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UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for Oceans and Atmosphere
Washington, D.C. 20230

FEB 13 1998

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Environmental Assessment of Fishery Management Plan Amendments that would Create and Manage a Forage Fish Species Category

LOCATION: Exclusive Economic Zone (EEZ) off Alaska

SUMMARY: These amendments establish a new forage fish species category and associated management measures. The intended effect of this action is to prevent the development of an unrestricted fishery for forage fish, which are a critical food source for many marine mammal, seabird, and fish species. Directed fishing for forage fish is prohibited at all times in the BSAI and GOA, but a maximum retainable bycatch (MRB) amount of 2 percent is established for forage fish. The sale, barter, trade, or processing of forage fish is prohibited, except that limited incidental harvests of forage fish may be processed into fishmeal and sold. Subsistence fishing for forage fish species is exempt from this prohibition.

RESPONSIBLE OFFICIAL:
Steven Pennoyer
Administrator, Alaska Region
National Marine Fisheries Service
709 West 9th Street
Juneau, AK 99802
Telephone: 907-586-7221

The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information. Also, please send one copy of your comment to me in Room 5805, PSP, U.S. Department of Commerce, Washington, D.C. 20230

Sincerely,

Susan Fruchter

Acting NEPA Coordinator

Enclosure

FINAL

ENVIRONMENTAL ASSESSMENT AND REGULATORY IMPACT REVIEW
FOR
AMENDMENT 36 TO THE FISHERY MANAGEMENT PLAN FOR THE GROUNDFISH FISHERY OF THE BERING SEA AND ALEUTIAN ISLANDS AREA AND AMENDMENT 39 TO THE FISHERY MANAGEMENT PLAN FOR GROUNDFISH OF THE GULF OF ALASKA
TO
CREATE AND MANAGE A FORAGE FISH SPECIES CATEGORY

Prepared by

National Marine Fisheries Service
Juneau, AK
with contributions by
Alaska Fisheries Science Center
US Fish and Wildlife Service

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EXECUTIVE SUMMARY

Forage fish species are abundant fishes that are preyed upon by marine mammals, seabirds and other commercially important groundfish species. Forage fish perform a critical role in the complex ecosystem functions of the Bering Sea and Aleutian Islands management area (BSAI) and the Gulf of Alaska (GOA) by providing the transfer of energy from the primary or secondary producers to higher trophic levels.

Significant declines in marine mammals and seabirds in the GOA and the BSAI have raised concerns that changes in the forage fish biomass may contribute to the further decline of marine mammal, seabird and commercially important fish populations. Members of the fishing industry have expressed concern that the current FMP structure with respect to forage fish may allow unrestricted commercial harvest to occur *on one or more of these species.*

For purposes of this analysis, forage fish species have been defined to include Osmeridae (which includes capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea. These species have been grouped together because they are considered to be primary food resources for other marine animals and they have the potential to be the targets of a commercial fishery. These species are currently *managed under the BSAI* and GOA FMPs under either the "other species" or "non-specified species" categories.

This analysis examines two alternatives:

Alternative 1: Status quo. Catch of forage fish could be retained as groundfish under either the "other species" category TAC or as a "nonspecified species". Under this alternative a relatively unrestricted commercial fishery could develop for these species. Catch of those forage fish species in the "other species" category are restrained by an overall TAC limit set for the whole category but any one of the forage fish species could be harvested in relatively large and unconstrained amounts within the "other species" TAC. The non-specified species would not be subject to any catch restrictions or reporting *requirements.*

Alternative 2: A forage fish species category would be established for both the BSAI and GOA FMPs. Four options for management of the forage fish species category are presented.

Option 1: Manage the forage fish category as for other groundfish species with an ABC, TAC and overfishing limit.

Option 2 [PREFERRED] : Restrict the forage fish category to a bycatch only fishery. A directed fishery for forage fish would not be allowed but these species could be harvested as bycatch in other directed fisheries. A suggested 2 percent maximum retainable bycatch amount could be established for the forage fish category in aggregate.

Option 3: Manage the forage fish category as prohibited species. Under this option the incidental catch of these species would not be retained and any incidental catch would need to be returned to the sea with a minimum of injury, as is currently done with other prohibited species.

Option 4 [PREFERRED]: *The sale, barter, trade and any other commercial exchange,* as well as the processing of forage fish in a commercial processing facility, would be prohibited, except that retained catch of forage fish species not exceeding the MRB may be processed into fishmeal and sold. Some forage fish are harvested in subsistence activities and this option does not intend to prohibit subsistence harvest and traditional trade and barter of forage fish.

Under Alternative 2, Option 1 entails the setting of an ABC and TAC amount for the forage fish category. This may be difficult given the lack of information on the abundance of forage fish species and the limited catch history. In addition, an overfishing limit (OFL) would be established based on historical catch, which, when reached, could potentially result in the closure of other target species groups that incidentally harvest forage fishes. Option 2 would establish the forage fish category as a bycatch only category with the harvest limited to 2 percent of the harvest of those species for which a directed fishery occurs. Option 2 would allow incidental harvest amounts of the forage fish category while preventing a directed fishery from occurring and would not have the constraints of establishing an ABC, TAC or OFL. Management under Option 3 would treat the forage fish category as prohibited species to be discarded at sea with a minimum of injury. This management strategy is typically reserved for economically important species other than federally managed groundfish. Option 3 could result in unnecessary discards and cause an unnecessary burden to catcher vessels that do not sort at sea and to processors who must handle these prohibited species. Option 2 would accomplish the objective of preventing the establishment of a directed fishery on forage fish, while minimizing any unnecessary discards and avoiding the problems associated with establishing an ABC, TAC and OFL amount. Option 4 would prevent a directed commercial fishery from developing on any of the forage fish species; while avoiding the problems associated with Option 1 or 3. Option 4 would also alleviate the potential for any "topping-off" activities that may be associated with a bycatch only status, as outlined under Option 2.

Based on historical information, the total burden to the Alaska fishing industry resulting from restricting a fishery on the forage fish species would be minimal because a total of only 6 vessels have reported targeting any species in this proposed category from 1984-1994, no annual commercial fishery has been established, and market availability for capelin varies.

In June 1997, the North Pacific Fishery Management Council (Council) adopted Amendment 36 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area and Amendment 39 to the Fishery Management Plan for Groundfish of the Gulf of Alaska (FMPs) to establish a separate species category for forage fish. In adopting Amendments 36/39 the Council approved both options 2 and 4 as management measures in the regulations implementing Amendments 36/39.

1.0 INTRODUCTION

The groundfish fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) off Alaska are managed under the Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska and the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area. Both FMPs were developed by the North Pacific Fishery Management Council (Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The GOA FMP was approved by the Secretary of Commerce and became effective in 1978 and the BSAI FMP became effective in 1982.

Actions taken to amend FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA). NEPA, E.O. 12866 and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1 of this document. Section 2 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 3 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered.

This Environmental Assessment/Regulatory Impact Review (EA/RIR) analyzes the establishment and management of a forage fish species category. For the purpose of this analysis forage fish are defined as Osmeridae (which includes capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea. Clupeidae (herring) are not included in the list of forage fish species for purposes of this document because this family currently falls under the Prohibited Species category of the FMPs.

1.1 Purpose of and Need for the Action

Forage fish comprise an important part of the diet of commercial groundfish species, marine mammals and seabirds in the Gulf of Alaska (GOA) and the Bering Sea and Aleutian Islands management area (BSAI). Significant declines in marine mammals and seabirds in the GOA and the BSAI have raised concerns that changes in the forage fish biomass may contribute to the further decline of marine mammal, seabird and commercially important fish populations. Members of the fishing industry and public have expressed concern that the current FMP structure with respect to forage fish may allow unrestricted commercial harvest to occur on one or more of these species. One of the recommendations from the International Council for the Exploration at Sea (ICES, 1994) indicated that fishery managers should develop measures to avoid the commercial targeting of food resources that are key to marine mammals and seabirds. The Council's 1995 Stock Assessment and Fishery Evaluation Report states that if any significant directed fishing on any component of the "other species" category develops, particularly those that serve as prey for marine mammals and seabirds, then future assessments should reflect this change by separating these species out (SAFE, 1995). Establishing forage fish as a separate category would provide the mechanism to better manage these species.

For purposes of this analysis forage fish species have been defined to include Osmeridae (which includes capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea. These species have been grouped together because they are considered to be primary food resources for other marine animals and they have the potential to be the targets of a commercial fishery. Some of these forage fish species are currently managed under the BSAI and GOA FMPs under either the "other species" or "non-specified species" categories. These categories were established to account for species that are currently of slight economic value and upon which there is little, if any, directed fishing (SAFE: 1995).

Capelin, eulachon, and other Osmeridae (other smelts) are within the "other species" category of the FMPs. In the BSAI a single TAC applies to the entire "other species" category and the ABC is estimated as the average annual catch. In the GOA, an ABC is not established for the "other species" category but the TAC is calculated as 5 percent of the sum of the TACs for all other species categories.

Sand lance (belong to Ammodytidae), Pacific Sandfish (belong to Trichodontidae), Myctophidae (lanternfish) and Bathylagidae are within the "nonspecified species" category of the FMPs. A TAC for the "nonspecified species" category is not specified or managed but is defined in the FMPs as the amount taken incidentally while fishing for other groundfish. No reporting is required and no ABC is estimated for this category.

Insufficient data and management measures exist to manage each species separately in the "other species" and "non-specified species" categories in Federal waters. Therefore the forage fish species should be grouped together in a separate category to allow better management of these important prey species. This analysis presents alternatives for more restrictive management of forage fish than exists under the current FMPs.

1.2 Alternatives Considered

1.2.1 Alternative 1: Status quo. Catch of forage fish could be retained as groundfish under either the "other species" category TAC or as a "nonspecified species". Under this alternative a relatively unrestricted commercial fishery could develop for these species. Catch of those forage fish in the "other species" category are restrained by an overall TAC limit set for the whole category but any one of the forage fish species could be harvested in relatively large and unconstrained amounts within the "other species" TAC. The non-specified species would not be subject to any catch restrictions or reporting requirements.

1.2.2 Alternative 2: A forage fish species category would be established for both the BSAI and GOA FMP. Four options for management of the forage fish category are presented below.

Presently, the FMPs contain four categories of groundfish species or species groups that are likely to be taken in the groundfish fishery which are primarily grouped for allocative and economic reasons. These four categories are: (1) Prohibited species--those species and species groups the catch of which must be returned to the sea with a minimum of injury; (2) Target species--those species which are commercially important; (3) Other species--those species and species groups which currently are of slight economic value and are not generally targeted upon; and (4) Nonspecified species--those species and species groups generally of no current economic value taken by the groundfish fishery in Federal waters only as incidental catch.

Those forage fish species currently in the "other species" and "nonspecified species" categories that are preyed upon by marine mammals, seabirds and other commercial fish species would be regrouped in a separate forage fish category. This category would include the following forage fish: Osmeridae (which includes capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea.

Although sandfish (Trichodontidae) may be restricted to State waters, they have been included in the list above because of their significance as a prey item for other fish and for pinnepeds. If this species were to remain in the forage fish category, cooperative management with the State of Alaska would be necessary to ensure its protection. However, if necessary this particular species could be removed from the forage fish category.

Option 1: Manage the forage fish category as for other groundfish species with an ABC, TAC and overfishing limit. This option may be difficult to achieve given that little is known about the biomass and abundance of the various species in this category. In addition, the overfishing limit (OFL) would be established based on historical catch, which, when reached, could potentially result in the closure of other target species groups that incidentally harvest forage fishes. Under Option 1 the potential for a directed fishery on forage fish exists, provided that a high enough TAC were established. This may have unknown and unquantifiable impacts on the forage fish resource and on predators of these forage species.

Option 2 [PREFERRED]: Restrict the forage fish category to a bycatch only fishery. A directed fishery for forage fish would not be allowed but these species could be harvested as bycatch in other directed fisheries. A maximum retainable bycatch (MRB) percentage would need to be established that would allow an incidental amount, not to exceed the MRB amount, of the,aggregated forage fish species to be retained relative to other directed fisheries. A suggested MRB is 1 percent for the forage fish in aggregate. Under this option, however, the total harvest of forage fish would not be limited by a total allowable catch; however, the harvest during any one trip would be limited by the MRB amount as a percentage of other directed catch that was on board. This option would prevent a directed fishery from developing on the forage fish species while allowing vessels to retain for use a small incidental take amount, thus preventing any unnecessary discards (as could occur under Option 3) and alleviating the difficulties associated with establishing an ABC, TAC and OFL (as would occur under Option 1).

Option 3: Prohibit harvest of the forage fish category. Under this option the harvest of these species would not be permitted and any incidental take would need to be returned to the sea with a minimum of injury, as is currently done with other prohibited species. For those vessels that do not sort at sea this management regime would place a potentially significant operational burden on those vessels as well as on processors that must handle the prohibited species so that they can be returned to sea. This option would prevent a directed fishery from developing on this group but it would also be a more restrictive management regime in that it would force discards of any incidental take of forage fish, which could otherwise be utilized. Some anecdotal information indicates that incidental harvests of forage fish are used for private human consumption.

Option 4 [PREFERRED]: The sale, barter, trade and any other commercial exchange, as well as the processing of forage fish in a commercial processing facility, would be prohibited, except that retained catch of forage fish species not exceeding the MRB may be processed into fishmeal and sold. Some forage fish are harvested in subsistence activities and this option does not intend to prohibit subsistence harvest and traditional trade and barter of forage fish.

1.3 Forage Fish Biology

Forage fish species are abundant fishes that are preyed upon by marine mammals, seabirds and other commercially important groundfish species. Forage fish perform a critical role in the complex ecosystem functions of the Bering Sea and Aleutian Islands management area and the Gulf of Alaska by providing the transfer of energy from the primary or secondary producers to higher trophic levels. This analysis has grouped the following forage fish species into the new category: Osmeridae (which includes capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea.

1.3.1 Forage Fish - Abundance, Distribution, and Food Habits

Forage fishes as a group occupy a nodal or central position in the North Pacific food web, being consumed by a wide variety of fish, marine mammals and seabirds.

Many species undergo large, seemingly unexplainable fluctuations in abundance. Most of these are R-selected species (e.g. pollock, herring, Atka mackerel, capelin, sand lance), which generally have higher reproductive rates, are shorter-lived, attain sexual maturity at younger ages, and have faster individual growth rates than K-selected species (e.g., rockfish, many flatfish). Predators which utilize r-selected fish species as prey (marine mammals, birds and other fish) have evolved in an ecosystem in which fluctuations and changes in relative abundances of these species have occurred. Consequently, most of them, to some degree, are generalists who are not dependent on the availability of a single species to sustain them, but on a suite of species any one (or more) of which is likely to be abundant each year.

There is some evidence, mostly anecdotal, that osmerid abundances, particularly capelin and eulachon, have declined significantly since the mid 1970s. Evidence for this comes from marine mammal food habits data from the Gulf of Alaska (Calkins and Goodwin 1988), as well as from data collected in biological surveys of the Gulf of Alaska (not designed to sample capelin; Anderson et al. in press) and commercial fisheries bycatch from the eastern Bering Sea (Fritz et al. 1993). It is not known, however, whether smelt abundances have declined or whether their populations have redistributed vertically, due presumably to warming surface waters in the region beginning in the late 1970s. This conclusion could also be drawn from the data presented by Yang (1993), who documented considerable consumption of capelin by arrowtooth flounder, a demersal lower-water column feeder, in the Gulf of Alaska.

