4.4 Cumulative Effects

To meet the requirements of NEPA, an EIS must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) guidelines for evaluating cumulative effects state that "...the most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time" (CEQ 1997).

The CEQ regulations for implementing NEPA define cumulative effects as follows:

> "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Cumulative effects are linked to incremental actions or policy changes that individually may have small outcomes, but that, in the aggregate and combined with other factors, can result in greater environmental effects on the affected environment. At the same time, the CEQ guidelines recognize that it is not practical to analyze the cumulative effects of an action on the universe. Analyses should focus on those effects that are truly meaningful.

This section analyzes the potential cumulative effects of the three actions considered in this EIS: describing and identifying EFH, establishing an approach to identify HAPCs, and minimizing the effects of fishing on EFH. This evaluation addresses the direct and indirect effects of the alternatives as well as other factors that affect the physical, biological, and socioeconomic components of the BSAI and GOA environment.

4.4.1 Methods and Criteria for Evaluating Cumulative Effects

The intent of the cumulative effects analysis is to capture the total effects of many actions over time that would be missed by evaluating each action individually. A cumulative effects analysis describes the additive and synergistic results of the actions proposed in this EIS as they interact with factors external to those proposed actions.

The methods for cumulative effects analysis in this EIS consist of the following steps:

- Identify past and present characteristics and trends within the affected environment that are relevant to assessing the cumulative effects of the alternatives.
- Identify reasonably foreseeable external factors such as other fisheries, other types of human activities, and natural phenomena that could have additive or synergistic effects.
- Identify reasonably foreseeable future management actions that are likely to be relevant when assessing the cumulative effects of the alternatives.
- Describe the potential direct and indirect effects of each of the alternatives.
- Evaluate the relative importance of potential cumulative effects using the same criteria established for the analysis of direct and indirect effects and summarize the relative contribution of the alternatives to cumulative effects.

The criteria used to evaluate the level of impact in the cumulative effects analysis are the same criteria identified in Sections 4.1 (Effects of Describing and Identifying EFH), 4.2 (Effects of Identifying

HAPCs), and 4.3 (Effects of Minimizing the Adverse Effects of Fishing on EFH). Table 4.4-1 summarizes the evaluations made in those sections of the EIS.

4.4.2 Previous Actions and Other External Factors Potentially Contributing to Cumulative Effects

4.4.2.1 Previous Actions Potentially Contributing to Cumulative Effects

Each section of this analysis begins with a brief summary of past and present trends contributing to the existing condition of the criterion under discussion. Although not explicitly spelled out in those discussions, numerous previous actions to protect fish habitat have contributed to those existing conditions. For example, actions taken to protect habitat from the potential negative effects of groundfish fisheries include gear restrictions, time and area closures, and harvest restrictions that have been imposed in the past. Closure of areas to certain gear types is among the most common actions taken and has, in effect, created marine protected areas. Other measures, such as effort limitation and fishery rationalization, which were originally adopted for another purpose, also benefit fish habitat.

Allowable gear definitions (50 CFR 600.725) have been implemented primarily as a way to reduce bycatch, but have also served to reduce adverse fishing effects on EFH. Restrictions have been imposed on scallop dredge sizes, groundfish and crab pot size and gear specifications, the use of bottom trawl gear for BSAI pollock, as well as an absolute prohibition on use of gillnets, explosives, chemicals, and other harvest practices that could have adverse effects on EFH. More detail on these restrictions is available in Chapter 2.0, Section 2.2.2.1, of this EIS. The ADF&G website (http://www.cf.adfg.state.ak.us) provides more information concerning current restrictions on salmon fishing; however, since salmon fishing gear does not contact the sea floor, these restrictions are not discussed here.

Marine protected areas are defined as follows:

> "Geographically defined areas designated with year round protection to enhance the management of marine resources (NRC 2001). This definition includes areas where extraction of certain fishery resources is prohibited, and/or areas where specific gear types are prohibited. NMFS recognizes the definition of a Marine Protected Area as defined by Executive Order 13158: 'Any area of the marine environment reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein' (NRC Meeting Notes, May 5, 2003)."

As noted by the NRC, "Closed areas effectively protect biogenic habitats such as corals, bryozoans, hydroids, sponges, and seagrass beds, that are damaged by even minimal fishing" (NRC 2002). Marine protected areas in the BSAI and GOA include the Pribilof Island Habitat Conservation Area, Bristol Bay Trawl Closure Area, Red King Crab Savings Area, Kodiak Trawl Closure Area, Southeast Trawl Prohibition Area, Cook Inlet Trawl Closure Area, Sitka Pinnacles Marine Reserve, Walrus Islands Closure Areas, Scallop Dredge Closure Areas, and State Waters Trawl and Dredge Closure Areas. Other restricted areas include the Steller Sea Lion Closure Areas and the Seasonal Groundfish Closure Areas. More detail on these areas is available in Section 2.2.2.2 of this EIS.

Harvest limits are applied to "taking" of species that provide structural habitat for other species assemblages or communities, as well as limits on the take of prey species. In Alaska, this includes tightly controlled catch limits for target species, which are based on conservative catch quotas set at or below acceptable harvest levels from a stock perspective. Optimum yield (OY) limits are also implemented to account for uncertainties in stock estimation and fishery management techniques. Forage fish prohibitions prevent any direct fishery on capelin, smelt, and many other species that are prey for groundfish, seabirds, and marine mammals. More detail on these measures is available in Section 2.2.2.3 of this EIS.

Effort reduction and limitation include measures for the groundfish, crab, and scallop fisheries to control fishing effort and prevent overfishing. Limiting fishing efforts has indirect habitat benefits. Effort reduction measures include a groundfish and crab vessel moratorium, a scallop vessel moratorium, groundfish and crab license limitation, scallop license limitation, and crab pot limits in the EBS.

Fishing impacts on habitat are also associated with the temporal and spatial distribution of effort. These aspects of BSAI and GOA fisheries management are reflected in seasonal and management subarea apportionments of TAC, PSC cap releases, AFA, and Steller sea lion management provisions that require geographic and temporal dispersion of effort, among others.

Fishery rationalization programs can reduce excess fishing capital and, with it, effort; allow fisheries to occur in a more orderly and efficient manner; and create economic incentives for fishing to occur in areas where catch rates are highest while bycatch and gear loss are lowest. Current rationalization efforts include halibut and sablefish individual fishing quotas, groundfish and crab community development quotas, and the AFA.

Other regulations that protect fish habitat include the 1999 EBS and AI prohibition on bottom trawling for pollock, the roe stripping prohibition from 1991, and the 1998 EFH and HAPC identifications. EFH description and identification was required under the Sustainable Fisheries Act of 1996, and this EIS is part of that effort. In June 1998, HAPCs were adopted as part of the EFH amendments. The identification of HAPCs is based on the following:

- The importance of ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether, and to what extent, development activities are, or will be, stressing the habitat type
- The rarity of the habitat type

HAPC types identified by the Council include the following:

- Areas with living substrates in shallow waters (e.g., eelgrass, kelp, and mussel beds)
- Areas with living substrates in deep waters (e.g., sponges, corals, and anemones)
- Freshwater areas used by anadromous fish (e.g., migration, spawning, and rearing areas)

The Council and the Alaska Board of Fisheries are working together throughout the HAPC identification process and the process to designate marine protected areas. The process of HAPC identification is ongoing and part of this EIS process.

4.4.2.2 External Factors

For the purposes of this EIS, the definition of external factors contributing to cumulative effects includes both human controlled events such as other fisheries, non-fishing activities, and pollution, as well as natural events such as short- and long-term climate change. The following external factors were considered with respect to habitat, target species, other fisheries, protected species, ecosystems, and biodiversity:

Historical Fisheries (Foreign, Joint Venture (JV), and Domestic): Other fisheries considered in this cumulative effects analysis include foreign fisheries, both today and in the past, and past JV fisheries. In addition to the brief summary provided below, Section 2.7.2 of the draft programmatic groundfish SEIS provides a detailed discussion of the evolution of the fisheries management plans in use today and includes descriptions of the historical foreign and JV fisheries (NMFS 2001a). Figure 2.7-6 in the draft programmatic groundfish SEIS shows changes in the balance of domestic, JV, and foreign harvests over time.

