine mammal stocks and their incidental take requirements.

b. Social and economic factors affecting abundance levels

c. Interdependence of fisheries or stocks of fish

d. Identifying, restoring, and mapping of essential fish habitat

e. Assessment of effects of fishing on essential fish habitat and development of ways to minimize adverse impacts.

2. Conservation Engineering Research

- Continue to conduct research to measure direct effects of bottom trawling on seafloor habitat according to a five-year research plan.
- Conduct fishing gear performance and fish behavioral studies to reduce bycatch and bycatch mortality of prohibited, undersized, or unmarketable species, and to understand performance of survey gear.
- Work with industry and the Council to develop bycatch reduction techniques.

3. Research on the Fisheries

a. Social and economic research

b. Seafood safety research

c. Marine

4. Information Management Research

- Continue to build data infrastructure and resources for easy access and data processing. The AFSC's key data bases are its survey data bases from the 1950s (or earlier) and the scientific observer data base that extends back to the foreign fishing days of the 1960s.
- Continue to provide information products based on experts and technical data that support NMFS, the Council, international scientific commissions, and the overall research and management community.

H.4 Essential Fish Habitat Research and Information Needs

The EIS for Essential Fish Habitat Identification and Conservation (NMFS 2005) identified the following research approach for EFH regarding minimizing fishing impacts.

Objectives

Reduce impacts. (1) Limit bottom trawling in the AI to areas historically fished and prevent expansion into new areas. (2) Limit bottom contact gear in specified coral garden habitat areas. (3) Restrict higher impact trawl fisheries from a portion of the GOA slope. (4) Increase monitoring for enforcement. (5) Establish a scientific research program.

Benthic habitat recovery. Allow recovery of habitat in a large area with relatively low historic effort.

Research Questions

Reduce impacts. Does the closure effectively restrict higher-impact trawl fisheries from a portion of the GOA slope? Is there increased use of alternative gears in the GOA closed areas? Does total bottom trawl effort in adjacent open areas increase as a result of effort displaced from closed areas? Do bottom trawls affect these benthic habitats more than the alternative gear types? What are the research priorities? Are fragile habitats in the AI affected by any fisheries that are not covered by the new EFH closures? Are sponge and coral essential components of the habitat supporting FMP species?

Benthic habitat recovery. Did the habitat within closed areas recover or remain unfished because of these closures? Do recovered habitats support more abundant and healthier FMP species? If FMP species are more abundant in the EFH protection areas, is there any benefit in yield for areas that are still fished without EFH protection?

Research Activities

Reduce impacts. Fishing effort data from observers and remote sensing would be used to study changes in bottom trawl and other fishing gear activity in the closed (and open) areas. First, the recent gear-specific fishing pattern must be characterized to establish a baseline for comparison with observed changes in effort after closures occur. An effective analysis of change requires comprehensive effort data with high spatial resolution, including accurate information about the tow path or setting location, as well as complete gear specifications. Effects of displaced fishing effort would have to be considered. The relative effects of bottom trawl and alternative gear/footrope designs and, thus, the efficacy of the measure should be investigated experimentally in a relatively undisturbed area that is representative of the closed areas. The basis of comparison would be changes in the structure and function of benthic communities and populations, as well as important physical features of the seabed, after comparable harvests of target species are taken with each gear type. Ultimately, there should be detectable increases in FMP species that are directly attributable to the reduced impacts on sponge and coral habitat.

Benthic habitat recovery. Monitor the structure and function of benthic communities and populations in the newly closed areas, as well as important physical features of the seabed, for changes that may indicate recovery of benthic habitat. Whether these changes constitute recovery from fishing or just natural variability/shifts requires comparison with an area that is undisturbed by fishing and otherwise comparable. A reference site would have to remain undisturbed by fishing during the entire course of the recovery experiment. Such a reference site may or may not exist, and the essential elements of comparability for identifying this area are presently unknown. Without proper reference sites, it may still be possible to deduce recovery dynamics based on changes observed in comparable newly closed areas with different histories of fishing disturbance.

Research Time Frame

Changes in fishing effort and gear types should be readily detectable. Biological recovery monitoring may require an extended period if undisturbed habitats of this type typically include large or long-lived organisms and/or high species diversity. Recovery of smaller, shorter-lived components should be apparent much sooner.