Smelts (Capelin, Rainbow Smelt and Eulachon). Smelts (family Osmeridae) are slender schooling fishes that can be either marine (such as capelin) or anadromous (rainbow smelt and eulachon). Figure 1 shows a generalized distribution of these three smelt species in the southeastern Bering Sea based on data collected by NMFS summer groundfish trawl surveys and by fisheries observers.

Capelin are distributed along the entire coastline of Alaska and south along British Columbia to the Strait of Juan de Fuca. In the North Pacific, capelin can grow to a maximum of 25 cm at age 4. Most capelin spawn at age 2-3, when they are only 11-17 cm (Pahlke 1985). Spawning occurs in spring in intertidal zones of coarse sand and fine gravel--especially in Norton Sound, northern Bristol Bay and Kodiak. Very few capelin survive spawning. The age of maturity of capelin in the Barents Sea has been shown to be a function of growth rate, with fast-growing cohorts reaching maturity at an earlier age than slow-growing cohorts. Thus, it is possible to have slow and fast-growing cohorts mature in the same year, resulting in large spawning biomasses one year preceded and potentially followed by small spawning biomasses.

In the Bering Sea adult capelin are only found near-shore during the months surrounding the spawning run. During other times of the year, capelin are found far offshore in the vicinity of the Pribilof Islands and the continental shelf break. The seasonal migration may be associated with the advancing and retreating polar ice front, as it is in the Barents Sea. In the eastern Bering Sea, winter ice completely withdraws during the summer months. If migration follows the ice edge, the bulk of the capelin biomass in the Bering Sea could be located in the northern Bering Sea, beyond the area worked by the groundfish fisheries and surveys. Very few capelin are found in surveys, yet they are a major component of the diets of marine mammals feeding along the winter ice edge (Wespestad 1987), and of marine birds, especially in the spring. In the Gulf of Alaska, which remains ice free year round, capelin overwinter in the bays of Kodiak Island and in Kachemak Bay.

Rainbow smelt ascend rivers to spawn in spring shortly after the breakup of the ice. After spawning, they return to the sea to feed. Surveys have found concentrations of rainbow smelt off Kuskokwim Bay, Togiak Bay and off Port Heiden (Figure 1), but they also probably occur in many nearshore areas near river mouths. Rainbow smelt mature at ages 2-3 (19-23 cm), but can live to be as old as 9 years and as large as 30 cm. Little is known about trends in abundance of this species.

Eulachon also spawn in spring in rivers of the Alaska Peninsula, and possibly other rivers draining into the southeastern Bering Sea. Eulachon live to age 5 (and grow to 25 cm), but most die following first spawning at age 3. Eulachon are consistently found by groundfish fisheries and surveys between Unimak Island and the Pribilof Islands in the Bering Sea, and in Shelikof Strait in the Gulf of Alaska (Figure 1). Evidence from fishery observer and survey data suggests that eulachon abundances declined in the 1980s (Fritz et al. 1993). These data should be interpreted with caution since surveys were not designed to sample small pelagic fishes such as eulachon, and fishery data was collected primarily for total catch estimation of target groundfish. Causes of the decline, if real, are unknown, but may be related to variability in year-class strength as noted for capelin.

Pacific Sand Lance (Ammodytidae). Pacific sand lance are usually found on the bottom, at depths between 0-100 m except when feeding (pelagically) on crustaceans and zooplankton. Spawning is believed to occur in winter. Sand lance mature at ages 2-3 years and lengths of 10-15 cm. Little is known of their distribution and abundance: they are rarely caught by trawls. In the Bering Sea, sand lance are common prey of salmon, northern fur seals and many species of marine birds. Thus, they may be abundant in Bristol Bay, along the Aleutian Islands and Alaska Peninsula. In the Gulf of Alaska, sand lance are prey of harbor seals, northern fur seals and marine birds, especially in the Kodiak area and *along the southern Alaska Peninsula. Given the sand lance's short life span and the large number of* species which prey on it, mortality, fecundity and growth rates of Pacific sand lance are probably high.

Myctophidae and Bathylagidae. Myctophids (lanternfishes) and bathylagids (deep-sea smelts) are *distributed pelagically in the deep sea throughout the world's ocean. Most species in both families occur* at depth during the day and migrate to near the surface to feed (and be fed upon) at night. A common myctophid in the Bering Sea and Gulf of Alaska is the northern lampfish (*Stenobrachius leucopsarus*), which has a maximum length of approximately 13 cm. Bathylagids of the north Pacific include *Bathylagus* spp. (blacksmelts) and *Leuroglossus stilbius schmidti* (northern smoothtongue), each of which have maximum lengths of between 12-25 cm. Myctophids and bathylagids are important forage fishes for marine birds and marine mammals. Since they are rarely caught in survey or fishery trawls, nothing is known of recent trends in their abundance.

Pacific sandfish (Trichodontidae). The Pacific sandfish (*Trichodon trichodon*) lives in shallow inshore waters to about 50 m depth and grows to a maximum length of 30 cm. Nothing is known of trends in their abundance. They are feed upon by salmon and other fish, as well as pinnipeds.

Euphausiids. Along with many copepod species, the euphausiids form a critical zooplanktonic link between the primary producers (phytoplankton) and all upper pelagic trophic levels. These crustaceans.

also known as krill, occur in large swarms in both neritic and oceanic waters. Members of at least 11 genera of euphausiids are known from the North Pacific, the most important (in terms of numbers of species) being *Thysanopoda, Euphausia, Thysanoëssa* and *Stylocheiron* (Boden et al. 1955; Ponomoreva 1963). Euphausiids are generally thought to make diurnal vertical migrations, remaining at depth (usually below 500 m) during the day and ascending at night to 100 m or less. However, this is complicated by the fact that as euphasiids grow they are found at deeper depths, except during spawning, which occurs in surface waters. Spawning occurs in spring to take advantage of the spring phytoplankton bloom, and the hatched nauplii larvae live near the surface (down to about 25 m). By fall and winter, the young crustaceans are found mainly at depths of 100 m or less, and make diurnal vertical migrations. Sexual maturity is reached the following spring at age 1. After spawning, adult euphausiids gradually descend to deeper depths until fall and winter, when they no longer migrate daily to near-surface waters. In their second spring, they again rise to the surface to spawn; euphausiids older than 2 years are very rarely found. This classical view of euphausiid life history and longevity was recently questioned by Nicol (1990), who reported that Antarctic euphausiids may live as long as 6-10 years; annual euphausiid production, then, would be much lower than if they lived only 2 years.

While euphausiids are found throughout oceanic and neritic waters, their swarms are most commonly encountered in areas where nutrients are available for phytoplankton growth. This occurs primarily in areas where upwelling of waters from depth into the surface region is a consistent oceanographic feature. Areas with such features are at the edges of the various domains on the shelf or at the shelf-break, at the heads of submarine canyons, on the edges of gullies on the continental shelf (e.g., Shumagin, Barnabus, Shelikof gullies in the Gulf of Alaska), in island passes (on certain tides) in the Aleutian Islands (e.g., Seguam Pass, Tanaga Pass), and around submerged seamounts (e.g. , west of Kiska Island). It is no coincidence that these are also prime fishing locations used by commercial fishing vessels seeking zooplanktivorous groundfish, such as walleye pollock, Atka mackerel, sablefish and many species of rockfish and flatfish (Livingston and Goiney 1983; Fritz 1993; Yang 1993).

The species comprising the euphausiid group occupy a position of considerable importance within the North Pacific food web. Euphausiids are fed upon by almost all other major taxa inhabiting the pelagic realm. The diet of many species of fish other than the groundfish listed above, including salmon, smelts (capelin, eulachon, and other osmerids), gadids (Arctic cod and Pacific tomcod), and Pacific herring is composed, to varying degrees, by euphausiids (Livingston and Goiney 1983), while euphausiids are the principal item in the diet of most baleen whales (e.g. minke, fin, sei, humpback, right, and bowhead whales; Perez 1990). While copepods generally constitute the major portion of the diet of planktivorous birds (e.g. auklets), euphausiids are prominant in the diets of some predominately piscivorous birds in some areas (e.g. kittiwakes on Buldir Island in the Aleutians, Middleton Island in the Gulf of Alaska, and St. Matthew Island in the Bering Sea; Hatch et al. 1990). Euphausiids are not currently sought for human use or consumption from the North Pacific ocean on a scale other than local, but large (about 500,000 mt per year) krill fisheries from Japan and Russia have been operating in Antarctic waters since the early 1980s (Swartzman and Hofman 1991).

Pholidae (Gunnels) and Stichaeidae (Pricklebacks, Warbonnets, Eelblennys, Cockscombs and Shannys). Gunnels and pricklebacks are long, compressed, eel-like fishes with long dorsal fins often joined with the caudal fin. Pricklebacks are so named because all rays in the dorsal fin are spinous in most species (while some may have soft rays at the rear of the dorsal fins). Gunnels have flexible dorsal fin rays, and differ from pricklebacks in that the anal fin is smaller (the distance from the tip of the snout to the front of the anal fin is shorter than the length of the anal fin). Most species of both families live in shallow nearshore waters among seaweed and under rocks and are mostly less than 45 cm in length. There are approximately 14 species of Stichaeidae and 5 species of Pholidae in Alaska. Nothing is known about absolute or trends in their abundance, and little about their growth rates, maturity schedules, and trophic relationships. They feed mostly on small crustacea and arthropods, and are thought to grow quickly. Some cockscombs in British Columbia attain sexual maturity at age 2 years.

Gonostomatidae (Bristlemouths. Lightfishes. Anglemouths). This is a large and diverse family of small (to about 8 cm), bathypelagic fish that are rarely observed except by researchers. They can be abundant at depths of up to 5000 m. There may be as many as 6 species in the North Pacific Ocean and Bering Sea.

1.3.2 Diets of forage fish species in the North Pacific

Bathylagid. Since bathylagids have a small mouth, dense flat gill rakers, a small stomach and long intestine, they consume weak swimming soft-bodied animals (pteropods, appendicularia, ctenophores, chaetognath, polychaete, jellyfish etc.). Bathylagids in the epipelagic zone can also feed on euphausiids and copepods at night when they are abundant (Gorelova and Kobylyanskiy, 1985; Balanov, et al., 1995).

Myctophid. Because of their large mouth, relatively sparse and denticulate gill rakers, well developed stomach and short intestine, myctophids mostly consume actively swimming animals like copepods and euphausiids (Balanov, et al. 1995).

Pacific sandfish. The diet of sandfish consists of small crustaceans such as mysids, amphipods, and cumaceans (Mineva 1955, Kenyon 1956).

Eulachon. The diet of eulachon in the North Pacific generally consists of planktonic prey (Hart, 1973; Macy et al., 1978). As larvae they primarily consume copepod larvae; post-larvae consume a wider variety of prey that includes phytoplankton, copepod eggs, copepods, mysids, ostracods, barnacle larvae, cladocerans worm larvae and larval eulachon. Juvenile and adult eulachon feed almost exclusively on euphausiids, with copepods and cumaceans occasionally in the diet.

Sand lance. Hart (1973) and Trumble (1973) summarized the diet of sand lance in the North Pacific as primarily planktivorous: their primary prey changing with ontogeny. Larval sand lance consume diatoms and dinoflagellates: post-larvae prey upon copepods and copepod nauplii. Adult sand lance prey upon chaetagnaths, fish larvae, amphipods, annelids and common copepods. Sand lance exhibit seasonal and diurnal variation in feeding activity and are opportunistic feeders upon abundant plankton blooms.

Capelin. The diet of capelin in the north Pacific as summarized by Hart (1973) and Trumble (1973) is primarily planktivorous. Small crustaceans such as euphausiids and copepods are common to the diet of capelin, although marine worms and small fish are also part of their diet. In the Bering Sea, adult capelin consume copepods, mysids, euphausiids, and chaetognaths. Juveniles primarily consume only copepods (Naumenko. 1984). The largest capelin (>13cm) consume euphausiids nearly exclusively. Capelin feed throughout the year in the Bering Sea. However, the diet exhibits seasonal variation that is due in part to spawning migration and behavior.

The primarily planktivorous diets of eulachon, sand lance, and capelin reduce the potential for dietary competition with the piscivorous and benthic diets of most groundfish. However, the potential for dietary competition is greater between pollock and forage fish due to the importance of planktonic prey such as euphausiids and copepods in their diets.

Gonostomatid. Gonostomatids have large gill openings and well-developed gill rakers, characteristics of a zooplankton feeder. The primary zooplankton prey of gonostomatids are calanoid copepods. The other food includes ostracods and euphausiids. Some larger gonostomatids also consume some fish (Gorelova 1980).

Stichaeidae. There are many species in the Family Stichaeidae, a family with long, slender, compressed bodies. Some of the diets of the stichaeids are described below. The longsnout prickleback eats copepods almost exclusively (Barraclough 1967). Young ribbon pricklebacks eat copepods and oikopleura (Robinson, Barraclough and Fulton 1968). The food of the adults of this species includes crustaceans and red and green algae. Black prickleback consumed copepods, copepod nauplii and clam larvae (Barraclough, Robinson, and Fulton 1968). Peppar (1965) reported that the important food of high cockscomb was green algae. Other food of this species included polychaete worms, amphipods, molluscs, and crustaceans.

Euphausiacea. The diets of euphausiids in the North Pacific consist of planktonic prey. Species of the genus Euphausia consume diatoms, dinoflagellates, tintinnids, chaetagnaths, echinoderm larvae, amphipods, crustacean larvae, ommatidians, and detritus (Mauchline 1980). Species of the genus Thysannoessa consume diatoms, dinoflagellates, tintinnids, radiolarians, foraminiferans, chaetagnaths, echinoderm larvae, molluscs, crustacean larvae, ommatidians and detritus (Mauchline 1980). Several species of Thysannoessa also consume walleye pollock eggs in the Gulf of Alaska (Brodeur and Merati 1993).

Pholidae. The diets of gunnels (family Pholidae) consists primarily of benthic and epibenthic prey. Amphipods, isopods, polychaete worms, harpacticoid copepods, cumaceans, munid crabs, insects, mysids, algae, ostracods, bivalves, crustacean larvae, and tunicates have been described as their main prey (Clemens and Wilby 1961, Simenstad et al. 1979, Williams 1994). Juvenile fish prey (English sole, *Parophry vetulus*, and sand lance, *Ammodytes hexapterus*) have also been described as infrequent components of the diet in Puget Sound, Washington (Simenstad et al. 1977).

1.3.3 Significance of Forage Fish in the Diet of Eastern Bering Sea Groundfish

Forage fish, as defined in this EA, are found in the diets of walleye pollock, Pacific cod, arrowtooth flounder, Pacific halibut, Greenland halibut, yellowfin sole, rock sole, Alaska plaice, flathead sole, and skates in the eastern Bering Sea region. However, forage fish do not represent a large portion of the diet by weight of these predators with the exception of shelf rock sole (14.3%) and slope pollock (12.6%). Tables 1 and 2 present the ten most important prey by weight in the diets of each predator for the eastern Bering Sea shelf and slope regions, respectively. All forage fish species are italicized. Forage fish that are in the diet but not one of the ten most important prey by weight are also listed. The miscellaneous fish category represents all fish prey not included as one of the ten most important prey categories, primarily unidentified fish. All groundfish diet data are from the AFSC, REFM, groundfish food habits database.