A very robust foreign groundfish fishery operated off Alaska long before the Magnuson-Stevens Act was passed in April 1976. The United States had little ability to restrict the large offshore Japanese and Soviet operations (among others) during their initial build-up. United States/foreign bilateral agreements were the main mechanism for managing the foreign fisheries. By 1973, foreign operations had spread from Alaska south to the Pacific Coast off Washington and Oregon, leaving very depressed stocks in their wake off the coast of Alaska. Catches of yellowfin sole in the EBS, for example, had fallen sharply after very large removals by Japan and the Soviet Union. Pacific ocean perch stocks in the GOA were overfished. Pollock catches were increasing rapidly and were thought likely to follow the same pattern as the perch and sole. When the Magnuson-Stevens Act was passed in 1976, groundfish fisheries were, for all practical purposes, totally foreign. Most regulatory measures were designed to lessen foreign fleets' impacts on the domestic fisheries for salmon, halibut, and crab. United States commercial fisheries were limited mainly to shrimp in the GOA, red king crab in the GOA and EBS, herring in the coastal waters, salmon, and halibut. Very few groundfish, other than sablefish and small amounts of Pacific cod off Southeast Alaska, were taken by the domestic fleet.

By the end of 1985, only minor foreign fisheries, directed on pollock and Pacific cod, were being allowed in the GOA. Foreign harvesting continued in the EBS. Even there, foreign trawling had ended within 20 nautical miles (nm) of the AI, and foreign longlining for cod was restricted to north of 55° N and west of 170° W, depending on ice conditions. Foreign harvests dropped to less than 1 million mt in 1985. In contrast, United States/foreign JVs had grown rapidly through the early 1980s. They harvested about 880,000 mt in 1985, using more than 100 United States trawlers working within some 28 different company arrangements with such countries as Japan, South Korea, Poland, the Soviet Union, Portugal, and Iceland. Completely domestic annual processing (DAP) reached 105,000 mt in 1985, mostly by trawler catcher/processors.

During the five years from 1986 to 1991, the groundfish fisheries became totally domestic. The last years of foreign-directed fishing in the GOA and BSAI were 1986 and 1987, respectively. Foreign JV peaked in 1987, and their last years of operation in the GOA and the EBS were 1988 and 1991, respectively.

The Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (Convention) was initiated due to concern over the unregulated pollock fishery occurring in the central BS ("Donut Hole") during the mid- to-late 1980s. As part of the UN Stocks Agreement, the "Donut Hole" Agreement among Japan, the People's Republic of China, the Republic of Korea, the Republic of Poland, the Russian Federation, and the United States provides a management structure for the pollock fishery in the central BS. Fishing in the donut hole for pollock has been closed since 1994 (Pautzke 1997).

Current Foreign Fisheries (outside the Exclusive Economic Zone): The transboundary nature of pollock in the EBS increases the stock's vulnerability to overfishing. Currently, the condition of pollock within the western BS is difficult to determine due to differences in survey approaches. If significant harvest of juvenile pollock that will recruit to the EBS population occurs in the Russian Exclusive Economic Zone

(EEZ), there could be a reduction in the exploitable biomass and yield in the United States EEZ. Management decisions based on poor knowledge of the pollock stock could be disastrous for the United States and Russian fisheries C. Pautzke, per. comm.).

High Seas Drift Net Fisheries: The world community does not consider high seas driftnetting a sustainable fishery. High bycatch of seabirds and marine mammals, discards, and spoiled catch were associated with high seas driftnetting. United Nations General Assembly Resolution 46/214 banned large-scale high seas driftnet fishing beginning in 1993. Nations of the world have, for the most part, complied with this non-binding resolution. With the exception of a few rogue vessels, this type of fishing is no longer conducted. The Coast Guard and Canadian Maritime Forces patrol the North Pacific to detect any possible illegal driftnet activity.

State of Alaska Fisheries: A summary of the scope of State of Alaska managed fisheries in the EBS and GOA is provided in Chapter 3 of this EIS. Although not managed by the State, the International Pacific Halibut Commission (IPHC) fishery is included in the analysis.

Native Subsistence Fisheries and Harvests: These fisheries have traditionally focused on nearshore species such as salmon, herring, and shellfish (molluscan and crustacean), as well as a few demersal or groundfish species such as cod, halibut, and rockfish. These subsistence fisheries, which have high value for local residents, account for small amounts of fish relative to the commercial fisheries.

Non-fishing Activities: Non-fishing activities with the potential to affect EFH include mining, dredging, impoundment, discharge, water diversions, and thermal additions to water that may affect water quality, and hence, EFH. These activities are primarily land-based or occur near shore, so are most likely to potentially affect EFH for anadromous salmon in freshwater and nearshore habitat used by many target species.

Other Anthropogenic Effects: Pollution was given consideration as an external factor that may affect fish habitat. Oil and gas leasing activities on the outer continental shelf of the GOA and BSAI were considered but are not incorporated into the analysis because such leasing is unlikely in the reasonably foreseeable future. Similarly, onshore development in the Bristol Bay area, in connection with the regional Native corporations, has reportedly been under discussion ®. McConnaughey per. comm. 2003). However, insufficient information is currently available to make any assessment of (1) the likelihood of such development, (2) the timing of such development, and, least of all, (3) the implications of such development for EFH.

Climate Effects: Atmospheric-forced sea surface temperature impacts include two principal modes of remotely forced sea surface temperature anomalies: shorter term El Niño/southern oscillation (ENSO) events and longer term Pacific decadal oscillations (PDO) (Mantua et al. 1997). These anomalies and their associated environmental changes are discussed in detail in Section 3.1.9 of the draft programmatic groundfish SEIS (NMFS 2001a).

In general, ENSO events typically occur every 4 to 7 years and last 6 to 18 months. Signatures of ENSO events are most evident in the tropics, but extend up the west coast of North America. ENSO impacts to Alaska climate are variable, depending on interactions with other factors that are operating (such as whether the PDO is in a warm or cool cycle). Further, the modest effects that ENSO has on Alaska are most evident in western and interior Alaska, and less so in the GOA. Nevertheless, the very strong 1997 to 1998 ENSO event significantly changed fish stock distribution off the west coast of North America, including the GOA.

In contrast to ENSO, PDOs last 20 to 30 years, alternating between cool and warm regimes. Cool regimes occurred from 1890 to 1924 and again from 1947 to 1976, while warm regimes prevailed from 1925 to 1946 and 1977 to at least the mid-1990s. It is as yet unclear whether the PDO has entered into a new cool cycle.

Current evidence suggests that PDO events impact salmon production. During warm cycles, Alaska populations of salmon benefit from higher rainfall and subsequent higher streamflow (Hare et al. 1999). Higher sea surface temperatures in the GOA and BSAI during warm PDO events may also increase oceanic productivity (e.g., zooplankton, cocolithophorid blooms), although this relationship is still unclear (Francis et al. 1998). Zooplankton do exhibit interannual and interdecadal changes in abundance in Alaska that appear linked to wind and storm intensities (as well as sea surface temperatures). Winds can physically move zooplankton out of the Alaska Gyre into the more southern California current system. These wind cycles, however, have not been firmly linked with PDO events. Regardless, climate change plays a major role in variations in Alaska marine ecosystems.

Life Cycle Effects: Disease was determined not to be significant at the level of population effects for all resource categories (NRC 1996) and, therefore, is not included in this analysis.