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Appendix I Information on Marine Mammal and Seabird Populations

This appendix contains information on the marine mammal and seabird populations in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) management areas. Much of the information in this appendix is from the Programmatic Supplemental Environmental Impact Statement for Alaska Groundfish Fisheries, published by National Marine Fisheries Service (NMFS) in 2004.

I.1 Marine Mammal Populations

Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982). In the areas fished by the federally managed groundfish fleets, twenty-six species of marine mammals are present from the orders Pinnipedia (seals, sea lion, and walrus), Carnivora (sea otter and polar bear), and Cetacea (whales, dolphins, and porpoises) (Lowry and Frost 1985). Most species are resident throughout the year, while others seasonally migrate into and out of Alaskan waters.

I.1.1 Potential impacts of fisheries on marine mammals

Direct Mortality from Intentional Take

Commercial harvests of marine mammals have occurred at various times and places, sometimes with devastating impacts on the populations of particular species. In some cases, such as the northern right whale, the species have not recovered to pre-exploitation population levels even though commercial whaling was halted decades ago.

Direct Mortality from Incidental Take in Fisheries

Some types of fisheries are much more likely to catch marine mammals incidentally than others. High seas driftnet fishing killed thousands of mammals before it was prohibited in 1991. Longline and pot fisheries very rarely catch marine mammals directly.

Indirect Effects through Entanglement

The following effects are classified as indirect because the impacts are removed in time and/or space from the initial action although in the analysis, these effects are considered together with the direct effect of incidental take. In some cases, individual marine mammals may be killed outright by the effect. In other cases, individuals are affected in ways that may decrease their chances of surviving natural phenomenon or reproducing successfully. These sub-lethal impacts may reduce their overall “fitness” as individuals and may have population-level implications if enough individuals are impacted.

Although some fisheries have no recorded incidental take of marine mammals, all of them probably contribute to the effects of entanglement in lost fishing gear. Evidence of entanglement comes from observations of animals trailing ropes, buoys, or nets or bearing scars from such gear. Sometimes stranded marine mammals also have evidence of entanglement but it my not be possible to ascertain whether the entanglement caused the injury or whether the corpse picked up gear as it floated around after death.

Sometimes an animal is observed to become entangled in specific fishing gear, in which case an incidental take or minor injury may be recorded for that particular fishery, but many times the contributions of individual fisheries to the overall effects of entanglement are difficult to document and quantify.

The Marine Plastic Pollution Research and Control Act of 1987 (33 USC §§ 1901 et seq.), implements the provisions relating to garbage and plastics of the Act to Prevent Pollution from Ships (MARPOL Annex V). These regulations apply to all vessels, regardless of flag, on the navigable waters of the U.S. and in the exclusive economic zone of the U.S. It applies to U.S. flag vessels wherever they are located. The discharge of plastics into the water is prohibited, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics.

Indirect Effects through Changes in Prey Availability

The availability of prey to marine mammals depends on a large number of factors and differs among species and seasons. Among these factors are oceanographic processes such as upwellings, thermal stratification, ice edges, fronts, gyres, and tidal currents that concentrate prey at particular times and places. Prey availability also depends on the abundance of competing predators and the ecology of prey species, including their natural rates of reproduction, seasonal migration, and movements within the water column. The relative contributions of factors that influence prey availability for particular species and areas are rarely known. Most critical is the lack of information on how events outside an animal's foraging range or in a different season may influence the availability of prey to animals in a particular place and time.

Marine mammal species differ greatly from one another in their prey requirements and feeding behaviors, leading to substantial differences in their responses to changes in the environment. For some species, such as the baleen whales, diets consist largely of planktonic crustaceans or small squid and have no overlap of prey with species that are targeted or taken as bycatch in the groundfish fisheries. For other species, notably Steller sea lions, there is a high degree of overlap between their preferred size and species of prey and the groundfish catch. Many other species are in between, perhaps feeding on the same species but smaller sizes of fish than what is typically taken in the fisheries. Although they may take a wide variety of prey species during the year, many species may depend on only one or a few prey species in a given area and season. In addition, the prey requirements and foraging capabilities of nursing females and subadult animals may be much more restricted than for non-breeding adults, with implications for reproductive success and survival.