Eastern Bering Sea Shelf. Despite the generally piscivorous diet of cod, arrowtooth flounder, Pacific halibut, Greenland turbot and skates, forage fish are not principal components in the diet by weight (Table 1). Sand lance are the most prevalent forage fish in the diet of cod (0.8%) while capelin, Osmeridae, Bathylagidae, Myctophidae, and eulachon each represent 0.1% or less of the diet by weight. In the diet of arrowtooth flounder, capelin and eulachon each represent 0.2% of the diet by weight, while Osmeridae, Myctophidae, and sand lance each constitute 0.1% or less. The diet of Pacific halibut contains 2.2% sand lance and 1.8% capelin; Osmeridae and eulachon each represent 0.1% or less. Myctophidae represent 0.2% of the diet of Greenland turbot; Bathylagidae, Osmeridae, and sand lance represent 0.1% or less. Sand lance are the most important forage fish in the diet of skates (0.7%); capelin, sandfish, and Myctophidae each represent 0.1% or less.

Sand lance is the most prevalent forage fish species in the diet of walleye pollock (0.5%); Osmeridae, Bathylagidae, Myctophidae, and eulachon each represent <0.1% of the diet by weight. The total contribution (0.6%) of forage fishes to the diet of yellowfin sole is primarily due to sand lance; Bathylagidae and capelin each represent <0.1% by weight. Sand lance are the second most important prey in the diet of rock sole, 14.3% by weight; Osmeridae are the only other forage fish present in the diet (<0.1%). Sand lance are the only forage fish found in the diet of Alaska plaice, representing 0.5% of the diet. Flathead sole consumes capelin (1.3%), sand lance (0.5%), Osmeridae (0.1%) and Myctophidae (<0.1%).

Eastern Bering Sea Slope. Lang and Livingston (1996) studied the diets of groundfish in the eastern Bering Sea slope region. In this region, forage fish are relatively unimportant in the diets of Greenland halibut, flathead sole, arrowtooth flounder, and cod (Table 2). However, 12.6 % of the diet of pollock on the slope consists of forage fishes. Greenland halibut consume Bathylagidae (0.4%) and Myctophidae (0.4%) as the only forage fish in their diet. Flathead sole also consumed Bathylagidae (0.3%) and Myctophidae (0.1%). Myctophidae (0.2%) is the only forage fish found in the diet of arrowtooth flounder. Pollock consume Bathylagidae (7.0%), Myctophidae (5.5%), Osmeridae (0.1%), and sand lance (<0.1%). Forage fish are negligible in the diet of cod; Bathylagidae represent <0.1% of the diet by weight.

1.3.4 Significance of Forage Fish in the Diet of Gulf of Alaska Groundfish

Yang (1993) studied the diets of groundfish in the Gulf of Alaska shelf during summer. He found that the main fish prey of groundfish in the Gulf of Alaska included walleye pollock, Pacific herring, capelin, Pacific sand lance, eulachon, Atka mackerel, bathylagids, and myctophids (Table 3). Although walleye pollock was the most important fish prey of arrowtooth flounder, Pacific halibut, sablefish, Pacific cod, and walleye pollock in the Gulf of Alaska area, other forage fish species comprised 1-18% of the diet of groundfish (Table 3). Capelin was important food of arrowtooth flounder and pollock, comprising 8% and 13 % of the diet of arrowtooth flounder and walleye pollock, respectively. The capelin consumed by these groundfish were mainly located in the northeast and southwest of Kodiak Island. Eulachon comprised 6% of the food of sablefish. Myctophids were important forage fish for shortraker rockfish, comprising 18% of the diet of shortraker rockfish. Pacific sand lance were found in the stomachs of arrowtooth flounder, Pacific halibut, sablefish, Pacific cod, and walleye pollock, but its contribution to the diet was small (≤1 %). Bathylagids were only found in the diet of walleye pollock, they contributed less than 1% of the diet of walleye pollock. Pacific sandfish was not found in the diet of the groundfish in the Gulf of Alaska area.

In the Atlantic, strong interactions between cod and capelin have been recorded (Akenhead, et al. 1982). Even though Pacific cod did not feed so heavily on capelin in the Gulf of Alaska, capelin was one of the important fish prey of several groundfish species. The distributions and the abundances of the forage fish in the Gulf of Alaska are not well known. However, a series of years with poor forage fish recruitment, which decreases the availability of small fish, may have greater impact on piscivorous groundfishes.

1.3.5 The Significance of Forage Fish in the Diet of Aleutian Island Groundfish

Yang (1996) studied the diets of groundfish in the Aleutian Islands during summer. He found that main fish prey of groundfish in the Aleutian Islands included Atka mackerel, walleye pollock, Pacific herring, capelin, myctophids, bathylagids, Pacific sand lance, and eulachon (Table 4). Although Atka mackerel and walleye pollock were important fish prey of arrowtooth flounder, Pacific halibut, and Pacific cod, other forage fish species comprised from 1-37% of the diet of groundfish. Most of the Atka mackerel consumed by the groundfish were located near Attu, Agattu, Amchitka, Tanaga, Atka, and Unalaska Islands. Myctophids were an important forage fish. Large amounts of myctophids were found in the diets of Greenland turbot, walleye pollock, Pacific ocean perch, and short raker rockfish (Table 4). They were also found in arrowtooth flounder, Pacific cod, rougheye rockfish, Atka mackerel, and northern rockfish. Most myctophids consumed by the groundfish were located near Kiska, Adak, Seguam, and Yunaska Islands. It is notable that nine out of eleven groundfish species shown in Table 4 consumed myctophids as food. If the abundance of the myctophids declines dramatically, it could impact the growth of groundfish in the Aleutian Islands area which depend on myctophids for a main food resource. Bathylagids were found in the diets of Greenland turbot and walleye pollock. Capelin were found in the diet of Pacific halibut and walleye pollock collected in the Akutan Island area, but they contributed only 5% and less than 1% of the diets of Pacific halibut and walleye pollock, respectively. Pacific sand lance were food of arrowtooth flounder, Pacific halibut, Pacific cod, and walleye pollock, but they contributed less than 1% of the diets. Only a small amount (less than 1%) of eulachon was found in the diet of walleye pollock. Pacific sandfish was not found in the diets of the groundfish in the Aleutian Islands area.

1.3.6 Euphausiacea, Stichaeidae, Pholidae, and Gonostomatidae in the Diets of Eastern Bering Sea, Gulf of Alaska, and Aleutian Islands Groundfish

Euphausiacea. Euphausiids represent a significant portion of the diet of walleye pollock in the eastern Bering Sea Shelf region (Livingston 1991a). Euphausiids represent as much as 70% of the diet in the winter and spring and are generally more important to larger pollock than smaller ones. Euphausiids are also the primary prey of small (<35 cm) Greenland turbot in the eastern Bering Sea shelf, but are of little importance to larger fish (Livingston and deReynier 1996). Small (< 35 cm) arrowtooth flounder also consume euphausiids as a large (50% by weight) portion of their diet; euphausiids are of little importance to the larger ones (Livingston and deReynier 1996). Euphausiids were not found as a significant component of the diet of any other eastern Bering Sea shelf groundfish.

In the eastern Bering Sea slope region euphausiids were found in the diets of several groundfish species. Euphausiids represent 26% of the overall diet by weight of walleye pollock but are more important seasonally (80% by weight in winter) and are more important to smaller (<50 cm) fish (Lang and Livingston 1996). Euphausiids also play a small role (<1% by weight) in the diets of Pacific cod, flathead sole, and arrowtooth flounder (Lang and Livingston 1996).

Euphausiids are an important food item of many groundfish species in the Gulf of Alaska and Aleutian Islands areas. Yang (1993) showed that the diets of plankton feeding groundfish in the Gulf of Alaska such as dusky rockfish, Pacific ocean perch, and northern rockfish had large percentages (more than 65%) of euphausiids. Euphausiids also comprised 39% of the diet of walleye pollock in the Gulf of Alaska. In the Aleutian Islands, euphausiids also comprised 43, 55, 51, and 50% of the stomach contents of walleye pollock, Atka mackerel, Pacific ocean perch, and northern rockfish, respectively. Euphausiids were also a constituent of the diets of arrowtooth flounder (5%), rougheye rockfish (2%), shortspine thornyhead (1%), and shortraker rockfish (1%) in the Aleutian Islands. (Yang 1996).

Stichaeids. Stichaeids represent a minimal portion of the diets of several groundfish species in the eastern Bering Sea shelf region. Pacific cod (Livingston 1991b), arrowtooth flounder (Yang 1991a), and flathead sole (Pacunski 1991) consume unidentified stichaeids as < 1% of their diets by weight. Greenland turbot consume a combination of unidentified stichaeids and daubed shanny (*Lumpenus maculatus*) as a small portion (<1%) of their diet.

Stichaeids represent a small portion (<1% by weight) of the diet of Pacific cod, arrowtooth flounder, and Greenland turbot in the eastern Bering Sea slope region (Lang and Livingston 1996). Yang (1993) studied the diets of the groundfish in the Gulf of Alaska area during summer. He found that stichaeids comprised about 1% of the stomach content weight of arrowtooth flounder, Pacific cod, and walleye pollock, respectively. Pacific halibut, sablefish, and Pacific ocean perch also consumed stichaeids, but their contribution to the diets was small (<1%). Yang (1996) also studied the diet of the groundfish in the Aleutian Islands area. He found that stichaeids comprised 2% of the stomach contents weight of arrowtooth flounder. Stichaeids comprised <1% of the diets of Pacific cod, walleye pollock, and Atka mackerel.

Gonostomatids. Gonostomatids were not found as a significant portion of the diets of eastern Bering Sea shelf or slope groundfish (Livingston and deReynier, 1996). Gonostomatids are probably not important prey of the groundfish in the Gulf of Alaska area since they were not found in a recent study of groundfish diets in that area (Yang 1993). Gonostomastids were found in walleye pollock stomachs in the Aleutian Islands area; however, they contributed less than 1% of the total stomach contents weight (Yang 1996).

Pholids. Pholids (saddleback gunnel) were found in the Pacific cod stomachs in the Aleutian Islands area: their contribution was less than 1% of the total stomach contents weight. Pholids were not found as a significant portion of the diets of eastern Bering Sea shelf or slope groundfish. Pholids are probably not important prey of the groundfish in the Gulf of Alaska area since they were not found in a recent study of groundfish diets in that area (Yang 1993).

1.3.7 Significance of Forage fish to Seabirds

Some seabird populations in the Bering Sea/Aleutian Islands and Gulf of Alaska regions declined during part or all of the period since 1975. The principal colony of the Red-legged Kittiwake has declined by 50% during the past 20 years (Hatch et al. 1993). (Latin names of birds are given in Table 5A.) Other species such as Black-legged Kittiwakes, murres, Pigeon Guillemots, and Marbled Murrelets have declined to a lesser extent (Climo 1993, Dragon and Sundseth 1993, Hatch et al. 1993, Klosiewski and Laing 1994, Kuletz 1996, Oakley and Kuletz 1996). Most of the population declines have been concentrated on islands of the southeastern Bering Sea and in the northern Gulf of Alaska (Francis et al. 1996, Figure 6.11). Declines in the GOA appear to have preceded the *Exxon Valdez* oil spill (Klosiewski and Laing 1994, Piatt and Anderson 1996). In other areas of Alaska where populations have been monitored, numbers have fluctuated, but there have been no long-term multispecies trends (reviewed in Francis et al. 1996).

Forage fish are the principal diet of more than two thirds of Alaskan seabirds (Table 5A). The only seabird species that do not depend on fish during the breeding season are very small ones such as auklets (*Aethia* spp.; Table 5A). The four seabirds that commonly visit Alaskan waters during their nonbreeding season also depend on forage fish here (Table 5B). Capelin and sandlance are crucial to many bird species: other forage fish include Myctophids, herring, Pacific saury, and walleye pollock (Tables 5A, 53). Many seabirds can subsist on a variety of invertebrates and fish during nonbreeding months but can only raise their nestlings on forage fish (Sanger 1987a, Vermeer et al. 1987).

Seabird population trends throughout the Arctic and subarctic are largely determined by forage fish availability (Birkhead and Furness 1985). Lack of prey usually causes population declines through breeding failure rather than adult mortality. Although seabirds can adapt to occasional years of poor food and reproduction, a long-term scarcity of forage fish leads to population declines. Reproductive success in Alaskan seabirds is strongly linked to the availability of appropriate fish. Breeding failure as a result of forage fish scarcity has been documented in Alaska for Black-legged Kittiwakes, Glaucous-winged Gulls, Pigeon Guillemots, and murres (Kuletz 1983, Baird 1990, Murphy et al. 1984, Murphy et al. 1987, Springer 1991). Similar observations have been made for seabirds in British Columbia (Vermeer et al. 1979, Vermeer 1980) and the north Atlantic (Harris and Hislop 1978, Brown and Nettleship 1984, Barrett et al. 1987, Monaghan et al. 1989, Vader et al. 1990). Breeding failure can result when adults lack sufficient energy reserves to complete a nest, lay eggs, or complete incubation, or when they cannot feed the nestlings adequately.

Seabirds depend on forage fish that are small, high in energy content, and form schools within efficient foraging range of the breeding colony. Fish 5 to 20 cm long are easily captured and handled by seabirds. Schools must be available near the breeding colony, within 20 km or less for inshore feeders such as terns, guillemots, and cormorants, but up to 60 km or farther for kittiwakes and murres (Schneider and Hunt 1984). Seabirds such as kittiwakes and terns can take prey only when they are concentrated at the surface; these species are affected more frequently by food shortage than are diving seabirds such as murres, murrelets, puffins, and cormorants (Furness and Ainley 1984, Uttley et al. 1994).

Although Alaskan seabirds consume several species of fish, only one or two forage species are available near most colonies. If an important fish stock is depleted locally, birds may have no alternative that can support successful breeding. Regional variations in dominant forage fish include sandlance along most of the Aleutians and the coast and northern islands of the Bering Sea (Springer 1991, Springer et al. 1996); capelin and walleye pollock on most of the Alaska Peninsula (Springer 1991, Hatch and Sanger 1992); and pollock on St. Matthew Island and the Pribilof Islands (Hunt et al. 1981a, b, Springer et al. 1986).

The preferred forage species in each area usually is essential for successful seabird reproduction. Black-legged Kittiwakes bred successfully in the northern Bering Sea when sandlance were available, but not in years when they had to rely on cods (Springer et al. 1987). After capelin declined in the Gulf of Alaska in the late 1970's, Black-legged Kittiwakes switched to pollock and sandlance, but this diet did not prevent breeding failure (Baird 1990, Piatt and Anderson 1996). Capelin have increased again near some GOA colonies since 1994, and kittiwake breeding success has improved there recently (D.B. Irons, pers. comm.). Productivity on St. Matthew and the Pribilofs increased with pollock in the diet (Springer et al. 1986).

Theories have attributed reductions in the forage fish of seabirds to both commercial fisheries and climatic cycles. However, recent studies have concluded that both factors probably are significant (Francis et al. 1996). Climate has been recognized as the dominant factor in fluctuations of pelagic fish stocks (Wooster 1993). Climate in the Gulf of Alaska and Bering Sea undergoes cycles of varying lengths (Royer 1993), which influences the numbers and distribution of forage fish and hence avian productivity (Piatt and Anderson 1996, Francis et al. 1996). The same has been found in eastern Canada and northern Britain (Carscadden 1984, Bailey 1989).