Based on the factors noted above, the external factors determined to be most applicable to the EFH cumulative effects analysis are the following:

- Foreign fisheries
- Subsistence harvest
- Non-fishing activities
- Pollution
- Climate effects

4.4.3 Reasonably Foreseeable Future NMFS and Council Actions

In addition to the external factors discussed above, there are reasonably foreseeable future actions within the purview of NMFS and the Council that could contribute to cumulative effects. Elements that were considered for inclusion in this analysis are the research and monitoring programs associated with each of the alternatives to minimize the effects of fishing on EFH, future management actions, and periodic review and revision of EFH information.

4.4.3.1 Research and Monitoring Approaches for Evaluating EFH Fishing Impact Minimization Alternatives

The Council has developed a research and monitoring plan to evaluate the effects of the EFH fishing effects minimization alternatives. An approach is described for each alternative in Appendix K of this EIS. Research and monitoring will be used to determine if the anticipated effects, including direct effects, indirect effects, and cumulative effects, occur once the selected alternative is implemented.

4.4.3.2 Future NMFS and Council Management Actions

Future management includes actions that are reasonably foreseeable and that appear likely to occur, based on current knowledge. The predicted effects of these actions are considered as part of the cumulative effects analysis. Reasonably foreseeable future management actions include the following:

Refinement of Improved Retention and Improved Utilization (Flatfish) Multispecies

In October 2002, the Council voted to delay implementation of 100 percent retention requirements for yellowfin sole and rock sole in the BSAI until June, 2004, (Amendment 75) to allow further development of a more generic groundfish retention standard (GRS), labeled Amendment C. NMFS only partially approved Amendment 75, effectively removing the 100 percent flatfish retention requirements in the BSAI. Amendment C, adopted in June 2003, will allow for a phased-in GRS for the non-AFA catcher-processor sector in the BSAI (the head and gut, or H&G fleet), to begin in 2005.

Further refinement of Amendment A (to establish sector allocations in the BSAI and to establish a fishery cooperative for the H&G fleet) will occur at the October 2003 meeting, with a target implementation of 2006. Amendment D has already been approved by the Council and will still be relevant to the GOA. This Amendment will outline requirements and exemptions for full flatfish retention in the GOA, specifying an annual review process to ascertain whether sectors in the GOA are meeting the 5 percent maximum bycatch threshold to remain exempt from full flatfish retention requirements. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to reduce bycatch and discards of flatfish.

Pribilof Islands Blue King Crab Rebuilding Plan

The Pribilof Island blue king crab (*Paralithodes platypus*) stock has been declared overfished and found to be below minimum stock size threshhold (MSST) with no signs of recovery. This fishery has been closed since 1999, due to declining stock size. EA has been submitted for Secretarial review, which evacuates alternative harvest strategies for rebuilding this stock over a 10-year time frame, as mandated by the MSFCMA. Alternative harvest strategies proposed include higher biomass thresholds for openings and reduced harvest rates. The Council is expected to take final action to recommend approval and implementation of a rebuilding plan to the SOC for consideration at its October 2003 meeting.

GOA Groundfish Rationalization

The Council is considering measures to improve the economic efficiency of the GOA groundfish fisheries through rationalization. "Rationalization" is a term used to describe an allocation of labor and capital that maximizes the net value of production. In the context of fisheries management, the term is often associated with conveyance of quasi-property rights (e.g., ITQs, cooperatives) that permit economic and operational efficiencies to be realized by participants (e.g., reduced capital, improved utilization of catch, increased quality and value, higher net revenues, and increased net benefits to the nation). Recipients of the benefits of fishery rationalization include harvesters, processors, residents of fishing communities, suppliers of goods and services that support fishing activities, and "consumers" of fishery products at every level of the market. In addition, the American public, as the "owner" of the resource, benefits as well through more efficient, less wasteful, better managed utilization of these economic assets.

The Council is considering these new management policies at the request of the GOA groundfish industry to address its increasing concerns about the economic stability of the fisheries. Some of these concerns include changing market opportunities and stock abundance, increasing concern about the long-term economic health of fishing dependent communities, and the limited ability of the fishing industry to respond to environmental concerns under the existing management regime. Management measures that may be implemented as part of the GOA rationalization program include issuance of quota shares, additional allocation of TAC among sectors, allowance for formation of cooperatives, and establishment of a closed class of processors. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide economic and socioeconomic benefits to participants and communities.

Also being considered as part of the GOA rationalization program is implementation of bycatch limits for salmon and crab taken incidentally in trawl fisheries. Management measures that may be considered include closure areas, seasons, and bycatch limits that trigger closure areas.

BSAI Crab Rationalization

In 2001, Congress directed the Council to conduct an analysis of several different approaches to rationalizing the BSAI crab fisheries, some of which are beyond the current authority of the Council, such as processor quotas, cooperatives, and quotas held by communities. The Council conducted a comprehensive analysis of several rationalization alternatives. At its June 2002 meeting, the Council, by unanimous vote, selected a preferred rationalization alternative, a "voluntary three pie cooperative," from the several alternatives considered. Between June 2002 and April 2003, the Council selected several amendments and clarified several provisions, finalizing the identification of the preferred alternative. The Council developed the program to address the particular needs of the BSAI crab fisheries. The primary elements of the program are as follows:

- Harvest shares will be allocated for 100 percent of the TAC.
- Processing shares will be allocated for 90 percent of the TAC.
- Regional share identifications will apply to processor allocations and the corresponding 90 percent of the harvest allocations, distributing landings and processing among specific regions.
- A mandatory binding arbitration program will be used to settle price disputes between harvesters and processors.
- Voluntary harvester cooperatives will be permitted to achieve efficiencies through the coordination of harvest activities and deliveries to processors.
- Community development quota allocations will be increased from 7.5 percent to 10 percent of the TAC.
- A captain's share allocation of 3 percent of the TAC will be reserved for exclusive use by captains and crews.
- A crew loan program will be initiated to assist crewmember entry to the fisheries.
- Comprehensive data collection program and program review will be followed to assess the success of the rationalization program.

Congressional action is necessary to authorize final action on the Council's preferred alternative. Once Congress provides the Council with this authority, the Council will release the EIS for review and take action on this issue. Implementation of the program may require two years following adoption by the Council. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide additional stability and benefits to participants of the BSAI crab fisheries.

Review of Groundfish FMPs/ Draft Programmatic Groundfish SEIS

The Draft Programmatic Groundfish SEIS contains a broad, comprehensive analysis of the environmental consequences (physical, biological, and socioeconomic) of groundfish fisheries management in federal waters off Alaska, and it is intended to provide agency decisionmakers and the public with the information necessary to consider potential changes to the current management approach. The preliminary preferred alternative consists of a management policy and a set of example FMP alternatives that illustrate and serve as proxies for a range of management actions for that management policy.

Management measures that may be implemented as a result of the Draft Programmatic Groundfish SEIS include a variety of measures covering all aspects of fishery management. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide policy direction for future management activities.

HAPC Proposals

On May 20, 2003, NMFS and the plaintiffs in the *AOC v. Daley* litigation filed a joint stipulation to amend the original settlement agreement deadlines for preparation of the EFH EIS. The revised settlement agreement requires that "final regulations implementing HAPC identification, if any, and any associated management measures that result from this process will be promulgated no later than August 13, 2006, and will be supported by appropriate NEPA analysis." The Council had previously indicated that it planned to initiate a HAPC proposal and review process in October 2003. Management measures that may result from the HAPC process include establishment of marine protected areas, marine reserves, gear restrictions, or other measures. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide additional protection to areas and habitats where it appears needed.