The question of whether different types of commercial fisheries have had an effect on the availability of prey to marine mammals has been addressed by examining the degree of direct competition (harvest) of prey and by looking for potential indirect or cascading effects of the fisheries on the food web of the mammals. For marine mammals whose diets overlap to some extent with the target or bycatch species of the fisheries, fishery removals could potentially decrease the density of prey fields or cause changes in the distribution of prey such that the foraging success of the marine mammals is affected. If alternate prey is not available or is of poorer nutritional quality than the preferred species, or if the animal must spend more time and energy searching for prey, reproductive success and/or survival can be compromised. In the case of marine mammals that do not feed on fish or feed on different species than are taken in the fisheries, the removal of a large number of target fish from the ecosystem may alter the predator and prey dynamics and thus the abundance of another species that is eaten by marine mammals. The mechanisms and causal pathways for many potential food web effects are poorly documented because they are very difficult to study scientifically at sea.

Although reductions in the availability of forage fish to marine mammals have been attributed to both climatic cycles and commercial fisheries, a National Research Council study on the Bering Sea ecosystem (NRC 1996) concluded that both factors probably are significant. Regime shifts are major changes in atmospheric conditions and ocean climate that take place on multi-decade time scales and trigger community-level reorganizations of the marine biota (Anderson and Piatt 1999). Two cycles of warm and cold regimes have been documented in the GOA in the past 100 years, with the latest shift being from a cold regime to a warm regime in 1977. The consequences of this shift on fish and crustacean populations have been documented, including major improvements in groundfish recruitment and the collapse of some high-value forage species such as shrimp, capelin, and Pacific sand lance (Anderson and Piatt 1999). Directed fisheries on forage fish can deepen and prolong their natural low population cycles (Duffy 1983, Steele 1991), with potential effects on marine mammal foraging success. There is some evidence that another regime shift may have begun in 1998 with colder water temperatures and increases in certain forage populations (NPFMC 2002), but the implications for marine mammals are still unclear. Climate change may also affect the dynamics of the ice pack, with serious consequences for the marine mammals associated with the ice pack, such as bowhead whales, the ice seals, and walrus.

Direct Effects through Disturbance by Fishing Vessels

The effects of disturbance caused by vessel traffic, fishing operations, engine noise, and sonar pulses on marine mammals are largely unknown. With regard to vessel traffic, many baleen and toothed whales appear tolerant, at least as suggested by their reactions at the surface. Observed behavior ranges from attraction to the vessel to course modification or maintenance of distance from the vessel. Dall's porpoise, Pacific white-sided dolphins, and even beaked whales have been observed adjacent to vessels for extended periods of time. Conversely, harbor porpoise tend to avoid vessels. However, a small number of fatal collisions with various vessels have been recorded in California and Alaska in the past decade and others likely go unreported or undetected (Angliss et al. 2001).

Reactions to some fishing gear, such as pelagic trawls, are poorly documented, although the rarity of incidental takes suggests either partitioning of foraging and fishing areas or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary. Sonar devices are used routinely during fishing activity as well as during vessel transit. The sounds produced by these devices may be audible to marine mammals and may thus constitute disturbance sources. Wintering humpback whales have been observed reacting to sonar pulses by moving away (Maybaum 1990, 1993), although few other cases of reaction have been documented.

Indirect Effects through Contamination by Oil Spills

For species such as the pinnipeds and sea otters that spend a substantial amount of time on the surface of the water or hauled out on shore, oil spills pose a significant environmental hazard, even in small amounts. The toxicological effects of ingested oil, ranging from potential organ damage to weakening of the immune system, are poorly known for most species, especially in regard to chronic low doses. Sea otters are particularly susceptible to oil spills because they depend on their thick fur to protect them from cold water, rather than layers of fat, and oil destroys the insulative properties of their fur. Thousands of sea otters died over a large expanse of the GOA as a result of the Exxon Valdez oil spill in 1989 (Garshelis 1997, Garrot et al. 1993, DeGange et al. 1994). There is very little data on the mortality of marine mammals from the much smaller volumes of oil that are more typical of marine vessel spills, resulting from fuel transfer accidents and bilge operations.

I.1.2 Statutory protection for marine mammals

There are two major laws that protect marine mammals and require the North Pacific Fishery Management Council (Council) to address their conservation in the FMPs. The first is the Marine Mammal Protection Act (MMPA) of 1972 (amended 1994). Management responsibility for cetaceans and pinnipeds other than walrus is vested with National Marine Fisheries Service (NMFS) Protected Resources Division (PRD). The United States Fish and Wildlife Service (USFWS) is responsible for management of walrus and sea otters. The goal of the MMPA is to provide protection for marine mammals so that their populations are maintained as a significant, functioning element of the ecosystem. The MMPA established a moratorium on the taking of all marine mammals in the United States with the exception of subsistence use by Alaska Natives. Under the authority of this Act, NMFS PRD monitors populations of marine mammals to determine if a species or population stock is below its optimum sustainable population. Species that fall below this level are designated as "depleted." Populations or stocks (e.g., the western stock of Steller sea lions) listed as threatened or endangered under the Endangered Species Act (ESA), are automatically designated as depleted under the MMPA.