However, directed fisheries on forage fish can deepen and prolong their natural population cycles (Duffy 1983, Steele 1991). In other nations with directed forage-fish fisheries, several stocks have "crashed" due to a combination of climatic and fishery pressures, which has led to local population declines in seabirds. Examples include fisheries on anchoveta (*Engraulis ringens*) in Peru (Schaeffer 1970, Duffy 1983), herring in Norway (Lid 1981, Anker-Nilssen and Barrett 1991), and pilchard (*Sardinops oscellata*) in South Africa (Crawford and Shelton 1978). In northwestern Russia, where several forage species (capelin, herring, and Arctic cod (*Boreogadus saida*) were overfished, sandlance are still available to seabirds, but the birds appear to compete for them more intensely than before (Krasnov et al. 1995).

1.3.8 Significance of Forage Fish to Marine Mammals

In general small forage fish such as capelin, herring, sandlance and eulachon, have been recognized as important prey items for a variety of marine mammal species. Among these are northern fur seal, Steller sea lion, harbor seal, spotted seal and bearded seal as well as humpback whale and fin whale. Northern fur seals, Steller sea lions, and harbor seals have been declining in abundance for a number of years (Table 6) and some theories attribute these declines to the lack of availability of prey species.

Largely due to the variable nature of the food habits data on different predators with respect to sampling method, timing and location, and lack of survey data on non-commercial prey species, the relative importance of forage species can appear uncertain. However, taken in aggregate, the available data suggest that forage fish species are important to marine mammals when and where they are available. Table 6 shows the relative rank of forage fish species in the diets of Pribilof fur seals, Steller sea lions, and harbor seals in the Gulf of Alaska. Capelin are an important component of the diet of all three of these species. In addition, of those species forming the forage fish category, Bathylagids and sandlance contribute to the diet of the fur seal, with eulachon as another important component of the harbor seal diet (Table 7). A summary of capelin and other forage fish use by selected marine mammal species in Alaska follows (data for pinnepeds from Alaska Fisheries Science Center).

Northern fur seal. Examination of 3,530 stomachs collected from seals taken at sea in 1960, 1962 to 1964, 1968, 1973 and 1974 indicated that capelin was the third most prevalent prey item, behind walleye pollock and Pacific herring. Available information on fur seal feeding habits prior (1892 to 1950's) to the pelagic collections also describe capelin and bathylagid smelt as primary prey in seal spewings and stomachs. Pacific herring and capelin were absent from stomachs collected in the 1980's and 1990's. Absence of forage fish in the samples was thought to be related to fluctuations in the abundance and availability of these fish, environmental changes in the Bering Sea or exclusion by the existence of large populations of walleye pollock.

Steller sea lion. Few opportunities exist to collect food habits data for Steller sea lions in offshore waters of the Bering Sea. Stomach samples collected by ADF&G in 1981, and 1985 to 1986 did not indicate the presence of forage fish species, but rather contained predominantly walleye pollock and yellowfin sole. However, capelin comprised about 60% of the stomach contents identified from samples collected in the Gulf of Alaska during summer 1975 to 1978 (n=37).

Harbor seal. Analyses of harbor seal stomach contents from collections made by ADF&G during 1973 to 1978 in the Gulf of Alaska indicated the presence of several forage fish species, including capelin, eulachon, Pacific herring and Pacific sand lance. In particular, capelin, eulachon and Pacific herring ranked 3rd, 4th and 5th respectively out of 15 species compared using the Index of Relative Importance (IRI) method. Seasonal and area differences were pronounced; capelin were most common in collections from the Kodiak island area, but were absent in samples from the south side of the Alaska Peninsula. Similarly, eulachon comprised 95% of the contents volume for collections in the Copper River Delta, 30% in Lower Cook Inlet, and 4.6% around Kodiak Island.

Spotted seal. Collections of spotted seal stomachs (n=14) during March - June 1976 to 1978 in the southeastern Bering Sea indicated that capelin was the predominant prey item. Similar collections from the northern Bering Sea (n=12) in 1976 to 1978 contained predominantly Arctic cod, capelin and saffron cod. In March - June 1972 and 1973 spotted seal collections from the Gulf of Anadyr contained predominantly Arctic cod, but pollock and sand lance were present as well.

Bearded seal. Pelagic collections of bearded seals near St. Matthew Island in the Bering Sea in spring 1981 indicated a very high occurrence of capelin in the diet, 82%, based on 16,940 individual capelin remains recovered. The authors suggest that the high occurrence was related to the presence of dense schools of capelin that rise in the water column and move toward shore in the early spring. This prey species, like the other forage fishes, therefore, may be very important in specific areas and times of year, but would not necessarily appear as important prey if sampling were to occur elsewhere, at different times.

Humpback whale. The major prey species of humpback whale are small schooling fishes and large zooplankton, mainly euphasiids (Nemato 1957, 1959, 1970; Krieger and Wing 1984, 1986). Important prey species in southeastern Alaska are capelin, herring, walleye pollock and krill (Bryant et al. 1981; Krieger and Wing 1984, 1986; Dolphin 1987). Shifts in distribution of humpback whales in southeastern Alaska have also been documented in apparent response to changes in prey abundance (Bryant et al. 1988, 1981; von Ziegesar and Matkin 1986; Baker et al. 1988).

Fin Whale. Fin whales are seasonally associated with coastal and continental shelf habitats and food resources. In the North Pacific (Kawamura 1982) fin whales compete with commercial fisheries for common prey species such as herring, northern anchovy, walleye pollock, capelin, sandlance and lanternfish. Data compiled over the past 25 years suggest that these whales feed in Eastern North Pacific waters (e.g. Shelikof Strait and the Gulf of Alaska).

1.3.9 Commercial Forage Fish Harvest

Forage fish form only a small part of the bycatch of commercial groundfish fisheries. Forage fish are taken incidental to the Alaska groundfish trawl fisheries in amounts of less than one percent of any directed fishery (L. Fritz, per. comm). Annual osmerid bycatch (principally capelin caught by the yellowfin sole fishery) by all groundfish fisheries in the Bering Sea and Aleutian Islands ranged between 43-800 mt in 1992-95 (Fritz 1996). Annual bycatch totals by BSAI groundfish fisheries of a wide variety of other fish, including bathylagids, myctophids, sandfish, sandlance, eelpouts, snipe eels, greenlings, lumpsuckers, pricklebacks, and snailfishes have amounted to about 1,000 mt for both 1994 and 1995 (Fritz 1996). While it is not known what percentage these values are of their actual biomasses in the BSAI region, this amount of bycatch probably has little affect on the reproducibility of each species nor does it represent significant competition with other apex predators (marine mammals, birds and other fish).

Because a specific reporting category exists for smelts, some catch data are available for this species group. Data from the GOA (Tables 8-11) indicate that smelts are taken as bycatch predominately in the bottom pollock, pelagic pollock and rockfish trawl fisheries. In the BSAI (Tables 12-15) the bycatch of smelts occurs mainly in the yellowfin sole fishery and to a lesser extent in the pelagic pollock fishery.

These data indicate that both midwater and bottom trawl fisheries capture incidental amounts of forage fish.

Although there is little commercial fishing on forage fish species, documentation exists of a small and sporadic commercial fishery on capelin as early as the 1960's (ADF&G, 1993). The largest harvest of capelin was taken in 1984 (489 mt; sorted) and in 1993, 31 mt of capelin were harvested in Nunavachuk Bay. Data reveal that no more than three vessels per year participated in a capelin fishery. Data from 1992 and 1994 indicate that less than 1 mt of capelin was commercially harvested by one boat. The limited annual harvest of capelin in the North Pacific is due to sporadic market conditions, processing limitations, and fluctuation of available capelin biomass. However, declining Atlantic stocks have the potential to change the market interest for capelin.

Presently, commercial fishing for capelin is open by regulation, not managed by emergency order, and is restricted by few regulations. The opportunity for a directed fishery on capelin or the other forage fish species exists under the current management system. Presently, species contained in the proposed forage fish category are not actively managed by the State of Alaska; however, cooperative State and Federal management would be necessary for those forage fish that may be distributed in State waters during spawning times.

1.3.10 Subsistence Harvest of Forage Fish

The Alaska Department of Fish and Game (ADF&G) Subsistence Division conducts household surveys to determine subsistence use of forage fish species. Data from these surveys (Table 16) show that smelt are reported harvested in a large number of coastal Alaska communities, including communities in the southeast, southcentral, southwest, west and arctic regions. Reported smelt harvests range from a few pounds to several thousand pounds per community, depending on the place and year. In the southeast, southcentral and southwest region, eulachon are the smelt most commonly taken. Rainbow smelt, capelin and "unknown" smelt are also reported harvested in communities in the arctic, west, southwest, and southcentral regions. The ADF&G database contains no records of subsistence harvests of other forage fish categories; however, it is possible that in particular communities some subsistence harvests of other forage fish species may occur (B. Wolfe, ADF&G Subsistence Div. per. comm.).

2.0 NEPA REQUIREMENTS: ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in significant impact on the human environment. The environmental analysis in the EA provides the basis for this determination and must analyze the intensity or severity of the impact of an action and the significance of an action with respect to society as a whole, the affected region and interests, and the locality. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact study (EIS) must be prepared for major Federal actions significantly affecting the human environment.

An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers. The purpose and alternatives were discussed in Sections 1.1 and 1.2, and the list of preparers is in Section 7. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

2.1 Environmental Impacts of the Alternatives

The environmental impacts generally associated with fishery management actions are effects resulting from (1) harvest of fish stocks which may result in changes in food availability to predators, changes in the population structure of target fish stocks, and changes in community structure; (2) changes in the physical and biological structure of the benthic environment as a result of fishing practices, e.g., effects of gear use and fish processing discards; and (3) entanglement/entrapment of non-target organisms in active or inactive fishing gear. A summary of the effects of the 1996 groundfish total allowable catch amounts on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the final environmental assessment for the 1996 groundfish total allowable catch specifications (NMFS 1996a).

Alternative 1, the status quo, could affect predator/prey relationships if a relatively unrestricted directed fishery were allowed to develop on the forage fish species included in this analysis (Osmeridae, Bathylagidae, Myctophidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea). Currently these forage fish species are not harvested in large numbers, but to the extent that a potential future market develops, the existing status quo management structure could allow the harvest of large amounts, or possibly unlimited amounts in the case of those "non-specified" species. As noted from the discussions above on the significance of forage fish species to the diets of seabirds and marine mammals, as well as other commercially important groundfish species, the unrestricted harvest of forage fish could have a negative impact on these higher trophic level animals (see Section 1 above for details).

Alternative 2, under any one of the options would restrict the potential harvest of forage fish species. The extent to which that might occur and the circumstances would depend on the option chosen. However, this Alternative would prevent uncontrolled harvest of forage fish and better ensure that the food resources of predators would not be unduly diminished as a result of fishing activities.

2.2 Impacts to ESA-listed Endangered or Threatened Species

Listed and candidate species that may be present in the GOA and BSAI are discussed in detail in the EA/RIR/Initial Regulatory Flexibility Analysis conducted on the annual total allowable catch specifications. The following species are currently listed under the ESA and could be present in the BSAI and GOA management areas. As mentioned above, some of these species could be negatively affected by the status quo option of Alternative 1 and the potential for removal of important forage fish prey under this alternative. Alternative 2 would ensure that the unrestricted harvest of forage fish prey, as defined in this analysis, would not occur. This action would benefit these marine mammals and seabirds listed below that feed on forage fish species (see Section 1 above for details).

Endangered Species

Bowhead whale	*Balaena mysticetus*
Northern right whale	*Balaena glacialis*
Sei whale	*Balaenoptera borealis*
Blue whale	*Balaenoptera musculus*
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Sperm whale	*Pyseter macrocephalus*
Snake River sockeye salmon	*Oncorhynchus nerka*

Short-tailed albatross	*Diomedea albatrus*
Steller sea lion (eastern stock)	*Eumetopias jubatus*

Threatened Species

Steller sea lion (western stock)	*Eumetopias jubatus*
Snake River spring/summer/fall chinook salmon	*Oncorhynchus tshawytscha*
Spectacled eider	*Somateria fischeri*
Steller's eider	*Polysticta stelleri*

2.3 Impacts on Marine Mammals

Marine mammals not listed under the Endangered Species Act that may be present in the GOA and BSAI include cetaceans, [minke whale (*Balaenoptera acutorostrata*), killer whale (*Orcinus orca*), Dall's porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and the beaked whales (e.g., *Berardius bairdii* and *Mesoplodon* spp.)] as well as pinnipeds [northern fur seals (*Callorhinus ursinus*), and Pacific harbor seals (*Phoca vitulina*)] and the sea otter (*Enhydra lutris*).

As mentioned above (Section 1.3.8), some of these species could be negatively impacted by the status quo Alternative 1 and the potential for removal of important forage fish prey under this alternative. Alternative 2 would ensure that the unrestricted harvest of forage fish prey, as defined in this analysis, would not occur, thus likely having indirect positive effects on marine mammals.

2.4 Impacts on Marine Birds

Seabirds not listed under the ESA that may be present in the GOA and BSAI are listed in Table 5A. Alternative 2 would restrict the removal of forage fish that are important prey resources for marine birds. Alternative 1 could potentially negatively impact marine birds by allowing the unrestricted harvest of these prey species (see details in Section 1.3.7).

2.5 Coastal Zone Management Act

Implementation of each of the alternatives considered would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

2.6 Finding of No Significant Impact

For the reasons discussed above, implementation of any one of the alternatives to the status quo would not significantly affect the quality of the human environment, and the preparation of an environmental impact statement on the final action is not required under Section 102(2)(c) of the National Environmental Policy Act or its implementing regulations.

Assistant Administrator for Fisheries, NOAA

2/6/98
Date

3.0 REGULATORY IMPACT REVIEW: ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade offs between qualitative and quantitative benefits and costs.

The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

> In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

Executive Order 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant". A "significant regulatory action" is one that is likely to:

1. Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

2. Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

3. Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

4. Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant."

A brief discussion of potential costs and benefits of this action is provided for purposes of assessing the alternatives considered. The total burden to the Alaska fishing industry resulting from restricting harvest of forage fish likely would be minimal.

The only known directed fishery and commercial sale of any of the species of fish in the forage fish category was for capelin. From 1984 through 1994, a maximum of three vessels per year harvested capelin commercially. The commercial harvest of capelin has occurred directly after or during the herring season and is dependent on the buyers' availability to market capelin products. During this period, a minimum of 1 mt of capelin was harvested in 1994 and a maximum of 1,321 mt were landed (489 mt sorted) in 1984. Roe bearing females are sorted from the entire landing.

The capelin fishery is experimental and efforts to develop a commercial interest in this fishery are slow. This is largely due to the industry's present market interest which is focused on herring roe and salmon at the time when the capelin fishery is most viable. If a capelin fishery could be successfully developed the price of capelin roe could be comparable to herring roe prices. The capelin biomass, however, would most likely remain sporadic.