Steller Sea Lion Mitigation

In 2001, the Council funded work by the National Academy of Sciences' National Research Council (NRC) to review and summarize the scientific evidence on the decline of Steller sea lions in the North Pacific, and how fisheries have affected or may be affecting these animals. In early 2003, the NRC released its report entitled, "Decline of the Steller Sea Lion in Alaskan Waters: Untangling Food Webs and Fishing Nets," which outlined various hypotheses for the decline and concluded that fishing could have been a factor, but that other factors were more likely affecting the population. The principal recommendation from the Committee was the establishment of experimental closed and open areas near sea lion rookeries; such an experiment would continue for many years. The Council has asked their Steller Sea Lion Mitigation Committee to look at the NRC Committee's report and to determine whether such an experiment can be undertaken in the GOA, preferably with consideration given to reducing some of the economic hardships experienced by fishing communities in this region. Management measures that may result from these recommendations include area closures and seasonal changes. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide some relief to affected communities without impacting Steller sea lions.

4.4.3.3 Review and Revision of EFH Components of FMPs

The Council and NMFS plan to review the EFH provisions of FMPs periodically and revise or amend them as warranted based on available information. FMPs should outline the procedures the Council would follow to review and update EFH information. The review of information should include, but should not be limited to, evaluating published scientific literature and unpublished scientific reports, soliciting information from interested parties, and searching for previously unavailable or inaccessible data. The Council is to report on its review of EFH information as part of the annual SAFE report prepared pursuant to 50 CFR 600.315(e). A complete review of all EFH information should be conducted as recommended by the Secretary, but at least once every five years. Although it is not known at this time specifically how the recommendations might change fisheries or fisheries management, the intention is to provide additional species protection where it appears needed. Given the discussion above, most of the reasonably foreseeable NMFS and Council management actions seem likely to contribute to effects on EFH, as measured by the criteria used in this cumulative effects evaluation. The research and monitoring program (Section 4.4.3.1) and review and revision of EFH components of FMPs (Section 4.4.3.3) are intended to assess the expected predicted effects of direct management actions and will not be discussed in further detail in this analysis.

4.4.4 Cumulative Effects on Habitat

4.4.4.1 Prey Species

Past and Present Trends Contributing to Cumulative Effects

Feeding is one of the key life history functions mentioned in the definition of EFH. Principal prey species for the federally managed fish species of Alaska include planktonic prey, benthic and epibenthic prey, and forage fish. The current status of these species is described in Section 3.2.1 and Appendix F and is briefly summarized here with respect to cumulative effects. Prey species generally have very large numbers of offspring and correspondingly less parental investment than other species and tend to undergo large changes in abundance.

Planktonic prey, such as copepods and euphausiids, are important to a wide variety of federally managed fish species. Even many managed fish species that forage on larger prey as adults are dependent on planktonic prey as juveniles. In general, planktonic prey populations are considered stable within natural rhythms.

Benthic and epibenthic prey include polychaete worms, bivalves, amphipods, shrimp, crabs, brittle stars, and sand lance when confined to their bottom sediment habitats. Gammarid amphipods and sand lance are very important prey for salmon and demersal groundfish. All these prey populations are considered stable, but at some risk to impacts from bottom trawling activity. Sablefish, in particular, may be dependent on prey species that are susceptible to bottom trawling damage.

Forage fish include schooling mid-water fish such as herring, pollock, eulachon, capelin, and epibenthic and schooling sand lance (mentioned above). Adult forage fish are extremely important to many species of marine mammals and salmon, while larval forms are important to nektonic plankton feeding species, including adult forage fish. Incidental data suggest that eulachon and capelin stocks have declined, especially in the GOA (Calkins and Goodwin 1988, Anderson et al. 1997, Fritz et al. 1993), while walleye pollock stocks are stable at low levels, or slightly increasing. Pacific herring stocks are stable both in the GOA and BSAI, except in Cook Inlet and Prince William Sound where they are greatly depressed. In the EBS, fluctuations in many prey species are tied to ocean temperature and, for herring and capelin, to pollock populations (Brodeur et al. 1999).

Appendix B contains an analysis that estimates the long-term effects of recent fishing patterns on benthic habitat features that provide potential prey and structure functions for the marine fish species of Alaska. The data in Appendix B indicate that nearly all the negative effects to date on habitat and prey availability were linked to bottom trawl fishing. These negative effects on habitat features are expected to extend into the future if recent bottom trawl fishing patterns continue. Fixed gear or pelagic trawl gear may also have some effect on prey availability if it comes in contact with the sea bottom.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on prey species include non-fishing activities, pollution, and climate changes. Non-fishing activities could have negative effects on water quality and, hence, prey species. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their effect on EFH could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects on EFH could increase. Due to the uncertainty of effect, this factor's influence on cumulative effects on EFH is rated as unknown. If there is an increase in pollutants that affect prey species or the habitats for those species, there could be changes in their abundance, distribution, etc. However, there is no evidence at this time to suggest that pollution levels are likely to change sufficiently to have such an effect on prey species in the GOA or BSAI. Climatic cycles (such as PDO and ENSO events) that cause changes in ocean temperature are known to affect current prey distribution and will likely continue to do so. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, many of the specific effects of climate change on prey species populations are not well documented at this time. Higher recruitments of capelin and BS walleye pollock have been found to coincide with years of warm ocean conditions (Quinn and Nicbauer 1995, Piatt and Anderson 1996). Significant climate shifts are expected to continue.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect prey species include TAC reductions for additional conservation of rockfish and non-target species, closure areas or gear modifications associated with future HAPC measures, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to increase prey availability compared to the status quo.

Contributions to Cumulative Effects Related to EFH and HAPC Identification

The alternatives to describe and identify EFH are likely to have mixed indirect effects on prey species. Alternative 1 may have an indirect negative effect if EFH descriptions are removed, because these identifications serve as triggers for protective measures, as discussed in Section 4.1.2.2. Alternative 2 would have no effect on the current prey species, because there would be no change in the level of protection. Alternatives 3 through 6 involve additional identification of EFH, which could have indirect positive effects on prey habitat by triggering increased levels of protection. These alternatives, therefore, may lead indirectly to an increase in prey availability, especially in federally managed waters. Under Alternative 6, there would be no additional EFH description and Identification in state waters and, therefore, no indirect benefits in these areas.

Alternatives to identify HAPC would also have mixed indirect effects on prey species. Alternative 1 would have an indirect negative effect, because there would be no HAPC identification that could trigger protection of sensitive areas that provide habitat for some prey species. Alternative 2 would have no direct or indirect effects on prey availability, because there would be no change in the current regulations. Alternatives 3 through 5 would have indirect positive effects on prey availability by providing additional triggers for protection of sensitive areas that provide habitat to some prey species.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

For all EFH fishing impact minimization alternatives, there would be no substantial positive or negative effect on prey species (Table 4.4-1). Areas that may incur long-term positive effects are in sand/mud habitat of the EBS, near Unimak Island. However, these areas do not constitute a substantial portion of EFH for any managed species. As noted above, EFH description and identification has the potential for indirect positive effects on prey species by triggering increased levels of protection for EFH. However, none of the EFH fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on prey species. That said, there are some existing closures to bottom trawling in state waters of the GOA and Bristol Bay, and if the state chooses to mirror federal closures, then there could be an increase in prey availability in both state and federal waters under Alternative 6.

Cumulative Effects Summary

Much of the past history of GOA, EBS, and AI fish habitat has been influenced by an historically active foreign trawl fishery and a currently active domestic trawl fishery, both of which have had a negative effect on habitat. However, with the exception of herring, eulachon, and capelin, many of the prey species used by target species are currently considered stable. This stability may be due to the short reproductive cycles for many of these species that allow recovery of disturbed populations. In addition, climate cycles are believed to have altered the availability of prey by affecting water temperatures, currents, and nutrient availability, but the specific effects on prey species are not documented. More recent management actions have sought to reverse the negative effects on habitat caused by fishing, and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 2 through 5), and minimize the effects of fishing on EFH (Alternatives 2 through 6) would indirectly or directly augment other future management efforts to reverse the past habitat damage from fishing activity. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could increase protection of prey habitat. EFH fishing effects minimization Alternatives 3 through 6 would provide progressively more direct habitat protection, but are not expected to have a substantial impact on prey species. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) would have indirect negative effects on prey habitat and would not have the cumulatively beneficial direct or indirect effects of reversing the past trend toward habitat damage by bottom trawls. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternative 1 would maintain the status quo and would not affect the trend in habitat damage by bottom trawls. Overall, the alternatives that would have positive direct or indirect effects would contribute toward the reversal of negative trends in habitat and would help to maintain and enhance the availability of prey species.