The ESA was enacted in 1973 and reauthorized in 1988. This law provides broad protection for species that are listed as threatened or endangered under the Act. The species listed under the ESA that spend all or part of their time in the BSAI and GOA and that may be affected by the groundfish fisheries are included in the table below. There are eight whale species, and two distinct population segments of Steller sea lions.

Listed Species	Population or Distinct Population Segment (DPS)	Latin Name	Status
Blue whale	North Pacific	*Balaenoptera musculus*	Endangered
Bowhead whale	Western Arctic	*Balaena mysticetus*	Endangered
Fin whale	Northeast Pacific	*Balaenoptera physalus*	Endangered
Humpback whale	Western and Central North Pacific	*Megaptera novaeangliae*	Endangered
Right whale	North Pacific	*Eubalaena japonica*	Endangered
Sei whale	North Pacific	*Balaenoptera borealis*	Endangered
Sperm whale	North Pacific	*Physeter macrocephalus*	Endangered
Gray whale	Eastern Pacific	*Eschrichtius robustus*	Delisted
Steller sea lion	Western Alaska DPS	*Eumetopias jubatus*	Endangered
Steller sea lion	Eastern Alaska DPS	*Eumetopias jubatus*	Threatened

The mandatory protection provisions of the ESA have led to numerous administrative and judicial actions and have brought the issue of fisheries/sea lion interactions under intense scrutiny. Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of its designated critical habitat. For federal fishery management actions, the action agency, NMFS Sustainable Fisheries Division, is required under Section7(a)(2) to consult with the Steller sea lion expert agency, NMFS PRD, to determine if the proposed action may adversely affect Steller sea lions or their critical habitat. If the proposed action may adversely affect Steller sea lions or its designated critical habitat, formal consultation is required. Formal consultation is a process between the action and expert agency that determines whether a proposed action is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. The process begins with the action agency's assessment of the effects of their proposed action on listed species and concludes with the issuance of a "Biological Opinion" by the expert agency. A biological opinion is a document which includes: a) the opinion of NMFS PRD as to whether or not a federal action (such as federally authorized fisheries) is likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat; b) a summary of the information on which the opinion is based; and c) a detailed discussion of the effects of the action on listed species or designated critical habitat. If the Biological Opinion concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or adversely modify critical habitat, then the expert agency recommends Reasonable and Prudent Alternatives to avoid the likelihood of "jeopardy" or "adverse modification" of critical habitat. The resulting legal requirements limit the Council from adopting FMP policies that result in a jeopardy finding for the Steller sea lions.

I.1.3 Consideration of marine mammals in groundfish fishery management

In order to fulfill their oversight responsibilities under the MMPA, NMFS PRD and the U.S. Fish and Wildlife Service (USFWS) have developed appropriate survey methodologies to census the various species of marine mammals. The results of these surveys, and other factors that affect the status of each species, are published in an annual "Marine Mammal Stock Assessment" report that is available on the NMFS national website (www.nmfs.noaa.gov).

Some species are much more difficult to census accurately than others, so there is a great deal of variation in the uncertainty of various population estimates. In addition, the huge expanses over which many species traverse and the remoteness of their habitats make surveys logistically difficult and expensive. For budgetary and logistical reasons, surveys of most species are not carried out every year and survey effort is prioritized for species of management concern. As a result, population estimates for some species may be outdated and trend information may not exist.

NMFS PRD requires all commercial fisheries in the U.S. Exclusive Economic Zone to report the incidental take and injury of marine mammals that occur during their operations (50 CFR 229.6). In addition to self-reported records, which NMFS PRD considers to be negatively biased and under representing actual take levels, certified observers are required in some fisheries to provide independent monitoring of incidental take as well as other fishery data.