The ex-vessel price for capelin was 6 dollars per pound for roe bearing females caught in 1993 and 1994, and 20 cents per pound for capelin processed as bait or used as meal to feed zoo animals. The maximum cost to the industry cannot be determined at this time, however, because of industry's limited interest, the sporadic availability of capelin, and low catch amounts which result in a poorly developed commercial fishery. The costs of Alternative 2, however, are anticipated to be less than 5 percent of the gross annual receipts of the catcher vessels. None of the alternatives considered is expected to result in a "significant regulatory action" as defined in E.O. 12866.

3.1 Reporting Costs

Additional reporting costs or burden would entail the reporting and recordkeeping for those species that were formerly included in the "nonspecified species" category for which no records were previously necessary. Nonspecified species are defined under the FMP as any species not listed under prohibited, targeted, or the "other" species category. Processors and catcher vessels would undertake some additional recordkeeping costs under any of the options for Alternative 2.

3.2 Administrative, Enforcement and Information Costs

NMFS would not require additional staff personnel to administer, monitor, and enforce Alternative 2. However, additional staff time and resources would be required.

4.0 ECONOMIC IMPACTS ON SMALL ENTITIES

The objective of the Regulatory Flexibility Act is to require consideration of the capacity of those affected by regulations to bear the direct and indirect costs of regulation. If an action will have a significant impact on a substantial number of small entities an Initial Regulatory Flexibility Analysis (IRFA) must be prepared to identify the need for the action, alternatives, potential costs and benefits of the action, the distribution of these impacts, and a determination of net benefits.

NMFS has defined all fish-harvesting or hatchery businesses that are independently owned and operated, not dominant in their field of operation, with annual receipts not in excess of $3,000,000 as small businesses. In addition, seafood processors with 500 employees or fewer, wholesale industry members with 100 employees or fewer, not-for-profit enterprises, and government jurisdictions with a population of 50,000 or less are considered small entities. A "substantial number" of small entities would generally be 20% of the total universe of small entities affected by the regulation. A regulation would have a "significant impact" on these small entities if it reduced annual gross revenues by more than 5 percent, increased total costs of production by more than 5 percent, or resulted in compliance costs for small entities that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

If an action is determined to affect a substantial number of small entities, the analysis must include:

1. a description and estimate of the number of small entities and total number of entities in a particular affected sector, and total number of small entities affected; and

2. analysis of economic impact on small entities, including direct and indirect compliance costs, burden of completing paperwork or recordkeeping requirements, effect on the competitive position of small entities, effect on the small entity's cashflow and liquidity, and ability of small entities to remain in the market.

NMFS has determined that none of the alternatives would have a significant impact on a substantial number of small entities, therefore, an Initial Regulatory Flexibility Analysis was not prepared. All of the proposed options under Alternative 2 would affect a substantial number of small entities because the proposed management measures would apply to all vessels fishing for or processing groundfish in the BSAI or GOA. However, the impacts of the proposed action would not be "significant" as that term is defined by NMFS for the purpose of the RFA. Compliance costs of the preferred alternative would not be significant because vessels fishing for groundfish rarely, if ever, incidentally harvest forage fish in quantities that would exceed the 2-percent MRB proposed under option 2. While vessel operators would be required to monitor catch and discards of forage fish as part of their normal recordkeeping and reporting requirements, these compliance costs would not reduce annual gross revenues by more than 5 percent, increase total costs of production by more than 5 percent, or resulted in compliance costs for small entities that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

The proposed action would affect fishermen who wish to target forage fish. Several vessel operators have expressed interest in pursuing the capelin fishery and claim to have the capacity to handle 500 to 600 tons of capelin if select fish had been available in such quantities. No other commercial harvest has been reported on other forage fish species. Documented capelin harvests in the Togiak district from 1984-94 indicate that six vessels harvested a total of 1,493 mt. These six vessels do not represent a substantial number of small entities as this term is defined by NMFS.

5.0 SUMMARY AND CONCLUSIONS

The proposed action would create a new forage fish category in the FMPs and restrict the harvest of this group. The purpose of this action is to protect species that have little economic importance commercially but are essential components in the ecosystem as prey species for marine mammals, seabirds and other commercially important groundfish species. Alternative 2 is not expected to change fishing activities in a manner that would affect the amount of groundfish harvested. For the purpose of this analysis forage fish are defined as Osmeridae (which include capelin and eulachon), Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the Order Euphausiacea.

Forage fish species have been shown to be important components of the diets of seabirds, marine mammals and commercially important groundfish species. As a result, and in view of the declining populations of some of the predator species, restricting the potential harvest of these forage fishes would likely have positive indirect effects on predator species. Under Alternative 2, Option 1 entails the setting of an ABC, TAC and OFL amount for the forage fish category. This may be difficult given the lack of information on the abundance of the forage fish species and the limited catch history. Option 2 would establish the forage fish category as a bycatch only category with the harvest limited to 1 percent of the harvest of those species for which a directed fishery occurs. Option 2 would allow incidental harvest amounts of the forage fish category while preventing a directed fishery from occurring and would not have the constraints of establishing an ABC, TAC or OFL. Management under Option 3 would treat the forage fish category as prohibited species to be discarded at sea with a minimum of injury. This management strategy is typically reserved for economically important species other than federally managed groundfish. Option 3 could result in unnecessary discards and cause an unnecessary burden to catcher vessels that do not sort at sea and to processors who must handle these prohibited species. Option 2 would accomplish the objective of preventing a directed fishery on forage fish from establishing, while minimizing any unnecessary discards and avoiding the problems associated with establishing an ABC, TAC and OFL amount. Option 4 would prevent a directed commercial fishery from developing on any forage fish species; while avoiding the problems associated with Option 1 or 3. Option 4 would also alleviate the potential for any "topping-off" activities that may be associated with a bycatch only status, as outlined under Option 2.

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7.0 LIST OF PREPARERS and CONTRIBUTORS

Kaja Brix
Ellen Varosi
Kent Lind
National Marine Fisheries Service
Alaska Regional Office
P.O. Box 21668
Juneau, Alaska 99802-1668

Rich Ferrero
Lowell Fritz
Geoffrey Lang
Mei-Sun Yang
National Marine Fisheries Service
Alaska Fisheries Science Center
7600 Sand Point Way N.E.
Building 4
Seattle, Washington 98115

Vivian M. Mendenhall
U.S. Fish and Wildlife Service
1011 E. Tudor Rd
Anchorage, AK 99503

8.0 AGENCIES AND INDIVIDUALS CONSULTED

Herman Savikko
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
P.O. Box 25526
Juneau, AK 99802-5526

Robert Wolfe
Amy Page
Alaska Department of Fish and Game
Subsistence Division
P.O. Box 25526
Juneau, AK 99802-5526

9.0 LIST OF FIGURES

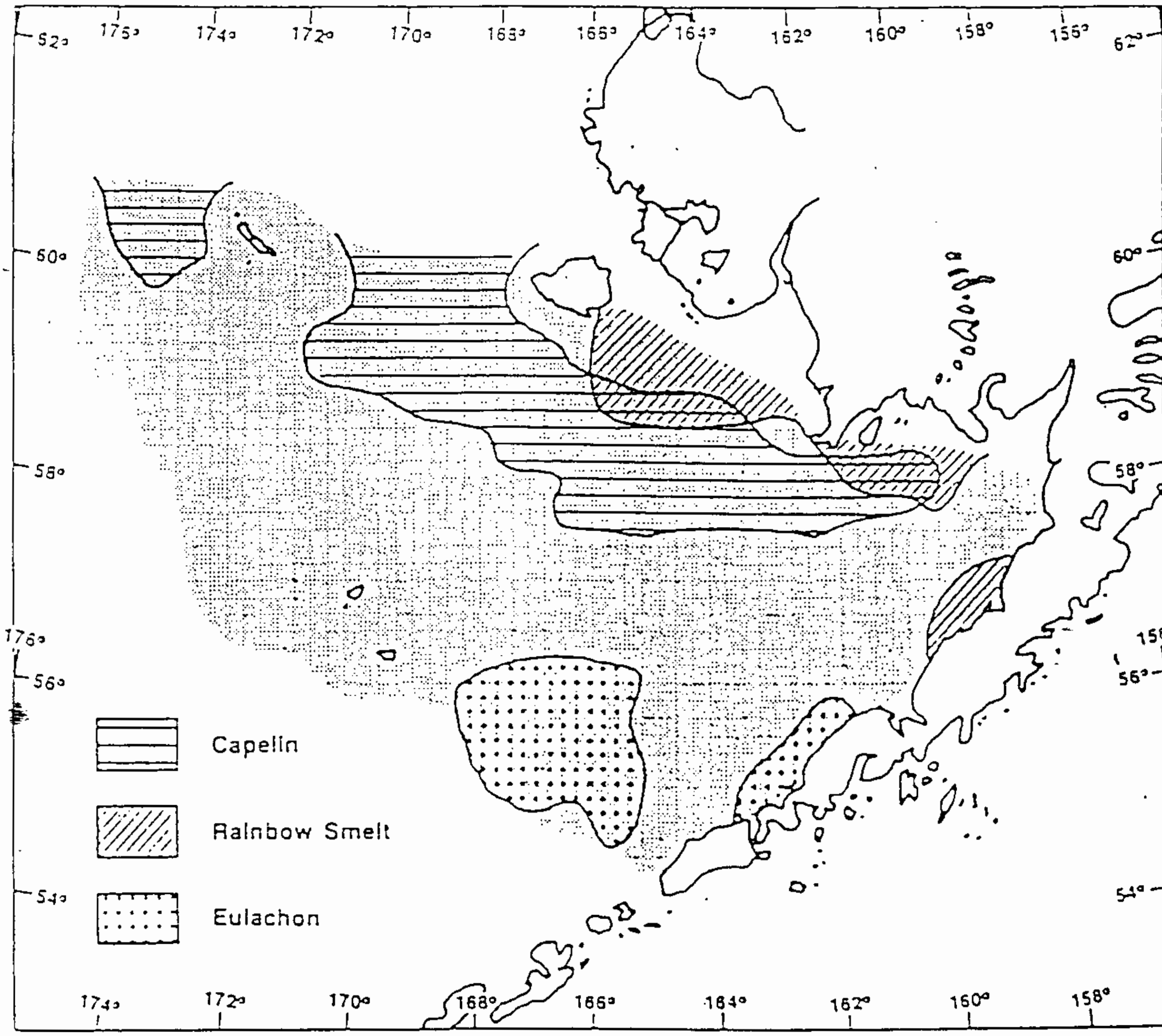

Figure 1. Distribution of capelin, rainbow smelt, and eulachon in Northwest and Alaska Fisheries Center summer groundfish trawl surveys.

10.0 LIST OF TABLES

Table 1. The diet of selected eastern Bering Sea shelf groundfish species. Forage fish in the diet appear in italics, numbers in parentheses represent percent by weight ontribution to the diet. N/A indicates no other forage fish in the diet.

Rank	Pollock	Cod	Arrowtooth flounder	Pacific halibut	Greenland halibut
1	Euphausiids (44.9)	Pollock (49.1)	Pollock (67.4)	Pollock (53.9)	Pollock (74.8)
2	Pollock (17.0)	Offal (12.1)	Misc. fish (15.3)	Flatfish (9.0)	Squid (11.1)
3	Copepods (11.4)	Brachyuran crab (10.3)	Herring (5.4)	Brachyuran crabs (7.8)	Misc. fish (6.2)
4	Shrimp (8.0)	Misc. fish (7.6)	Offal (3.6)	Misc. fish (7.6)	Offal (4.1)
5	Amphipods (4.1)	Flatfish (7.1)	Amphipods (1.8)	Anomuran crabs (4.6)	Flatfish (1.2)
6	Mysids (3.2)	Anomuran crabs (3.4)	Squid (1.8)	Cod (4.3)	Cod (0.9)
7	Misc. fish (2.8)	Shrimp (2.5)	Euphausiids (1.5)	Offal (4.1)	Herring (0.7)
8	Offal (1.1)	Polychaete worms (1.0)	Flatfish (1.0)	*Sand lance* (2.2)	*Myctophidae* (0.2)
9	*Capelin* (0.7)	*Sand lance* (0.8)	Scorpaenidae (0.3)	*Capelin* (1.8)	Shrimp (0.2)
10	*Sand lance* (0.5)	Gastropods (0.5)	*Capelin* (0.2)	Herring (1.1)	Cyclopteridae (0.2)
Other forage fish	*Osmeridae* (<0.1) *Bathylagidae* (<0.1) *Myctophidae* (<0.1) *Eulachon* (<0.1)	*Capelin* (0.1) *Osmeridae* (<0.1) *Bathylagidae* (<0.1) *Myctophidae* (<0.1) *Eulachon* (<0.1)	*Eulachon* (0.2) *Osmeridae* (0.1) *Myctophidae* (<0.1) *Sand lance* (<0.1)	*Osmeridae* (0.1) *Eulachon* (<0.1)	*Bathylagidae* (0.1) *Osmeridae* (<0.1) *Sand lance* (<0.1)

Table 1. Continued.

Rank	Yellowfin sole	Rock sole	Alaska plaice	Flathead sole	Skates
1	Echiuroid worms (22.4)	Polychaete worms (44.9)	Polychaete worms (55.5)	Echinoderms (28.3)	Pollock (56.7)
2	Bivalves (18.5)	*Sand lance* (14.3)	Bivalves (11.1)	Pollock (25.6)	Misc. fish (9.9)
3	Polychaete worms (18.1)	Echiuroid worms (11.0)	Echiuroid worms (10.7)	Shrimp (12.8)	Brachyuran crabs (8.8)
4	Amphipods (7.0)	Amphipods (7.2)	Sipunculid worms (10.7)	Misc. fish (5.8)	Flatfish (6.7)
5	Echinoderms (3.7)	Bivalves (5.1)	Amphipods (4.6)	Euphausiids (4.5)	Shrimp (5.5)
6	Anomuran crabs (3.7)	Sipunculid worms (5.0)	Priapulid worms (2.8)	Offal (3.9)	Offal (5.2)
7	Euphausiids (3.2)	Echinoderms (2.8)	Exhinoderms (2.0)	Mysids (3.5)	Anomuran crabs (3.1)
8	Shrimp (3.1)	Shrimp (2.0)	Unidentified crustacea (0.6)	Bivalves (3.1)	Ampipods (1.3)
9	Gastropods (2.6)	Misc. fish (1.6)	*Sand lance* (0.5)	Anomuran crab (2.5)	*Sand lance* (0.7)
10	Brachyuran crabs (2.4)	Priapulid worms (1.5)	Brachyuran crabs (0.2)	Brachyuran crab (2.3)	Cod (0.4)
Other forage fish	*Sand lance* (0.6) *Bathylagidae* (<0.1) *Capelin* (<0.1)	*Osmeridae* (<0.1)	N/A	*Capelin* (1.3) *Sand lance* (0.5) *Osmeridae* (0.1) *Myctophidae* (<0.1)	*Capelin* (0.1) *Sandfish* (0.1) *Myctophidae* (<0.1)

Table 2. The diet of selected eastern Bering Sea slope groundfish species. Forage fish in the diet appear in italics, numbers in parentheses represent percent by weight contribution to the diet. N/A indicates no other forage fish in the diet.