4.4.4.2 Benthic Biodiversity

Past and Present Trends Contributing to Cumulative Effects

Three-dimensional sessile epibenthic organisms can provide protective cover for some fish, particularly during growth to maturity. Fish-structure associations are described in the species sections of Appendix B, as well as Section 3.2.1 and Appendix F. Organisms that provide such structure include corals, sponges, anemones, sea whips, sea pens, and tunicates. Fishing may directly remove structure, disrupt it on the seafloor, or kill or injure structure-forming organisms. Detailed information on the current status and trends of living organisms that provide epibenthic structure is not known at this time.

Living organisms such as corals provide important habitat to fish species that use areas within the BSAI and the GOA. Due to their long life cycles and slow recovery periods, corals are particularly sensitive to disturbance by fishing and are used as a measure of the potential effects on other living substrata (D. Witherell per. comm. 2003). Fishing activities such as bottom trawling on hard corals (e.g., *Primnoa*) in areas that have been heavily fished have likely removed much of the resident coral, which will require a very long time to recover. Unfished or lightly fished areas are more likely to have most of their coral remaining. Coral species are known to commonly inhabit many areas of the BSAI and the GOA, with particular concentrations in both shallow and deep AI areas and the GOA slope. Coral population density trends for these areas are not known, but it is believed that damage to corals from bottom trawling has occurred (D. Witherell per. comm. 2003).

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on benthic biodiversity include non-fishing activities, pollution, and climate. Non-fishing activities could have negative effects on water quality and, hence, benthic biodiversity in nearshore areas. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their effect on EFH could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH could increase. Due to the uncertainty of effect, this factor's influence on cumulative effects on EFH is rated as unknown (Table 4.4-1). If pollution levels increase, there could be negative effects on the living organisms that create epibenthic structure and benthic biodiversity. However, there is no evidence at this time to suggest that pollution levels are likely to change sufficiently to have such an effect on benthic biodiversity in the GOA or BSAI. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on distribution, survival, reproduction, recruitment, and other processes of epibenthic organisms are not well documented at this time, though reasonable predictions associated with potential trends can be made. In nearshore areas where epibenthic organisms exist, and there is input from freshwater systems, warmer cycles may cause increases in the amount of freshwater input if rainfall and melting increase. Nutrient levels are likely to increase during warmer cycles, and this may increase available food resources for benthic organisms.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. During cooling events, coastal ocean biological productivity is expected to decrease in Alaska (http://tao.atmos.washington.edu/pdo/), which could reduce available food resources for benthic and epibenthic organisms.

Pollution could affect benthic biodiversity, but the direction and magnitude of those effects are unknown. Climate cycles may have positive or negative effects on benthic biodiversity, depending on whether the trend is hot or cold. Non-fishing activities, such as development that affects nearshore areas, may have negative effects on benthic biodiversity, while restoration and enhancement projects could have beneficial effects.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect habitat conservation, including benthic diversity, include TAC reductions for additional conservation of rockfish and non-target species, closure areas or gear modifications associated with future HAPC measures and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to increase benthic biodiversity compared to the status quo.

Contributions to Cumulative Effects Related to EFH and HAPC Identification

Alternatives to identify EFH and HAPC are likely to have mixed indirect effects on benthic biodiversity. For the alternatives to identify EFH, Alternative 1 may have a negative indirect effect if EFH descriptions are removed, because these identifications serve as triggers for protective measures, as discussed in Section 4.1.2.2. Alternative 2 would have no effect on the current benthic biodiversity, because there would be no change in the level of identification. Alternatives 3 through 6 involve additional identification of EFH, which could trigger increased levels of protection for benthic biodiversity. These alternatives, therefore, may indirectly increase benthic biodiversity, especially in federally managed waters. Under Alternative 6, there would be no additional protection in state waters provided by EFH description and identification. However, there are some existing closures to bottom trawling in state waters of the GOA and Bristol Bay. If the state chooses to mirror federal closures, then it could lead indirectly to natural recovery of benthic biodiversity in both state and federal waters under Alternative 6.

Alternatives to identify HAPC would also have mixed indirect effects on benthic biodiversity. Alternative 1 would have a negative indirect effect, because there would be no HAPC identification to trigger protection of sensitive areas that provide habitat for some benthic species. Alternative 2 would have no effect on benthic biodiversity trends, because there would be no change in the current regulations. Alternatives 3 through 5 could indirectly increase benthic biodiversity by providing additional HAPC identification, which could trigger additional protection to sensitive areas that provide habitat to some benthic species.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Of the EFH fishing impact minimization alternatives, Alternatives 1 and 2 would have no effect on benthic biodiversity, because they are not focused in areas with living substrata. Alternatives 3 through 6 would likely have positive effects on benthic biodiversity because they would provide additional protection to areas with a high probability of having living substrata.

Cumulative Effects Summary

GOA, EBS, and AI benthic habitat has been influenced by an historically active foreign trawl fishery and a currently active domestic trawl fishery that may have had negative effects on sensitive benthic areas. Pollution and non-fishing activities may have negative effects on benthic biodiversity, especially in nearshore areas, if activity levels increase. However, there is no evidence that pollution is likely to increase sufficiently to have substantial impacts on benthic biodiversity. In addition, climate cycles may have altered the benthic biodiversity by affecting water temperatures, currents, and nutrient availability. More recent management actions have sought to reverse effects on habitat that could decrease benthic biodiversity caused by fishing, and planned future actions are meant to do the same. In that respect, several alternatives to identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 2 through 5), and minimize the effects of fishing on EFH (Alternatives 3 through 6) would indirectly or directly augment other future management efforts to reverse the past damage from fishing activity. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could increase benthic biodiversity by protecting sensitive benthic habitat. EFH fishing effects minimization Alternatives 3 through 5 would provide progressively more direct habitat protection, working cumulatively with other current and planned future management actions to reverse the negative trends of the past. Alternative 6 would provide intermediate improvement in habitat protection compared to the status quo. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) would have indirect negative effects on benthic biodiversity and would not have the cumulatively beneficial direct or indirect effects of reversing the past trend toward habitat damage by bottom trawls. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternatives 1 and 2 would have no direct or indirect effects on benthic biodiversity and would not affect the trend in habitat damage by bottom trawls. The alternatives that would have positive indirect and direct effects on benthic biodiversity would cumulatively help to reverse the trends of past damage.

4.4.4.3 Habitat Complexity

Past and Present Trends Contributing to Cumulative Effects

Complexity of habitat is a measure of the number and distribution of different types of habitat within a given area. The complexity of benthic habitat on the sea floor influences the biotic diversity. Greater habitat complexity provides more variety for a greater diversity of species. Benthic habitat complexity is created by diversity in substrate and by sessile organisms that live on the sea floor. Three-dimensional epibenthic structure can provide concealment for some fish (particularly during growth to maturity), support prey populations, and spawning substrates for others (e.g., Atka mackerel). Fish-structure associations are described in the species sections of Appendix B, as well as in Section 3.2.1 and Appendix F. Such structure may be composed of non-living materials (sand or rocks) or living organisms such as corals and other species discussed in Section 4.4.4.2.