Management measures are in place in the BSAI and GOA groundfish fisheries to protect Steller sea lions. These protection measures were deemed necessary based on the hypothesis that the continued decline of the western stock of the Steller sea lion is due to nutritional stress and that groundfish fisheries contribute to this stress by competing with sea lions for their key prey species. Management measures were specifically developed to reduce competitive interaction between Steller sea lions and the groundfish fisheries (NMFS 2001a). Mitigation efforts have focused on protecting the integrity of food supplies near rookeries and haulouts. Competitive interactions with the fishery may have the greatest effect on juvenile Steller sea lions between the time they are weaned and the time they reach adult size and foraging capability as the diving capacity of juveniles (and thus available foraging space) is less than that of adults. Adult females may also be susceptible to nutritional stress due to reduced prey availability in the vicinity of rookeries because of the limited foraging distribution and increased energetic demands when caring for pups. Specifically, the intent of the protection measures was to avoid competition around rookeries and important haulouts with extra precaution in the winter, and to disperse the fisheries outside of those time periods and areas.

Section 118 of the MMPA (50 CFR 229.2) requires all commercial fisheries to be placed into one of three categories, based on the frequency of incidental take (serious injuries and mortalities) relative to the value of potential biological removal (PBR) for each stock of marine mammal. PBR is defined as the maximum number of animals, not including natural mortalities, that may be removed from a stock while allowing that stock to reach or maintain its optimum sustainable population. In order to categorize each fishery, NMFS PRD first looks at the level of incidental take from all fisheries that interact with a given marine mammal stock. If the combined take of all fisheries is less than or equal to 10 percent of PBR, each fishery in that combined total is assigned to Category III, the minimal impact category. If the combined take is greater than 10 percent of PBR, NMFS PRD then looks at the individual fisheries to assign them to a category. Category I designates fisheries with frequent incidental take, defined as those with takes greater than or equal to 50 percent of PBR for a particular stock; Category II designates fisheries with occasional serious injuries and mortalities, defined as those with takes between one percent and 50 percent of PBR; Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities, defined as those with take less than or equal to one percent of PBR. Owners of vessels or gear engaging in Category I or II fisheries are required to register with NMFS PRD to obtain a marine mammal authorization in order to lawfully take a marine mammal incidentally in their fishing operation (50 CFR 229.4). In Alaska, this registration process has been integrated into other state and federal permitting programs to reduce fees and paperwork. Owners of vessels or gear engaging in Category III fisheries are not required to register with

NMFS PRD for this purpose. Every year, NMFS PRD reviews and revises its list of Category I, II, and III fisheries based on new information and publishes the list in the Federal Register.

Under provisions of the MMPA, NMFS PRD is required to establish take reduction teams with the purpose of developing take reduction plans to assist in the recovery or to prevent the depletion of strategic stocks that interact with Category I and II fisheries. A "strategic" stock is one which: 1) is listed as endangered or threatened under the ESA, 2) is declining and likely to be listed as threatened under the ESA, 3) is listed as depleted under the MMPA, or 4) has direct human-caused mortality which exceeds the stock's PBR.

The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the incidental serious injury or mortality of marine mammals from commercial fishing to levels less than PBR. The long-term goal is to reduce, within five years of its implementation, the incidental serious injury and mortality of marine mammals from commercial fishing operations to insignificant levels approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional Fishery Management Plans. Take reduction teams are to consist of a balance of representatives from the fishing industry, fishery management councils, state and federal resource management agencies, the scientific community, and conservation organizations. Fishers participating in Category I or II fisheries must comply with any applicable take reduction plan and may be required to carry an observer onboard during fishing operations.

In 2002, all of the Alaska groundfish fisheries (trawl, longline, and pot gear in the BSAI and GOA) were listed as Category III fisheries (67 FR 2410). However, NMFS PRD has recently proposed that the BSAI groundfish trawl fishery be elevated to Category II status based on a review of Observer Program records of marine mammal incidental take from 1990-2000 (68 FR 1414). According to the records, total incidental take of all fisheries is greater than 10 percent of PBR for the Alaska stocks of western and central North Pacific humpback whales, resident killer whales, transient killer whales, and the western stock of Steller sea lions. Based on the incidental take of these species relative to their respective PBRs, and some other considerations in the case of humpback whales, NMFS PRD determined in their "Tier 2" analysis that the BSAI groundfish trawl fishery posed a modest risk to these species. In addition, a number of state-managed salmon drift and set gillnet fisheries are listed in Category II, including those in Bristol Bay, Aleutian Islands, Alaska Peninsula, Kodiak, Cook Inlet, Prince William Sound, and Southeast Alaska. NMFS PRD has recently proposed reclassifying the Cook Inlet drift and set gillnet fisheries from Category II to Category III (68 FR 1414).