Rank	Greenland Halibut	Flathead sole	Arrowtooth flounder	Pollock	Cod
1	Pollock (58.3)	Echinoderm (49.6)	Pollock (55.4)	Euphausiids (26.4)	Pollock (51.4)
2	Squid (18.5)	Offal (23.7)	Misc. fish (15.9)	Shrimp (16.4)	Offal (9.7)
3	Offal (11.9)	Scorpaenidae (10.1)	Squid (11.3)	Pollock (15.8)	Misc. fish (9.1)
4	Misc. fish (5.0)	Shrimp (4.2)	Herring (11.1)	Squid (8.3)	Shrimp (8.6)
5	Cyclopteridae (2.7)	Misc. fish (4.0)	Shrimp (4.6)	Misc. fish (7.0)	Brachyuran crab (6.2)
6	Flatfish (0.8)	Pollock (2.9)	Offal (0.7)	*Bathylagidae* (7.0)	Flatfish (4.0)
7	Herring (0.6)	Polychaete worms (1.6)	Echinoderm (0.3)	*Myctophidae* (5.5)	Herring (3.5)
8	*Bathylagidae* (0.4)	Brachyuran crab (1.4)	Misc/unident (0.3)	Offal (3.7)	Squid (1.9)
9	*Myctophidae* (0.4)	Squid (0.4)	Euphausiids (0.2)	Copepods (2.2)	Cod (1.0)
10	Anomuran crab (0.1)	Mysid (0.4)	*Myctophidae* (0.2)	Herring (2.5)	Polychaete worms (0.9)
Other forage fish	N/A	*Myctophidae* (0.3) *Bathylagidae* (0.1)	N/A	*Osmeridae* (0.1) *Sand lance* (<0.1)	*Bathylagidae* (<0.1)

Table 3. Percent by weight of the important prey or prey group consumed by the groundfish in the Gulf of Alaska. "-" means less than 1%. PLK, pollock; HER, herring; CAP, capelin; SAN, Pacific sand lance; EUL, eulachon; ATK, Atka mackerel; BAT, bathylagid; MYC, myctophid; TAN, Tanner crab; PAN, pandaliids; CEP, cephalopods; FSD, fishery discard; EUP, euphausiids; CAL, calanoid; ATF, arrowtooth flounder; PH, Pacific halibut; SAB, sablefish; COD, Pacific cod; SST shortspine thornyhead; ROU, rougheye rockfish; SRR, shortraker rockfish; DUS, dusky rockfish; POP, Pacific ocean perch; NOR, northern rockfish;

	Predator										
Prey	ATF	PH	SAB	COD	PLK	SST	ROU	SRR	DUS	POP	NOR
PLK	66	57	24	7	2	1	0	0	0	0	0
HER	9	0	2	-	-	0	0	0	0	0	0
CAP	8	1	-	2	13	1	0	0	0	0	0
SAN	-	1	-	-	-	0	0	0	0	0	0
EUL	1	-	6	-	0	0	0	0	0	0	0
ATK	1	0	0	0	0	0	0	0	0	0	0
BAT	0	0	0	0	-	0	0	0	0	0	0
MYC	0	0	-	0	0	0	0	13	0	1	0
TAN	0	6	-	12	0	1	2	0	0	-	-
PAN	4	-	4	9	19	54	51	0	4	2	0
CEP	2	5	8	10	3	1	21	32	6	1	-
FSD	1	7	29	13	0	0	0	0	0	0	0
EUP	3	0	7	1	39	0	2	0	69	87	96
CAL	0	0	0	0	1	0	0	0	2	2	3

Table 4. Percent by weight of the important prey or prey group consumed by the groundfish in the Aleutian Islands. "-" means less than 1%. ATK, Atka mackerel; PLK, pollock; HER, herring; CAP, capelin; MYC, myctophid; BAT, bathylagid; SAN, Pacific sand lance; EUL, eulachon; TAN, Tanner crab; COT, Cottid; CYC, cyclopterid; SHR, shrimp; CEP, cephalopods; EUP, euphausiids; CAL, calanoid; ATF, arrowtooth flounder; PH, Pacific halibut; COD, Pacific cod; GT, Greenland turbot; SST shortspine thornyhead; ROU, rougheye rockfish; SRR, shortraker rockfish; POP, Pacific ocean perch; NOR, northern rockfish;

	Predator										
Prey	ATF	PH	COD	GT	PLK	SST	ROU	SRR	ATK	POP	NOR
ATK	44	12	27	0	0	0	0	0	0	0	0
PLK	13	19	17	1	0	0	0	0	2	0	0
HER	-	2	1	0	0	0	0	0	0	0	0
CAP	0	5	0	0	-	0	0	0	0	0	0
MYC	7	0	3	28	37	0	4	15	1	34	1
BAT	0	0	-	13	1	0	0	0	0	0	0
SAN	-	-	-	0	-	0	0	0	0	0	0
EUL	0	0	0	0	-	0	0	0	0	0	0
TAN	0	7	2	0	-	0	0	0	-	0	0
COT	3	1	7	0	-	51	0	19	-	0	0
CYC	-	-	-	0	-	1	45	0	0	0	0
SHR	2	-	10	0	4	23	45	32	-	0	3
CEP	3	27	12	50	2	-	0	3	3	2	1
EUP	5	-	-	0	43	1	2	1	55	51	50
CAL	-	0	-	0	3	0	0	0	17	7	17

Table 5A. Estimated populations and principal diets of seabirds that breed in the Bering Sea/Aleutian Islands (BS/AI) and Gulf of Alaska (GOA) regions. Footnotes follow Table 5B.

Species	Population[1,2]		Diet[3,4]
	BS/AI	GOA	
Northern Fulmar (*Fulmarus glacialis*)	1,500,000	600,000	Q,M,F,Z,I
Fork-tailed Storm-Petrel (*Oceanodroma furcata*)	4,500,000	1,200,000	Q,Z, C
Leach's Storm-Petrel (*Oceanodroma leucorrhoa*)	4,500,000	1,500,000	Q,Z
Double-crested Cormorant (*Phalacrocorax auritis*)[5]	9,000	8,000	F,I
Pelagic Cormorant (*Phalacrocorax pelagicus*)	80,000	70,000	S,C,P,H,F,I
Red-faced Cormorant (*Phalacrocorax urile*)	90,000	40,000	C,S,H,F,I
Brandt's Cormorant (*Phalacrocorax penicillatus*)	0	100	?
Pomarine Jaeger (*Stercorarius pomarinus*)	Common	Common	C,S
Parasitic Jaeger (*Stercorarius parasiticus*)	Common	Common	C,S
Long-tailed Jaeger (*Stercorarius longicaudus*)	Common	Common	C,S
Bonaparte's Gull (*Larus philadelphia*)	Rare	Common	?
Mew Gull (*Larus canus*)[5]	700	40,000	C,S,I
Herring Gull (*Larus argentatus*)[5]	50	300	C,S,H,F,I,D
Glaucous-winged Gull (*Larus glaucescens*)	150,000	300,000	C,S,H,F,I,D
Glaucous Gull (*Larus hyperboreus*)[5]	30,000	2,000	C,S,H,I,D
Black-legged Kittiwake (*Rissa tridactyla*)	800,000	1,000,000	C,S,P,M,Z
Red-legged Kittiwake (*Rissa brevirostris*)	150,000	0	M,C,S,P,Z
Sabine's Gull (*Xema sabini*)	Common	Common	?
Arctic Tern (*Sterna paradisaea*)[5]	7,000	20,000	C,S,Z,F
Aleutian Tern (*Sterna aleutica*)	9,000	25,000	C,S,Z,F
Common Murre (*Uria aalge*)	3,000,000	2,000,000	C,S,P,H,F
Thick-billed Murre (*Uria lomvia*)	5,000,000	200,000	C,S,P,Q,Z,M,F,I
Pigeon Guillemot (*Cepphus columba*)	100,000	100,000	S,C,F,H,I
Marbled Murrelet (*Brachyramphus marmoratus*)	Uncommon	Common	C,S,P,F,Z,I
Kittlitz's Murrelet (*Brachyramphus brevirostris*)	Uncommon	Uncommon	S,C,H,P,F,Z,I
Ancient Murrelet (*Synthliboramphus antiquus*)	200,000	600,000	Z,F,C,S,P,I
Cassin's Auklet (*Ptychoramphus aleuticus*)	250,000	750,000	Z,Q,S,F,I
Least Auklet (*Aethia pusilla*)	9,000,000	50	Z,I
Parakeet Auklet (*Cyclorrhynchus psittacula*)	800,000	150,000	F,S,P,Z,I
Whiskered Auklet (*Aethia pygmaea*)	30,000	0	Z,I
Crested Auklet (*Aethia cristatella*)	3,000,000	50,000	Z,I
Rhinoceros Auklet (*Cerorhinca monocerata*)	50	200,000	C,S,H,A,F
Tufted Puffin (*Fratercula cirrhata*)	2,500,000	1,500,000	C,S,P,F,Q,Z,I
Horned Puffin (*Fratercula corniculata*)	500,000	1,500,000	C,S,P,F,Q,Z,I
Total 36,000,000	12,000,00		

Table 5B. Comparative population estimates and diets of nonbreeding seabirds that frequent the Bering Sea/Aleutian Islands and Gulf of Alaska regions.

Species	Population[2] BS/AI	GOA	Diet[3,4]
Short-tailed Albatross (*Diomedea albatrus*)	Rare	Rare	?
Black-footed Albatross (*Diomedea nigripes*)	Common	Common	M,F,Q,I,D
Laysan Albatross (*Diomedea immutabilis*)	Common	Common	M,Q,I,F
Sooty Shearwater (*Puffinus griseus*)	Common	Abundant	M,A,C,S,Q,F,Z
Short-tailed Shearwater (*Puffinus tenuirostris*)	Abundant	Common	M,A,Z, C,S,F
Ivory Gull (*Pagophila eburnea*)	Uncommon	0	?

[1] Source of population data for colonial seabirds that breed in coastal colonies: modified from U.S. Fish and Wildlife Service 1996. Estimates are minima, especially for storm-petrels, auklets, and puffins.

[2] Numerical estimates are not available for species that do not breed in coastal colonies. Approximate numbers: abundant $\geq 10^6$; common $= 10^5$-10^6; uncommon $= 10^3$-10^5; rare $\leq 10^3$.

[3] Abbreviations of diet components: M, Myctophid; P, walleye pollock; C, capelin; S, sandlance; H, herring; A, Pacific saury; F, other fish; Q, squid; Z, zooplankton; I, other invertebrates; D, detritus; ?: no information for Alaska. Diet components are listed in approximate order of importance. However, diets depend on availability and usually are dominated by one or a few items (see text).

[4] Sources of diet data: Ainley and Sanger 1979, Baird and Gould 1986, Bedard 1969, DeGange and Sanger 1986, P.J. Gould (pers. comm.), Gould et al. (in press), Hatch 1984, 1993, Hatch and Sanger 1992, Hunt et al. 1981a, b, c, Irons et al. 1986, Kuletz 1983, Murphy et al. 1984, 1987, Ogi 1984, Ogi and Tsujita 1973, Patten and Patten 1982, Sanger 1986, 1987a, b, Schneider and Hunt 1984, Springer et al. 1986, 1987, 1996, Vermeer et al. 1987, Vermeer and Westrheim 1984, Wehle 1982.

[5] Species breeds both coastally and inland; population estimate is only for coastal colonies.

Table 6. Numbers of Pribilof fur seals, Steller sea lions, and harbor seals in parts of the Gulf of Alaska and Bering Sea.

Pribilof fur seal[1]	Year	Steller sea lion[2]	Harbor seal[3]
1950	451,000		
1955	461,000		
1960	320,000	140,115	
1965	253,768		
1970	230,485		
1975	278,261	103,976	
1976	298,000		6,919
1977	235,200		6,617
1978	247,100		4,839
1979	245,932		3,836
1980	203,825		
1981	179,444		
1982	203,581		1,575
1983	165,941		
1984	173,274		1,390
1985	182,258	67,617	
1986	167,656		1,270
1987	171,422		
1988	202,300		1,014
1989	171,530	24,953	
1990	201,310	27,860	960

[1] Number of pups born at St. Paul Island: from York and Kozloff (1987) and NMFS (unpublished data).

[2] Index counts of adults and juveniles on rookeries and haulouts from the Kenai Peninsula to Kiska Island: from Loughlin et al. (1990) and Merrick et al. (1987, 1991).

[3] Mean counts of seals hauled out on Tugidak Island during the fall molt: from Pitcher (1990) and ADF&G (unpublished data).

Table 7. Rank of prey species in the diets of Pribilof fur seals, Steller sea lions, and harbor seals the Gulf of Alaska and Bering Sea.

Ranking	*Pribilof fur seal*[1]	*Steller sea lion*[2]	*Harbor seal*[3]
1	Squids (33.3)	Pollock (58.3)	Pollock (21.4)
2	Capelin (30.6)	Herring (20.6)	Octopus (18.3)
3	Pollock (25.1)	Capelin (7.4)	Eulachon (11.6)
4	Atka mackerel (3.5)	Salmon (5.1)	Capelin (10.4)
5	Herring (2.9)	Squid (4.2)	Herring (6.4)
6	Bathylagidae (2.9)	Sculpins (1.3)	Salmon (4.4)
7	Salmon (1.1)	Pacific cod (0.9)	Shrimps (3.3)
8	Flatfishes (0.6)	Rockfishes (0.8)	Pacific cod (3.2)
9	Sablefish (0.2)	Flatfishes (0.3)	Flatfishes (2.6)
10	Sand lance (0.2)	Octopus (<0.1)	Squids (1.6)

Rankings based on modified volume, numbers in parentheses are modified volumes; from Perez and Bigg (1991).

Rankings based on combination rank index, numbers in parentheses are percent of total sample volume; from Pitcher (1981).

Rankings based on modified index of relative importance, numbers in parentheses are percent of total sample volume; from Pitcher (1980).

Table 8.--Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Gulf of Alaska, 1990.

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	TWL	0.1
Bottom Pollock	HAL	-
	TWL	21.9
Cod	HAL	0.2
	POT	3.9
	TWL	6.8
Deepwater Flatfish	TWL	-
Other	TWL	-
Pelagic Pollock	TWL	27.8
Rockfish	HAL	0.2
	TWL	66.0
Sablefish	HAL	0.3
	TWL	0.0
Shallow flatfish	TWL	0.0
Gulf of Alaska Total		**127.2**

TWL- trawl
HAL- hook-and-line

Table 9. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Gulf of Alaska, 1991.

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	TWL	1.3
Bottom Pollock	TWL	5.9
Cod	HAL	-
	POT	1.0
	TWL	16.6
Deepwater Flatfish	TWL	-
Other	TWL	-
Pelagic Pollock	TWL	13.3
Rockfish	HAL	-
	TWL	126.6
Sablefish	HAL	0.1
	TWL	-
Shallow flatfish	TWL	0.4
Gulf of Alaska Total		165.2

TWL- trawl
HAL- hook-and-line

Table 10. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Gulf of Alaska, 1992.

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	HAL	-
	TWL	0.1
Bottom Pollock	HAL	-
	TWL	155.8
Cod	HAL	109.4
	POT	15.2
	TWL	5.6
Deepwater Flatfish	TWL	-
Other	TWL	-
Pelagic Pollock	TWL	71.9
Rockfish	HAL	2.9
	TWL	164.7
Sablefish	HAL	2.2
Shallow flatfish	HAL	-
	TWL	2.9
Gulf of Alaska Total		530.7

TWL- trawl
HAL- hook-and-line

Table 11. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Gulf of Alaska, 1993.