Habitat complexity is a measure of the capability of the habitat to support a diverse array of species. Benthic habitat is believed to be at greater risk due to impacts of fishing than non-benthic habitat, such as the water column. Fishing activities have, and do, adversely affect benthic habitat, including effects on infauna and epifauna that provide habitat structure for some managed species. These trends are noted under the descriptions of effects on target species in Section 4.4.5. Benthic and epibenthic habitat complexity is likely to decline wherever bottom trawling activity occurs.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on habitat complexity include non-fishing activities, pollution, and climate. Non-fishing activities could have negative effects on water quality and, hence, habitat complexity as provided by living substrata in nearshore areas. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their effect on EFH could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH could increase. Due to the uncertainty of effect, this factor's influence on cumulative effects on EFH is rated as unknown. If pollution levels increase, there could be negative effects on habitat suitability. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on the distribution of living substrata and benthic species that contribute to habitat complexity are not well documented at this time, although research designed to achieve better understanding of species responses to climate is continuing. PDO and ENSO-scale climate change has been shown to positively affect some groups of species when the phase is warm, while others are negatively affected. However, the direction of change is not well described for many species, including living substrata, and our ability to predict species' responses to change is quite limited.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects of this event on habitat complexity are not well documented at this time.

Pollution could affect benthic biodiversity, but the direction and magnitude of those effects are unknown. Climate cycles may have positive or negative effects on benthic biodiversity, depending on whether the trend is hot or cold. Non-fishing activities such as development that affects nearshore areas may have negative effects on benthic biodiversity, while restoration and enhancement projects could have beneficial effects.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect habitat conservation, including habitat complexity, include TAC reductions for additional conservation of rockfish and non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to increase habitat complexity compared to the status quo.

Changes to Cumulative Effects Related to EFH and HAPC Identification

The alternatives to identify EFH are likely to have mixed indirect effects on habitat complexity. Alternative 1 may have a negative indirect effect if EFH descriptions are removed, because these identifications would have served as triggers for protective measures, as discussed in Section 4.1.2.2. Alternative 2 would have no effect on the trends in current habitat suitability, because there would be no change in the level of identification. Alternatives 3 through 6 involve additional identification of EFH, which could indirectly trigger increased levels of protection for habitat. These alternatives, therefore, could indirectly increase habitat complexity, especially in federally managed waters. Under Alternative 6, there would be no additional protection in state waters provided by EFH description and identification. However, there are some existing closures to bottom trawling in state waters of the GOA and Bristol Bay. If the state chooses to mirror federal closures, then there could be increased recovery in habitat complexity in both state and federal waters under Alternative 6.

Alternatives to identify HAPC would also have mixed indirect effects on habitat complexity. Alternative 1 would have an indirect negative effect, because the triggers for additional protection of sensitive habitat areas would be removed. Alternative 2 would have no effect on the trends in habitat suitability, because there would be no change in the current regulations. Alternatives 3 through 5 could indirectly increase habitat complexity by providing additional triggers for protection measures to conserve sensitive habitat areas.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

EFH fishing impact minimization alternatives would have mixed effects on habitat complexity. Alternatives 1, 2, and 4 would have no substantial effect on habitat complexity, as determined by LEI models (see Appendix B). Alternatives 3, 5, and 6 would have beneficial effects on habitat complexity due to the protection of living and non-living substrate.

Cumulative Effects Summary

GOA, EBS, and AI benthic habitat complexity has been influenced by an historically active foreign trawl fishery and a currently active domestic trawl fishery, both of which have had negative effects on sensitive benthic areas. Pollution and non-fishing activities may have negative effects on habitat complexity, especially in nearshore areas, if water quality is degraded and living substrata are negatively affected. In addition, climate cycles may have altered the habitat complexity created by living epibenthic structure by affecting water temperatures, currents, and nutrient availability. More recent management actions have sought to reverse downward trends in habitat complexity caused by fishing (Section 4.4.3.2), and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 2 through 5), and minimize the effects of fishing on EFH (Alternatives 3 through 6) would indirectly or directly augment other future management efforts to reverse the past damage from fishing activity. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could increase habitat complexity by protecting sensitive benthic habitat. EFH fishing impact minimization Alternatives 3 and 5 would provide progressively more direct habitat protection, working cumulatively with other current and planned future management actions to reverse the negative trends of the past. Alternative 6 would provide intermediate improvement in habitat protection compared to the status quo. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) would have indirect negative effects on habitat complexity and would not have the cumulatively beneficial direct or indirect effects of reversing the past trend toward habitat damage by bottom trawls. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternatives 1, 2, and 4 would have no direct or indirect effects on habitat complexity and would not affect the current trend in habitat damage by bottom trawls. The alternatives that would have positive indirect and direct effects on habitat complexity would cumulatively help to reverse the trends of past damage.

4.4.5 Cumulative Effects on Target Species

4.4.5.1 Cumulative Effects on Target Groundfish Stocks

4.4.5.1.1 Fishing Mortality and Stock Biomass

Past and Present Trends Contributing to Cumulative Effects

All of the target groundfish species in the BSAI and GOA are above MSST, although individual species trends may vary. Populations of most species in the GOA are increasing or stable. Only Pacific cod and northern rockfish continue to decline. In the BSAI, populations of most target species are stable, although populations of Pacific cod, yellowfin sole, sablefish, and Atka mackerel have only recently stabilized following declines. Greenland turbot, rock sole, and flathead sole populations continue to decline. Table 4.4-2 summarizes the recent trends, where known, for each of the target species.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on fishing mortality and stock biomass include foreign and subsistence fishing, non-fishing activities, pollution, and climate effects. Foreign and subsistence fishing for target species is generally minimal and not likely to have any substantial impact on fishing mortality and stock biomass for groundfish stocks in the future. Historically, foreign fishing did significantly reduce the populations of yellowfin sole and Pacific ocean perch, but the fisheries for target species currently are dominated by domestic fishing. However, in certain years, when climate and oceanographic conditions permit, juvenile pollock from the United States EEZ do migrate north and west into international waters where they have been harvested in significant numbers by Russian and other foreign vessels. This harvest could negatively affect recruitment in the EBS.

Non-fishing activities could have negative effects on water quality and, hence, the biomass of target species that inhabit nearshore areas. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their effect on EFH for target species could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH for target species could increase. Due to the uncertainty of effect, this factor’s influence on cumulative effects on EFH is rated as unknown. Increasing pollution may affect groundfish stock biomass. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These climatic shifts affect abundance of most species of groundfish. Specific effects on each target groundfish species are not well documented at this time, though reasonable predictions can be made.

Increases in temperature will likely lead to increased nutrient levels and, therefore, the productivity of many species, including groundfish. In nearshore areas, warming cycles will likely cause increased rainfall and meltwater inputs, thereby increasing nutrient availability, where cooling trends would likely have the opposite effect (http://tao.atmos.washington.edu/pdo/).

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. Recent trends for populations of target species in the GOA and BSAI are shown in Table 4.1-1.

Non-fishing activities, pollution, and climate are likely to affect the biomass of groundfish; however, the magnitude and direction of these effects are unknown.

<u>Future Management Actions Contributing to Cumulative Effects</u>

A number of potential future management actions may affect target species, as indicated by effects on fishing mortality and stock biomass. Measures include changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the Improved Retention/Improved Utilization (IR/IU) program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species, as indicated by levels of fishing mortality and stock biomass, compared to the status quo.

<u>Contributions to Cumulative Effects Related to EFH Description and Identification</u>

Alternatives to describe and identify EFH would not likely affect fishing mortality or stock biomass because there are no provisions to change total allowable catch levels.

<u>Contributions to Cumulative Effects Related to HAPC Identification</u>

Although geographically HAPC is a subset of EFH, the additional identification increases the emphasis on conservation for these areas. Hence, although EFH identification may not have effects, the increases probability of protective measures in HAPC areas may result in potential effects to biomass. Alternatives to identify HAPCs would have mixed indirect effects on groundfish stock biomass. Alternative 1 would have an indirect negative effect on biomass because it would rescind existing HAPC identifications that would likely have triggered protection measures for areas that maintain habitat for groundfish and groundfish prey species. This lack of protection may affect the biomass or abundance of some groundfish populations. Alternative 2 would have no effect on trends in groundfish stock biomass because there would be no changes to current regulations. Alternatives 3 through 5 would be expected to have indirect positive effects on groundfish stock biomass because they would provide additional HAPC identifications, which would serve as triggers for additional protection for habitats that are used by some groundfish species and the prey for some groundfish species.