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I.2 Seabird Populations

Over 70 species of seabirds occur over waters off Alaska and could potentially be affected by direct and indirect interactions with the Bering Sea Aleutian Islands and Gulf of Alaska groundfish fisheries. Thirty-eight of these species regularly breed in Alaska and waters of the EEZ. More than 1,600 seabird colonies have been documented, ranging in size from a few pairs to 3.5 million birds (USFWS 2000). Breeding populations of seabirds are estimated at approximately 48 million birds and non-breeding migrant birds probably account for an additional 30 million birds (USFWS 1998). Most of the migrant birds are present only during the summer months (May through September) although some non-breeding albatross have been sighted at all months of the year (USFWS 1999). The distributions of species that breed in Alaska are well known in summer but for some species winter distributions are poorly documented or completely unknown.

I.2.1 Potential impacts of fisheries on seabird species

Potential fisheries impacts on a given seabird species could theoretically be measured by changes in survival or reproductive rates and ultimately by changes in the population. For all of these biological parameters, one would expect fluctuations in time and space as part of "normal" or natural conditions. The ability to distinguish these natural fluctuations from potential human-caused fluctuations requires reasonably accurate measurements of several parameters over a long time period and in many different areas. The USFWS surveys a number of large seabird colonies every year. Data is collected for selected species at geographically dispersed breeding sites along the entire coastline of Alaska. Some sites are scheduled for annual monitoring while others are monitored every three years. Although trends in sampling plots are reasonably well known at particular colonies, overall population estimates for most species are not precise enough to detect anything but the largest fluctuations in numbers. This is especially true for species that do not nest in dense concentrations. For some species, like the burrow and crevice-nesting alcids and storm-petrels, field methods for censusing populations are not available and require additional budgetary support for development. Population trends for those species that are regularly monitored are presented in an annual report entitled, "Breeding status, population trends, and diets of seabirds in Alaska", published by the USFWS (Dragoo et al. 2001).

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

Another direct fishery effect is the striking of vessels and fishing gear by birds in flight. Some birds fly away without injury but others are injured or killed and are thus considered incidental take. The Observer Program does not collect data on vessel strikes in a systematic way but there are some records of bird-strikes that have been collected on an opportunistic basis. These sporadic observations of vessel strikes from 1993-2000 have been entered into the Observer Notes Database, which is maintained by the USFWS, but have only received preliminary statistical analysis (seabird section of "Ecosystem Considerations for 2003", NPFMC 2002). Indirect effects refer to either positive or negative impacts on the reproductive success or survival of seabirds that may be caused by the fishery action but are separated in time or geographic location. The indirect effect which has received the most attention is the potential impact of fisheries competition or disturbance on the abundance and distribution of prey species that seabirds depend on, thus affecting seabird foraging success. Of particular note would be those effects on breeding piscivorous (fish-eating) seabirds that must meet the food demands of growing chicks at the nest colony. Reproductive success in Alaskan seabirds is strongly linked to the availability of appropriate fish (Piatt and Roseneau 1998, Suryan et al. 1998a, Suryan et al. 2000, Golet et al. 2000). Although seabird populations remain relatively stable during occasional years of poor food and reproduction, a long-term scarcity of forage fish leads to population declines. Other potential indirect effects on seabirds include physical disruption of benthic foraging habitat by bottom trawls, consumption of processing wastes and discarded offal, contamination by oil spills, introductions of nest predators (i.e., rats) to nesting islands, and ingestion of plastics released intentionally or accidentally from fishing vessels. Some of these potential impacts are related more to the presence of fishing vessels rather than the process of catching fish.