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	HAL	-
	TWL	2.1
Bottom Pollock	TWL	110.9
Cod	HAL	14.2
	POT	24.1
	TWL	18.3
Deepwater Flatfish	TWL	-
Other	TWL	-
Pelagic Pollock	TWL	13.2
Rockfish	HAL	3.0
	TWL	108.7
Sablefish	HAL	6.1
	TWL	0.1
Shallow flatfish	TWL	7.9
Gulf of Alaska Total		308.6

TWL- trawl
HAL- hook-and-line

Table 12. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Bering Sea/Aleutian Islands, 1990.

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	TWL	-
Atka mackerel	TWL	-
Bottom Pollock	TWL	0.3
Cod	HAL	-
	POT	-
	TWL	0.0
Other Flatfish	TWL	-
Pelagic Pollock	TWL	0.9
Rockfish	HAL	-
	TWL	0.4
Rock sole	TWL	-
Sablefish	HAL	-
	TWL	0.1
Greenland turbot	HAL	-
	TWL	0.1
Yellowfin sole	TWL	30.0
BSAI Total		31.8

TWL- trawl
HAL- hook-and-line

Table 13. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Bering Sea/Aleutian Islands, 1991

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	HAL	-
	TWL	0.2
Atka mackerel	TWL	-
Bottom Pollock	TWL	2.8
Cod	HAL	-
	POT	-
	TWL	0.4
Other Flatfish	TWL	-
Pelagic Pollock	TWL	57.2
Rockfish	HAL	-
	TWL	0.1
Rock sole	TWL	1.5
Sablefish	HAL	-
	TWL	-
Yellowfin sole	TWL	229.9
BSAI Total		**292.1**

TWL- trawl
HAL- hook-and-line

Table 14. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Bering Sea/Aleutian Islands, 1992

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	TWL	-
Atka mackerel	TWL	0.1
Bottom Pollock	TWL	5.8
Cod	HAL	-
	POT	-
	TWL	-
Other Flatfish	TWL	-
Pelagic Pollock	TWL	97.4
Rockfish	HAL	-
	TWL	-
Rock sole	TWL	0.2
Sablefish	HAL	-
Greenland turbot	HAL	-
Yellowfin sole	TWL	188.0
Gulf of Alaska Total		291.5

TWL- trawl
HAL- hook-and-line

Table 15. Estimated Osmerid (smelt) catch (mt) by gear type and fishery in the Bering Sea/Aleutian Islands, 1993

Fishery	*Gear*	*Smelts (mt)*
Arrowtooth	HAL	-
	TWL	-
Atka mackerel	TWL	-
Bottom Pollock	TWL	0.6
Cod	HAL	0.1
	POT	-
	TWL	0.0
Pelagic Pollock	TWL	9.8
Rockfish	HAL	-
	TWL	-
Rock sole	TWL	0.8
Sablefish	HAL	-
	TWL	-
Greenland turbot	HAL	-
	TWL	-
Yellowfin sole	TWL	117.5
BSAI Total		128.8

TWL- trawl
HAL- hook-and-line

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADF&G, Division of Subsistence, Community Profile Database, September 1996

			Percent of Households Participating						Conversion Factor	Mean lbs per Household	Estimated Total for the Community		Pounds Per Capita
Community	Yr	Resource	Trying	Harvesting	Using	Giving	Receiving	units	convfact	avglbhrv	Numbers xtotnum	Pounds xtotlbs	percap
ARCTIC													
Barrow	87	Capelin (grunion)		8.0				Individual	0.2	0.85	3960	792	0.26
Barrow	89	Capelin (grunion)						Individual	0.2	0.07	346	69	0.02
SOUTHEAST													
Yakutat	84	Capelin (grunion)	22.0	22.0	34.0	10.0	16.0	Pounds	1	18.36	3323	3323	6.12
SOUTHWEST													
Kodiak City	93	Capelin (grunion)	1.0	0.0	1.0	1.0	1.0			0.23	142	463	0.08
Sand Point	92	Capelin (grunion)	1.0	1.0	1.0	0.0	1.0	Gallons	6	0.58	20	118	0.19
WESTERN													
Tununak	86	Capelin (grunion)	39.4	39.4	93.9	27.3	48.5	5 Gal Bckt	25	150.33	405	10133	30.92
SOUTHCENTRAL													
Chase	86	Eulachon (hooligan, candlefish)	5.9	5.9	5.9	5.9	0.0	Gallons	3.2	0.94	9	28	0.35
Chenega Bay	84	Eulachon (hooligan, candlefish)	6.3	6.3	12.5	0.0	12.5	Gallons	3.25	0.63	3	10	0.18
Chickaloon	82	Eulachon (hooligan, candlefish)		5.6	5.6			Individual	0.25	1.04	125	31	0.44
Chistochina	87	Eulachon (hooligan, candlefish)	3.6	3.6	3.6	0.0	3.6	Individual	0.25	1.43	166	41	0.52
Cooper Landing	90	Eulachon (hooligan, candlefish)	3.7	3.7	4.9	1.2	1.2	Gallons	3.25	0.15	5	15	0.06
Cordova	88	Eulachon (hooligan, candlefish)	16.1	15.0	21.7	10.2	8.5	Gallons	3.25	2.17	581	1889	0.78
Cordova	91	Eulachon (hooligan, candlefish)	16.8	16.8	22.8	7.9	8.9	Gallons	3.25	4.93	1189	3865	1.69
Cordova	92	Eulachon (hooligan, candlefish)	9.8	9.8	19.5	12.2	12.2	Gallons	3.25	1.59	382	1243	0.46
Cordova	93	Eulachon (hooligan, candlefish)	6.7	5.8	12.5	5.8	8.7	Gallons	3.25	0.53	155	503	0.17
Hope	90	Eulachon (hooligan, candlefish)	4.8	4.8	9.7	3.1	4.0	Gallons	3.25	0.18	3	11	0.07
Kenai	91	Eulachon (hooligan, candlefish)	8.0	8.0	8.0	5.0	0.0	Gallons	3.25	1.58	1040	3381	0.50
Kenai	92	Eulachon (hooligan, candlefish)	2.7	2.7	5.4	5.4	2.7	Gallons	3.25	0.57	375	1220	0.18
Kenai	93	Eulachon (hooligan, candlefish)	2.0	1.0	2.0	1.0	2.0	Gallons	3.25	0.13	90	293	0.05
Nanwalek	87	Eulachon (hooligan, candlefish)	3.0	3.0	9.1	6.1	6.1	5 Gal Bckt	16.25	4.92	12	197	1.30
Nanwalek	90	Eulachon (hooligan, candlefish)	11.4	11.4	37.1	11.4	31.4	Gallons	3.25	1.46	18	60	0.33
Nanwalek	91	Eulachon (hooligan, candlefish)	3.4	3.4	24.1	13.8	20.7	Gallons	3.25	6.16	78	253	1.57
Nanwalek	92	Eulachon (hooligan, candlefish)	6.3	6.3	34.4	9.4	31.3	Gallons	3.25	4.06	51	167	0.98
Nanwalek	93	Eulachon (hooligan, candlefish)	3.0	3.0	24.2	12.1	21.2	Gallons	3.25	0.49	6	18	0.13
Parks Highway	85	Eulachon (hooligan, candlefish)	3.3	3.3	10.0	0.0	6.7	Individual	0.25	0.25	131	33	0.09
Port Graham	89	Eulachon (hooligan, candlefish)	6.3	6.3	25.0	4.2	22.9	Gallons	3.25	1.22	23	74	0.46
Port Graham	90	Eulachon (hooligan, candlefish)	4.3	4.3	41.3	8.7	39.1	Gallons	3.25	0.55	9	30	0.18
Port Graham	91	Eulachon (hooligan, candlefish)	6.1	4.1	53.1	20.4	49.0	Gallons	3.25	1.91	34	111	0.69
Port Graham	92	Eulachon (hooligan, candlefish)	2.1	2.1	62.5	16.7	60.4	Gallons	3.25	0.02	0	1	0.01
Seldovia	91	Eulachon (hooligan, candlefish)	1.5	1.5	15.2	3.0	15.2	Gallons	3.25	0.30	11	35	0.10
Seldovia	93	Eulachon (hooligan, candlefish)	1.5	1.5	7.7	3.1	6.2	Gallons	3.25	0.50	24	77	0.18
Talkeetna	85	Eulachon (hooligan, candlefish)	2.9	2.9	4.4	1.5	1.5	Individual	0.25	0.18	157	39	0.06
Tonsina	87	Eulachon (hooligan, candlefish)	1.4	1.4	1.4	0.0	0.0	Individual	0.25	0.17	66	16	0.05

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADFG, Division of Subsistence, Community Profile Database, September 1996

Community	Yr	Resource	Percent of Households Participating: Trying	Harvesting	Using	Giving	Receiving	units	Conversion Factor convfact	Mean lbs per Household avglbhrv	Estimated Total for the Community: Numbers xtotnum	Pounds xtotlbs	Pounds Per Capita percap
Tyonek	83	Eulachon (hooligan, candlefish)		25.0		6.3	22.5	6 Gal Bckt	30	9.75	26	780	2.86
Valdez	92	Eulachon (hooligan, candlefish)	2.0	2.0	4.0	2.0	2.0	Gallons	3.25	0.85	327	1062	0.28
Valdez	93	Eulachon (hooligan, candlefish)	2.9	2.9	2.9	2.9	2.9	Gallons	3.25	0.93	359	1167	0.31
Whittier	90	Eulachon (hooligan, candlefish)	2.3	2.3	2.3	2.3	0.0	Gallons	3.25	0.41	13	42	0.15
SOUTHEAST													
Edna Bay	87	Eulachon (hooligan, candlefish)		5.0	10.0	0.0	5.0	Pounds	1	0.12	3	3	0.04
Elfin Cove	87	Eulachon (hooligan, candlefish)		23.1	23.1	7.7	7.7	Pounds	1	4.06	77	77	1.29
Haines	87	Eulachon (hooligan, candlefish)		13.7	26.3	8.1	12.5	Pounds	1	7.86	4782	4782	2.95
Hoonah	85	Eulachon (hooligan, candlefish)	4.2	4.2	8.5			Pounds	1	0.70	197	196	0.22
Hyder	87	Eulachon (hooligan, candlefish)		3.0	3.0	0.0	3.0	Pounds	1	2.42	95	94	1.21
Kake	87	Eulachon (hooligan, candlefish)		2.9	13.7	2.9	10.8	Pounds	1	9.12	1757	1757	2.74
Klawock	84	Eulachon (hooligan, candlefish)	5.6	5.6	19.4	2.8	11.1	Pounds	1	8.00	1048	1048	2.22
Klawock	87	Eulachon (hooligan, candlefish)		1.1	13.9	0.0	12.7	Pounds	1	0.54	120	120	0.15
Klukwan	87	Eulachon (hooligan, candlefish)		55.4	86.3	38.6	50.3	Pounds	1	180.90	7104	7104	53.26
Pelican	87	Eulachon (hooligan, candlefish)		10.3	24.3	9.1	19.1	Pounds	1	12.62	1039	1039	4.34
Petersburg	87	Eulachon (hooligan, candlefish)		1.1	4.2	1.1	3.1	Pounds	1	0.09	99	99	0.03
Sitka	87	Eulachon (hooligan, candlefish)		2.4	2.4	0.0	0.0	Pounds	1	0.46	1319	1321	0.16
Skagway	87	Eulachon (hooligan, candlefish)		5.5	8.1	2.5	3.1	Pounds	1	0.93	189	189	0.32
Tenakee Springs	84	Eulachon (hooligan, candlefish)	4.2	4.2	4.2	0.0	0.0	Pounds	1	0.63	29	30	0.32
Wrangell	87	Eulachon (hooligan, candlefish)		7.7	36.2	9.2	31.7	Pounds	1	17.49	17711	17711	6.24
Yakutat	84	Eulachon (hooligan, candlefish)	28.0	28.0	64.0	22.0	36.0	Pounds	1	28.80	5213	5213	9.60
Yakutat	87	Eulachon (hooligan, candlefish)		43.5	73.8	23.8	50.2	Pounds	1	74.22	12554	12554	21.32
SOUTHWEST													
Chignik Bay	89	Eulachon (hooligan, candlefish)	5.7	5.7	22.9	0.0	17.1	Gallons	3.25	1.30	16	51	0.42
Ivanof Bay	89	Eulachon (hooligan, candlefish)	42.9	42.9	100.0	42.9	100.0	Gallons	3.25	21.36	46	149	4.66
Kodiak City	92	Eulachon (hooligan, candlefish)	1.0	1.0	3.0	1.0	2.0	Gallons	3.25	0.59	316	1026	0.22
Perryville	84	Eulachon (hooligan, candlefish)	80.0	80.0	90.0	75.0	35.0	Individual	0.13	46.28	9612	1250	10.89
Perryville	89	Eulachon (hooligan, candlefish)	55.6	55.6	77.8	40.7	40.7	Gallons	3.25	37.69	359	1168	10.07
ARCTIC													
Barrow	87	Rainbow Smelt						Individual	0.2	0.02	97	19	0.01
Barrow	89	Rainbow Smelt		2.0				Individual	0.12	0.19	1480	178	0.06
Kivalina	92	Rainbow Smelt	4.8	4.8	6.5	1.6	1.6	Individual	0.14	0.30	155	22	0.06
Nuiqsut	93	Rainbow Smelt	12.9	12.9	33.9	19.4	25.8	Individual	0.14	0.47	304	42	0.12
Wainwright	88	Rainbow Smelt		54.0				Individual	0.12	19.54	20194	2423	4.80
Wainwright	89	Rainbow Smelt		53.0				Individual	0.12	54.54	54083	6490	13.87
SOUTHWEST													
Aleknagik	89	Rainbow Smelt	23.7	18.4	60.5	28.9	47.4	Gallons	6	14.92	104	627	4.40
Chignik Bay	89	Rainbow Smelt	2.9	2.9	11.4	0.0	8.6	Gallons	3.75	0.11	1	4	0.03

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADF&G, Division of Subsistence, Community Profile Database, September 1996