<u>Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH</u>

The EFH fishing impact minimization alternatives would not have substantial effects on the level of mortality for any of the groundfish species identified in Section 4.3. There are slight differences in the amount of information known about each species, and many species would incur unknown effects from the alternatives, but none are determined to be substantial. Reductions in TAC would be 10 percent or less and are not considered significant. EFH fishing impact minimization alternatives may have some beneficial effects on sensitive benthic habitat and, thereby, on stock biomass of species that rely on such habitats; however, these effects are not considered to be substantial.

Cumulative Effects Summary

GOA, EBS, and AI groundfish target species have been caught by an historically active foreign trawl fishery and a currently active domestic trawl fishery. Past high levels of catch (fishing mortality) have had negative effects on population biomass for some species of groundfish; however, stocks are not currently considered overfished. Pollution and non-fishing activities may have negative effects on the biomass of some groundfish species, especially in nearshore areas, if water quality is degraded and living substrata are negatively affected. In addition, climate cycles may have altered the population levels of some groundfish species by affecting water temperatures, currents, and nutrient availability. More recent management actions have sought to reverse downward trends in biomass for some species caused by past fishing practices and levels of catch, and planned future actions are meant to do the same. In that respect, the action alternatives to identify HAPC (Alternatives 2 through 5) and minimize the effects of fishing on EFH (Alternatives 3 through 6) would indirectly or directly augment other future management efforts to reverse the past damage to biomass levels from fishing activity. HAPC identification could contribute indirectly by providing triggers for additional protective measures that could increase target species biomass by protecting sensitive benthic habitat used by some groundfish species. EFH fishing impact minimization Alternatives 3 through 5 would provide progressively more direct habitat protection, working cumulatively with other current and planned future management actions to reverse the negative trends of the past, although these positive effects are not expected to be substantial. Alternative 6 would provide intermediate improvement in habitat protection compared to the status quo. One alternative (HAPC identification Alternative 1) could have indirect negative effects on groundfish biomass and would not have the cumulatively beneficial direct or indirect effects of reversing the past trend toward habitat damage by bottom trawls. EFH description Alternative 2, HAPC identification Alternatives 1 through 5, and EFH fishing effects minimization Alternatives 1 and 2 would have no direct or indirect effects on biomass levels and would not affect the trend in habitat damage by bottom trawls. The alternatives that would have positive indirect or direct effects on habitat complexity would cumulatively help to reverse the trends of past damage.

4.4.5.1.2 Spatial/Temporal Concentration of Catch

Past and Present Trends Contributing to Cumulative Effects

The spatial and temporal concentration of catch for many of the target groundfish species is stable. The species included in this category are walleye pollock, Pacific cod, sablefish, Atka mackerel, yellowfin sole, Greenland turbot, arrowtooth flounder, BSAI rock sole, flathead sole, rex sole, Alaska plaice, shallow water flatfish, deep water flatfish, BSAI Pacific ocean perch, GOA shortraker and rougheye rockfish, and GOA northern rockfish. The catch concentration of GOA Pacific ocean perch is currently stable, but the trend is unknown. BSAI shortraker and rougheye rockfish are also considered currently stable, but more genetic information is needed to describe the trend conclusively. Other species of groundfish with unknown trends include pelagic shelf rockfish, shortspine thornyhead rockfish, and light dusky rockfish. Further detail on the spatial and temporal concentration of catch for each groundfish species is summarized in Section 4.3.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on spatial/temporal concentration of catch include non-fishing activities, subsistence fishing, pollution, and climate. Non-fishing activities could have negative effects on water quality and, hence, the distribution of target species, which could affect catch concentrations. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their potential effect on catch concentrations could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH for target species could increase, thereby increasing the potential for effects on catch concentrations. Due to the uncertainty of effect, this factor's influence on cumulative effects on EFH is rated as unknown. Pollution levels and climate may affect catch concentrations if changes in the environment result in significant changes in fish population distributions. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on spatial and temporal concentration of catch are not well documented at this time, though reasonable predictions can be made. Increased nutrient availability is associated with rising temperatures, and, conversely, decreased nutrients occur during cooling periods. Fluctuations in the distribution of nutrients and benthic species in the pelagic and nearshore environments could change the location of prey species for groundfish, and hence, the groundfish species distribution and catch concentration.

Future Management Actions Contributing to Cumulative Effects

A number of potential future management actions may affect target species, as indicated by the spatial/temporal concentration of catch. Measures may include changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, gear modifications associated with future HAPC measures, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo and would likely reduce catch concentration. In contrast, closure areas associated with future HAPC measures and marine protected areas implemented under the Groundfish Programmatic SEIS would increase catch concentrations.

Contributions to Cumulative Effects Related to EFH Description and Identification

The alternatives to describe and identify EFH would have mixed indirect effects on the spatial and temporal concentration of catch. Alternative 1 would remove existing EFH descriptions that could have served as triggers for protective measures to close certain areas to fishing. This alternative could indirectly reduce catch concentrations by removing the potential triggers for fishing closures. Alternative 2 would have no effect on catch distribution, because there would be no change in fishing regulations. Alternatives 3 through 6 could indirectly increase the concentration of the catch effort by designating additional EFH, which could trigger protective fishing closures, concentrating the fishing effort in the remaining open areas.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would have mixed indirect effects on the spatial and temporal concentration of catch. Much like EFH description alternatives, HAPC identification would serve as a trigger for protective measures to restrict fishing to open areas. Under Alternative 1, concentration of fishing could be indirectly reduced due to the removal of HAPC identification that would have served as a trigger for protective closures. Under Alternative 2, there would be no change in fishing regulations.

Under Alternatives 3 through 5, there would be an indirect negative effect on catch concentrations, because additional HAPC identification would serve as triggers for additional fishing closures, which would concentrate the fishing effort in fewer open areas.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, EFH description and identification has the potential to have indirect negative effects on spatial/temporal concentration of catch by triggering protective closures for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on spatial/temporal concentration of catch. There are many species for which the effects are unknown, but any potential effects are not considered substantial. Rotational closures in the EBS would have a minimal effect on the concentration of catch for groundfish due to low levels of catch currently taken from inside these areas of the EBS. EFH description and identification could trigger protection measures, which could force catch effort into a smaller area, potentially affecting the spatial and temporal concentration of groundfish catch. In the AI, under Alternative 5B, distinct small open areas would be available for Atka mackerel, cod, and rockfish, which are providing the majority of the TAC. TAC would be reduced to account for areas that would be closed under Alternative 5B. These effects could all occur, but are not expected to have substantial cumulative consequences.

Cumulative Effects Summary

GOA, EBS, and AI groundfish target species have been caught by an historically active foreign fishery and a currently active domestic fishery. High catch concentrations in the past have resulted in localized depletions for some species of groundfish. Pollution and non-fishing activities may have negative effects catch concentration of some groundfish species, especially in nearshore areas, if water quality is degraded and living substrata are negatively affected. In addition, climate cycles may have altered the distribution and catch concentration for some groundfish species by affecting water temperatures, currents, and nutrient availability. More recent management actions have sought to reverse downward trends in population levels of some species caused by past fishing practices and levels of catch, and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 2 through 5), and minimize the effects of fishing on EFH (Alternatives 2 through 6) would indirectly or directly augment other future management efforts to reverse the past damage to population levels from fishing activity, but may result in increased catch concentrations in the remaining open areas. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures such as closures that could increase catch concentrations in the remaining open areas. EFH fishing impact minimization Alternatives 3 through 5 would provide progressively more direct habitat protection through rotational closures and other methods, which would likely further concentrate catch in open areas, but these changes are unlikely to be substantial. Alternative 6 would provide intermediate improvement in habitat protection compared to the status quo. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) could indirectly reduce catch concentration by removing existing identifications, thereby removing triggers for additional closures. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternative 1 would have no direct or indirect effects on the concentration of catch. The cumulative effects of the management actions associated with the EFH action alternatives and other planned management actions would be to increase catch concentration in the remaining open areas.