I.2.2 Statutory protection for seabirds

There are two major laws that protect seabirds and require the Council to address seabird conservation in their Fishery Management Plans. The first is the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712), as amended over the years. This law pertains to all of the seabird species found in the BSAI and GOA area (66 FR 52282) and governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests. The definition of "take" in the Migratory Bird Treaty Act is "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). In a fishery context, "take" refers to birds killed or injured during commercial fishing operations, whether in fishing gear or by striking some part of a vessel. Under the Migratory Bird Treaty Act, take of migratory birds is illegal, even if it is accidental or inadvertent, unless permitted through regulations (such as hunting regulations or permit exemptions). Thus far, only certain forms of intentional take have been legalized in these ways. There are currently no regulations to allow unintentional take. The USFWS and Department of Justice are vested with enforcement discretion, which has been used in lieu of a permitting program. Enforcement has focused on those who take birds with disregard for the law and the impact of their actions on the resource, particularly where effective conservation measures are available but have not been applied ("Fact sheet" on the Migratory Bird Treaty Act, K. Laing, USFWS). Executive Order 13186 (66 FR 3853-3856), "Responsibilities of Federal Agencies to Protect Migratory Birds," which was signed by the President on January 10, 2001, directs federal agencies to develop and implement a "Memorandum of Understanding" with the USFWS to promote the conservation of migratory birds affected by their actions, including mitigation of activities that cause unintentional take. NMFS and USFWS are currently developing this framework document which will incorporate seabird protection measures designed for specific fisheries (K. Rivera, NMFS National Seabird Coordinator, personal communication).

The second law is the ESA which provides broad protection for species that are listed as threatened or endangered. Presently there are three species listed under the ESA that spend all or part of their time in the BSAI and GOA and that may be affected by the groundfish fisheries: short-tailed albatross (endangered), Steller's eider (threatened), and spectacled eider (threatened). Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of habitat important to the continued existence of the species (Critical Habitat). For ESA listed seabirds, the USFWS is the agency responsible for conducting an assessment of the proposed action and preparing the appropriate Section 7 document, a "Biological Opinion". If the Biological Opinion concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or adversely modify its Critical Habitat, then the agency must develop Reasonable and Prudent Alternatives to minimize or mitigate the effect of the action. Even if a "no jeopardy" determination is made, as has been done for all three listed species in the BSAI and GOA, the agency may require and/or recommend that certain mitigation measures be adopted. In addition, the agency may establish a threshold number of incidental takes that would trigger a new Section 7 consultation to reexamine the required mitigation measures. In the case of the short-tailed albatross, the number of incidental takes that could be reasonably expected, given the designated mitigation measures, has been adopted as a threshold value and is described in the Incidental Take Statement attached to the Biological Opinion (USFWS 1999). These provisions of the ESA, as applied to the short-tailed albatross, have played a major role in the development of seabird protection measures for the longline sector of the BSAI and GOA groundfish fisheries.

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

I.2.3 Consideration of seabirds in groundfish fishery management

Seabird protection measures in the BSAI and GOA groundfish fisheries were initiated in the 1990s and have focused primarily on collecting seabird and fishery interaction data and on requiring longliners to use specific types of gear and fishing techniques to avoid seabird incidental take. This emphasis on longline gear restrictions has been driven by conservation concerns for the endangered short-tailed albatross as well as other species. As of 2004, longline vessels over 26 ft LOA are required to use either single or paired streamer lines (or in some cases for smaller vessels, a buoy bag line) to reduce incidental take of seabirds (see www.fakr.noaa.gov/protectedresources.seabirds.html for further information).

Observers collect incidental take data in the trawl and pot sectors of the fishery. USFWS and the trawl sector of the fishing industry are collaborating on research into minimizing the effects of the trawl "third wire" (a cable from the vessel to the trawl net monitoring device) on incidental take of seabirds. However, there have been no regulatory or Fishery Management Plan-level efforts to mitigate seabird incidental take in the trawl and pot sectors.

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

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

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

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

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

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

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Appendix J Consolidated Appropriations Act, 2005 (Public Law 108-447): Provisions related to catcher processor participation in the BSAI non-pollock groundfish fisheries

J.1 Summary of the Consolidated Appropriations Act, 2005

On December 8, 2004, the President signed into law the Consolidated Appropriations Act, 2005 (Public Law 108-447). With respect to fisheries off Alaska, the Consolidated Appropriations Act, 2005, establishes catcher processor sector definitions for participation in: 1) the catcher processor subsectors of the BSAI non-pollock groundfish fisheries, and 2) the BSAI Catcher Processor Capacity Reduction Program. The following subsectors are defined in Section 219(a) of the Act: AFA trawl catcher processor; non-AFA trawl catcher processor; longline catcher processor; and pot catcher processor. Section 219(a) also states that 'non-pollock groundfish fishery' means target species of Atka mackerel, flathead sole, Pacific cod, Pacific Ocean perch, rock sole, turbot, or yellowfin sole harvested in the BSAI. Thus, this legislation provides the qualification criteria that each participant in the catcher processor subsectors must meet in order to operate as a catcher processor in the BSAI non-pollock groundfish fisheries and/or participate in the BSAI Catcher Processor Capacity Reduction Program.