Community	Yr	Resource	Percent of Households Participating: Trying	Harvesting	Using	Giving	Receiving	units	Conversion Factor convfact	Mean lbs per Household avglbhv	Estimated Total for the Community: Numbers xtotnum	Pounds xtotlbs	Pounds Per Capita percap
Chignik Lake	84	Rainbow Smelt	17.4	8.7	34.8	17.4	30.4	Individual	0.13	6.38	1522	198	1.27
Clark's Point	89	Rainbow Smelt	76.5	76.5	94.1	70.6	52.9	Gallons	6	62.82	178	1068	19.07
ARCTIC													
Deering	94	Unknown Smelt	16.2	13.5	45.9	16.2	40.5	Individual	0.14	0.07	21	3	0.02
Kotzebue	91	Unknown Smelt	32.0	32.0	44.0	9.0	17.0	Gallons	3.75	3.80	819	3072	0.84
Noatak	94	Unknown Smelt	2.9	2.9	5.9	1.5	4.4	Individual	0.14	0.13	78	11	0.03
SOUTHCENTRAL													
Chenega Bay	84	Unknown Smelt	18.8	18.8	37.5	12.5	37.5	Gallons	3.25	1.57	8	25	0.44
Chenega Bay	85	Unknown Smelt	31.3	31.3	37.5	12.5	18.8	Individual	3.5	3.94	19	67	1.11
Cordova	91	Unknown Smelt	5.0	5.0	7.9	2.0	5.9	Gallons	3.25	0.47	113	368	0.16
Cordova	92	Unknown Smelt	9.8	9.8	24.4	14.6	19.5	Gallons	3.25	1.00	242	786	0.29
Cordova	93	Unknown Smelt	8.7	8.7	21.2	7.7	15.4	Gallons	3.25	1.38	400	1301	0.44
Tatitlek	89	Unknown Smelt	4.5	4.5	9.1	4.5	4.5	Gallons	3.5	1.59	13	45	0.41
WESTERN													
Tununak	86	Unknown Smelt	24.2	21.2	90.9	15.2	39.4	5 Gal Bckt	25	9.09	23	582	1.78
ARCTIC													
Barrow	87	Smelt						Individual		0.87	4057	811	0.27
Barrow	89	Smelt		2.0				Individual		0.26	1825	247	0.08
Brevig Mission	89	Smelt	6.7	6.7	6.7	6.7	0.0	Individual	0.14	4.66	1430	200	1.09
Deering	94	Smelt	16.2	13.5	45.9	16.2	40.5	Individual	0.14	0.07	21	3	0.02
Golovin	89	Smelt	3.0	3.0	3.0	0.0	0.0	Individual	0.14	0.42	124	17	0.10
Kivalina	83	Smelt						Pounds	1	0.30	14	14	0.05
Kivalina	92	Smelt	4.8	4.8	6.5	1.6	1.6	Individual	0.14	0.30	155	22	0.06
Kotzebue	86	Smelt	17.5	17.5	24.3	4.7	6.8	Individual	0.14	3.09	16885	2364	0.88
Kotzebue	91	Smelt	32.0	32.0	44.0	9.0	17.0	Gallons	3.75	3.80	819	3072	0.84
Noatak	94	Smelt	2.9	2.9	5.9	1.5	4.4	Individual	0.14	0.13	78	11	0.03
Nuiqsut	85	Smelt	15.0	15.0	30.0	7.5	22.5	Individual	0.05	2.09	3173	159	0.40
Nuiqsut	93	Smelt	12.9	12.9	33.9	19.4	25.8	Individual	0.14	0.47	304	42	0.12
Point Lay	87	Smelt	6.8	6.8	13.6	3.4	10.2	Individual	0.14	0.86	265	37	0.31
Shishmaref	89	Smelt	19.0	19.0	33.3	19.0	19.0	Individual	0.14	6.03	5085	712	1.51
Wainwright	88	Smelt		54.0				Individual	0.12	19.54	20194	2423	4.80
Wainwright	89	Smelt		53.0				Individual	0.12	54.54	54083	6490	13.87
SOUTHCENTRAL													
Chase	86	Smelt	5.9	5.9	5.9	5.9	0.0	Gallons	3.2	0.94	9	28	0.35
Chenega Bay	84	Smelt	18.8	18.8	37.5	12.5	37.5	Gallons	3.25	2.20	11	35	0.61
Chenega Bay	85	Smelt	31.3	31.3	37.5	12.5	18.8	Individual	3.5	3.94	19	67	1.11
Chickaloon	82	Smelt		5.6	5.6			Individual	0.25	1.04	125	31	0.44
Chistochina	87	Smelt	3.6	3.6	3.6	0.0	3.6	Individual	0.25	1.43	166	41	0.52

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADF&G, Division of Subsistence, Community Profile Database, September 1996

Community	Yr	Resource	Percent of Households Participating: Trying	Harvesting	Using	Giving	Receiving	units	Conversion Factor convfact	Mean lbs per Household avglbhv	Estimated Total for the Community: Numbers xtotnum	Pounds xtotlbs	Pounds Per Capita percap
Cooper Landing	90	Smelt	3.7	3.7	4.9	1.2	1.2	Gallons	3.25	0.15	5	15	0.06
Cordova	85	Smelt	18.9	17.0	29.1	12.6	15.5	Gallons	3.5	3.67	894	3130	1.38
Cordova	88	Smelt	16.1	15.0	21.7	10.2	8.5	Gallons	3.25	2.17	581	1889	0.78
Cordova	91	Smelt	16.8	16.8	24.8	7.9	13.9	Gallons	3.25	5.40	1303	4234	1.85
Cordova	92	Smelt	17.1	17.1	36.6	22.0	24.4	Gallons	3.25	2.59	624	2029	0.76
Cordova	93	Smelt	13.5	12.5	25.0	12.5	19.2	Gallons	3.25	1.91	555	1803	0.61
Homer	82	Smelt		2.9	5.2		1.7	Individual	0.25	1.06	7649	1906	0.34
Hope	90	Smelt	4.8	4.8	9.7	3.1	4.8	Gallons	3.25	0.18	3	11	0.07
Kenai	82	Smelt		2.6	6.7		2.6	Individual	0.25	1.74	12892	3226	0.53
Kenai	91	Smelt	8.0	8.0	9.0	6.0	1.0	Gallons	3.25	1.58	1040	3381	0.50
Kenai	92	Smelt	2.7	2.7	5.4	5.4	2.7	Gallons	3.25	0.57	375	1220	0.18
Kenai	93	Smelt	2.0	1.0	3.0	1.0	3.0	Pounds	1	0.13	293	293	0.05
Nanwalek	87	Smelt	3.0	3.0	9.1	6.1	6.1	5 Gal Bckt	16.25	4.92	12	197	1.30
Nanwalek	90	Smelt	11.4	11.4	37.1	11.4	31.4	Gallons	3.25	1.46	18	60	0.33
Nanwalek	91	Smelt	3.4	3.4	24.1	13.8	20.7	Gallons	3.25	6.16	78	253	1.57
Nanwalek	92	Smelt	6.3	6.3	34.4	9.4	31.3	Gallons	3.25	4.06	51	167	0.98
Nanwalek	93	Smelt	3.0	3.0	24.2	12.1	21.2	Pounds	1	0.49	18	18	0.13
Ninilchik	82	Smelt		12.5	20.8		8.3	Individual	0.25	7.29	6329	1582	2.43
Parks Highway	85	Smelt	3.3	3.3	10.0	0.0	6.7	Individual	0.25	0.25	131	33	0.09
Port Graham	89	Smelt	6.3	6.3	25.0	4.2	22.9	Gallons	3.25	1.22	23	74	0.46
Port Graham	90	Smelt	4.3	4.3	41.3	8.7	39.1	Gallons	3.25	0.55	9	30	0.18
Port Graham	91	Smelt	6.1	4.1	53.1	20.4	49.0	Gallons	3.25	1.91	34	111	0.69
Port Graham	92	Smelt	2.1	2.1	62.5	16.7	60.4	Gallons	3.25	0.02	0	1	0.01
Seldovia	82	Smelt		2.9	14.3		11.4	Individual	0.25	2.86	1966	492	0.82
Seldovia	91	Smelt	1.5	1.5	15.2	3.0	15.2	Gallons	3.25	0.30	11	35	0.10
Seldovia	93	Smelt	1.5	1.5	7.7	3.1	6.2	Pounds	1	0.50	77	77	0.18
Talkeetna	85	Smelt	2.9	2.9	4.4	1.5	1.5	Individual	0.25	0.18	157	39	0.06
Tatitlek	88	Smelt	9.5	9.5	28.6	9.5	23.8	Gallons	3.5	1.00	8	28	0.28
Tatitlek	89	Smelt	4.5	4.5	9.1	4.5	4.5	Gallons	3.5	1.59	13	45	0.41
Tonsina	87	Smelt	1.4	1.4	1.4	0.0	0.0	Individual	0.25	0.17	66	16	0.05
Tyonek	83	Smelt		25.0		6.3	22.5	6 Gal Bckt	30	9.75	26	780	2.86
Valdez	92	Smelt	2.0	2.0	4.0	2.0	2.0	Gallons	3.25	0.85	327	1062	0.28
Valdez	93	Smelt	2.9	2.9	2.9	2.9	2.9	Gallons	3.25	0.93	359	1167	0.31
Whittier	90	Smelt	2.3	2.3	2.3	2.3	0.0	Gallons	3.25	0.41	13	42	0.15
SOUTHEAST													
Edna Bay	87	Smelt		5.0	10.0	0.0	5.0	Pounds	1	0.12	3	3	0.04
Elfin Cove	87	Smelt		23.1	23.1	7.7	7.7	Pounds	1	4.06	77	77	1.29
Haines	83	Smelt	24.5	23.1	29.3	6.8	6.1	Pounds	1	18.17	11992	11992	6.28

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADFG, Division of Subsistence, Community Profile Database, September 1996

			Percent of Households Participating						Conver-sion Factor	Mean lbs per Household	Estimated Total for the Community		Pounds Per Capita
Community	Yr	Resource	Trying	Harvesting	Using	Giving	Receiving	units	convfact	avglbhrv	Numbers xtotnum	Pounds xtotlbs	porcap
Haines	87	Smelt		13.7	26.3	8.1	12.5	Pounds	1	7.86	4782	4782	2.95
Hoonah	85	Smelt	4.2	4.2	8.5			Pounds	1	0.70	197	196	0.22
Hyder	87	Smelt		3.0	3.0	0.0	3.0	Pounds	1	2.42	95	94	1.21
Kake	87	Smelt		2.9	13.7	2.9	10.8	Pounds	1	9.12	1757	1757	2.74
Klawock	84	Smelt	5.6	5.6		2.8		Pounds	1	8.00	1048	1048	2.22
Klawock	87	Smelt		1.1	13.9	0.0	12.7	Pounds	1	0.54	120	120	0.15
Klukwan	83	Smelt	48.5	42.4	63.6	12.1	24.2	Pounds	1	29.24	1199	1199	7.78
Klukwan	87	Smelt		55.4	86.3	38.6	50.3	Pounds	1	180.90	7104	7104	53.26
Pelican	87	Smelt		10.3	24.3	9.1	19.1	Pounds	1	12.62	1039	1039	4.34
Petersburg	87	Smelt		1.1	4.2	1.1	3.1	Pounds	1	0.09	99	99	0.03
Sitka	87	Smelt		2.4	2.4	0.0	0.0	Pounds	1	0.46	1319	1321	0.16
Skagway	87	Smelt		5.5	8.1	2.5	3.1	Pounds	1	0.93	189	189	0.32
Tenakee Springs	84	Smelt	4.2	4.2	4.2	0.0	0.0	Pounds	1	0.63	29	30	0.32
Wrangell	87	Smelt		7.7	36.2	9.2	31.7	Pounds	1	17.49	17711	17711	6.24
Yakutat	84	Smelt						Pounds	1	47.16	8536	8536	15.72
Yakutat	87	Smelt		43.5	73.8	23.8	50.2	Pounds	1	74.22	12554	12554	21.32
SOUTHWEST													
Chignik Bay	89	Smelt	8.6	8.6	31.4	0.0	22.9	Gallons		1.41	17	55	0.46
Chignik Lake	84	Smelt	17.4	8.7	39.1	17.4	34.8	Individual	0.13	6.38	1522	198	1.27
Clark's Point	89	Smelt	76.5	76.5	94.1	70.6	52.9	Gallons	6	62.82	178	1068	19.07
Dillingham	84	Smelt	22.2	21.6	37.3	12.4	22.2	5 Gal Bckt	30	11.96	275	8264	4.05
Egegik	84	Smelt	44.0	44.0	52.0	36.0	16.0	Individual	0.13	12.42	4014	522	5.36
Ekwok	87	Smelt	6.9	6.9	51.7	10.3	48.3	Gallons	6	0.83	4	27	0.25
Igiugig	92	Smelt	10.0	10.0	40.0	10.0	40.0	Gallons	6	6.00	12	72	1.54
Ivanof Bay	89	Smelt	42.9	42.9	100 0	42.9	100.0	Gallons		21.36	46	149	4.66
King Salmon	83	Smelt		34.9				Individual	0.25	11.93	5822	1455	3.94
Kodiak City	92	Smelt	1.0	1.0	3.0	1.0	2.0	Gallons	3.25	0.59	316	1026	0.22
Kodiak City	93	Smelt	1.0	0.0	1.9	1.0	1.9			0.23	142	463	0.08
Kokhanok	92	Smelt	13.9	13.9	25.0	13.9	11.1	Gallons	6	37.81	246	1474	8.50
Koliganek	87	Smelt	7.1	7.1	38.1	10.0	33.3	Gallons	6	2.57	21	123	0.66
Levelock	88	Smelt	51.9	51.9	77.8	48.1	70.4	Gallons	6	17.28	95	570	5.24
Levelock	92	Smelt	66.7	66.7	73.3	63.3	43.3	Gallons	6	38.66	251	1508	13.65
Manokotak	85	Smelt	50.0	50.0	83.3	33.3	51.9	5 Gal Bckt	30	72.08	142	4253	13.80
Manokotak	94	Smelt	60.4	58.5	88.7	35.9	71.7	Gallons	6	29.11	374	2241	5.07
Naknek	83	Smelt		53.8				Individual	0.25	29.13	14334	3583	9.35
New Stuyahok	87	Smelt	7.5	5.0	60.0	12.8	57.5	Gallons	6	1.35	17	100	0.28
Perryville	84	Smelt	80.0	80.0	90.0	75.0	35.0	Individual	0.13	46.28	9612	1250	10.89
Perryville	89	Smelt	55.6	55.6	77.8	40.7	40.7	Gallons		37.69	359	1168	10.07

SUBSISTENCE HARVEST OF FORAGE FISH BY COMMUNITY AND YEAR

Source: ADF&G, Division of Subsistence, Community Profile Database, September 1996

Community	Yr	Resource	Percent of Households Participating: Trying	Harvesting	Using	Giving	Receiving	units	Conversion Factor convfact	Mean lbs per Household avglbhrv	Estimated Total for the Community: Numbers xtotnum	Pounds xtotlbs	Pounds Per Capita percap
Pilot Point	87	Smelt	70.6	64.7	76.5	47.1	23.5	Individual	0.25	28.40	2045	511	7.91
Port Heiden	87	Smelt	2.7	2.7	40.6	8.1	45.9	Individual	0.25	0.34	50	13	0.13
Sand Point	92	Smelt	1.0	1.0		0.0		Gallons	6	0.58	20	118	0.19
South Naknek	83	Smelt		85.7				Individual	0.25	35.63	6984	1746	12.68
South Naknek	92	Smelt	60.0	57.1	62.9	31.4	37.1	Gallons	6	32.23	226	1354	10.07
Togiak	94	Smelt	86.0	86.0	96.0	50.0	36.0	Gallons	6	68.59	1818	10906	14.85
Ugashik	87	Smelt	60.0	60.0	60.0	40.0	0.0	Individual	0.25	65.00	1300	325	32.50
WESTERN													
Alakanuk	80	Smelt		42.9				Individual	0.2	23.05	10371	2074	3.48
Kotlik	80	Smelt		14.3				Individual	0.2	30.36	8500	1700	4.52
Kwethluk	86	Smelt	32.1	32.1		19.9	30.0	Individual	0.07	15.28	24900	1712	3.33
Quinhagak	82	Smelt		75.0				Individual	0.2	77.27	37861	7572	15.99
Sheldon Point	80	Smelt		28.6				Individual	0.2	4.86	559	112	0.81
Tununak	86	Smelt						5 Gal Bckt	25	167.42	429	10715	32.69