The Consolidated Appropriations Act, 2005, includes numerous provisions that are not related to the management of groundfish and crab fisheries off Alaska. Only the portions of the legislation related to eligibility of the catcher processor subsectors are provided for reference. The portions of the legislation authorizing and governing the development of the BSAI Catcher Processor Capacity Reduction Program are not provided here.

J.2 Consolidated Appropriations Act, 2005: Section 219(a) and (g)

SEC. 219. (a) DEFINITIONS.—In this section:

(1) AFA TRAWL CATCHER PROCESSOR SUBSECTOR.—The term ''AFA trawl catcher processor subsector'' means the owners of each catcher/processor listed in paragraphs (1) through (20) of section 208(e) of the American Fisheries Act (16 U.S.C. 1851 note).

(2) BSAI.—The term ''BSAI'' has the meaning given the term ''Bering Sea and Aleutian Islands Management Area'' in section 679.2 of title 50, Code of Federal Regulations (or successor regulation).

(3) CATCHER PROCESSOR SUBSECTOR.—The term ''catcher processor subsector'' means, as appropriate, one of the following:

(A) The longline catcher processor subsector.
(B) The AFA trawl catcher processor subsector.
(C) The non-AFA trawl catcher processor subsector.
(D) The pot catcher processor subsector.

(4) COUNCIL.—The term ''Council'' means the North Pacific Fishery Management Council established in section 302(a)(1)(G) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1852(a)(1)(G)).

(5) LLP LICENSE.—The term ''LLP license'' means a Federal License Limitation program groundfish license issued pursuant to section 679.4(k) of title 50, Code of Federal Regulations (or successor regulation).

(6) LONGLINE CATCHER PROCESSOR SUBSECTOR.—The term ''longline catcher processor subsector'' means the holders of an LLP license that is noninterim and transferable, or that is interim and subsequently becomes noninterim and transferable, and that is endorsed for Bering Sea or Aleutian Islands catcher processor fishing activity, C/P, Pcod, and hook and line gear.

(7) NON-AFA TRAWL CATCHER PROCESSOR SUBSECTOR.—The term ''non-AFA trawl catcher processor subsector'' means the owner of each trawl catcher processor—

(A) that is not an AFA trawl catcher processor;

(B) to whom a valid LLP license that is endorsed for Bering Sea or Aleutian Islands trawl catcher processor fishing activity has been issued; and

(C) that the Secretary determines has harvested with trawl gear and processed not less than a total of 150 metric tons of non-pollock groundfish during the period January 1, 1997 through December 31, 2002.

(8) NON-POLLOCK GROUNDFISH FISHERY.—The term ''nonpollock groundfish fishery'' means target species of Atka mackerel, flathead sole, Pacific cod, Pacific Ocean perch, rock sole, turbot, or yellowfin sole harvested in the BSAI.

(9) POT CATCHER PROCESSOR SUBSECTOR.—The term ''pot catcher processor subsector'' means the holders of an LLP license that is noninterim and transferable, or that is interim and subsequently becomes noninterim and transferable, and that is endorsed for Bering Sea or Aleutian Islands catcher processor fishing activity, C/P, Pcod, and pot gear.

(10) SECRETARY.—Except as otherwise provided in this Act, the term ''Secretary'' means the Secretary of Commerce.

(g) NON-POLLOCK GROUNDFISH FISHERY.—

(1) PARTICIPATION IN THE FISHERY.—Only a member of a catcher processor subsector may participate in—

(A) the catcher processor sector of the BSAI non-pollock groundfish fishery; or

(B) the fishing capacity reduction program authorized by subsection (b).

(2) PLANS FOR THE FISHERY.—It is the sense of Congress that—

(A) the Council should continue on its path toward rationalization of the BSAI non-pollock groundfish fisheries, complete its ongoing work with respect to developing management plans for the BSAI non-pollock groundfish fisheries in a timely manner, and take actions that promote stability of these fisheries consistent with the goals of this section and the purposes and policies of the Magnuson-Stevens Fishery Conservation and Management Act; and

(B) such plans should not penalize members of any catcher processor subsector for achieving capacity reduction under this Act or any other provision of law.