4.4.5.1.3 Productivity (Spawning/Breeding)

Past and Present Trends Contributing to Cumulative Effects

Most species of groundfish have stable levels of spawning/breeding success. Included in this group are: Pacific cod, Atka mackerel, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, rex sole, Alaska plaice, shallow water flatfish, deep water flatfish, BSAI Pacific ocean perch, and northern rockfish. Walleye pollock are currently stable, but juveniles have potential to be injured through contact with fishing nets. Sablefish and GOA Pacific ocean perch are also currently stable, but at risk of decline. Spawning and breeding success for some groups of groundfish is unknown, including: shortraker and rougheye rockfish, pelagic rockfish, shortspine thornyhead rockfish, and light dusky rockfish. More detail on the spawning and breeding status for each groundfish species is provided in Section 4.3.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on productivity (spawning/breeding) include non-fishing activities, pollution, and climate. Non-fishing activities could have negative effects on water quality and, hence, on target species that use nearshore areas for spawning and breeding. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their potential effect on spawning and breeding of target groundfish species could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH for target species could increase, thereby increasing the potential for effects on spawning and breeding for these species. Due to the uncertainty of effect, this factor's influence on cumulative effects on EFH is rated as unknown. Pollution levels and climate may affect spawning and breeding if changes in the environment result in significant changes in fish population distributions. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers, and many of the zooplankton species that serve as major food resources for target species. This change may increase spawning and breeding activity. In nearshore areas where epibenthic organisms exist and there is input from freshwater systems, warmer cycles may cause increases in the amount of freshwater input if rainfall and melting increase. This change may alter the distribution of epibenthic organisms, which could have negative effects on spawning and breeding for those species that depend on living substrata for spawning or breeding. Other species that do not depend on these habitats would not be affected by changes in living substrata due to climate regime shifts.

Non-fishing activities, pollution, and climate will affect spawning and breeding, but the direction and magnitude of these effects is currently unknown.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on spawning/breeding success. Measures may include changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to contribute to spawning/breeding success for target species compared to the status quo.

Contributions to Cumulative Effects Related to EFH Description and Identification

Alternatives to describe and identify EFH would have mixed indirect effects on spawning and breeding of ground fish. Alternative 1 would likely have indirect negative effects on spawning/breeding and productivity of groundfish species, although the magnitude of the effect is unknown. Without identification of EFH, the trigger for additional protection for habitats required by some groundfish species for spawning and rearing would be removed, which would likely lead to greater potential for degradation of these habitats, and a resulting potential decrease in the productivity of some groundfish species. Alternative 2 would have no effect on groundfish trends, because there would be no changes to the current habitat protection regulations. Alternatives 3 through 6 would be likely to have indirect positive effects on spawning/breeding and productivity, especially in federal waters. These alternatives would provide additional identification of EFH in areas that are likely to be used, at least in part, as spawning and breeding areas for groundfish. This identification would provide a trigger for greater protection of these habitats. Alternative 6 would not provide EFH description and identification in state waters, and so there would not be a trigger for additional protection due to EFH. However, there are some existing closures to bottom trawling in state waters of the GOA and Bristol Bay. If the state chooses to mirror federal closures, then there could be an increase in protection for spawning and rearing areas in both state and federal waters under Alternative 6.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would have the same indirect effects on spawning/breeding and productivity that they would have on stock biomass. Under Alternative 1, with no HAPC identification, there would likely be fewer triggers for protection of areas for spawning/breeding of groundfish, and productivity for some species could decrease. Under Alternative 2, there would be no effect on spawning and breeding, because there would be no changes to current habitat protection regulations under this alternative. Under Alternatives 3 through 5, spawning/breeding and productivity of groundfish species could be indirectly benefitted by the additional triggers for habitat protection provided by the identification of HAPCs.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, EFH description and identification has the potential to have indirect positive effects on spawning and breeding by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on spawning and breeding. The potential effects of some of the alternatives on some species are unknown, but none of the potential effects are considered substantial.

Cumulative Effects Summary

GOA, EBS, and AI groundfish target species have been caught by an historically active foreign fishery and a currently active domestic fishery. High catch concentrations in the past may have resulted lower spawning and breeding success for some species. Past bottom trawling may have affected the sensitive habitats needed by some species for spawning and breeding. Pollution and non-fishing activities may have negative effects on spawning and breeding success for some groundfish species, especially in nearshore areas if water quality is degraded and living substrata are negatively affected. In addition, climate cycles may have affected the spawning and breeding success for some groundfish species by affecting water temperatures, currents, and nutrient availability. More recent management actions have sought to reverse downward trends in population levels of some species caused by past fishing practices, and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6) and identify HAPC (Alternatives 2 through 5) could indirectly augment other future management efforts to reverse the past damage to population levels from fishing activity. However, EFH description and identification Alternative 6 provides identification only in federal waters. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could increase target species spawning and breeding success by protecting sensitive benthic habitat used by some groundfish species. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) could have indirect negative effects on groundfish spawning and breeding, and would not have the beneficial direct or indirect cumulative effects of reversing past habitat damage by bottom trawls. EFH description Alternative 2, HAPC identification Alternative 2, and the EFH fishing effects minimization alternatives would have little or no direct or indirect effects on spawning and breeding. The alternatives that would have positive indirect and direct effects on spawning and breeding would help to reverse the trends of past damage and, through time, may result in recovery of habitat from past damage.

4.4.5.1.4 Feeding

Past and Present Trends Contributing to Cumulative Effects

Food resources and feeding habits for many of the target groundfish species are considered stable, within natural variability and, because of the small size of prey, would not likely be affected by fishing gear. The target species that are currently considered stable include walleye pollock, Pacific cod, Atka mackerel, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, flathead sole, rex sole, Alaska plaice, shallow water flatfish, deep water flatfish, BSAI Pacific ocean perch, GOA shortraker and rougheye rockfish, GOA northern rockfish, and dusky rockfish. Sablefish food resources are considered stable, but are currently at risk. For some groundfish species, such as GOA Pacific ocean perch, BSAI shortraker and rougheye rockfish, shortspine thornyhead rockfish, and light dusky rockfish, the trend in food availability and feeding habits is unknown. Further information on the feeding conditions for each groundfish species is found in Section 4.3 and Section 3.2.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on feeding include non-fishing activities, pollution, and climate. Non-fishing activities could have negative effects on water quality and, hence, the distribution of prey species, which could affect feeding success. However, to the extent that non-fishing activities are subject to environmental regulations and conservation measures, their potential effect on feeding of target species could be avoided, minimized, or mitigated. If other environmental regulations are relaxed, or if non-fishing activities increase overall, the negative effects of non-fishing activities on EFH for target species could increase, thereby increasing the potential for effects on feeding success. Due to the uncertainty of effect, this factor’s influence on cumulative effects on EFH is rated as unknown. Pollution may affect feeding habits if there is an increase in pollutants that affect prey species, or the habitats for those species. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These changes are known to affect current prey distribution and likely affect feeding habits as well. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distribution in the GOA. However, the effects of this event on feeding are not well documented at this time.

In summary, non-fishing activities, pollution, and climate affect feeding conditions for some species of groundfish, but the direction and magnitude of these effects is known.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on feeding. Measures may include changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to EFH Description and Identification

The alternatives to describe and identify EFH would likely have mixed indirect effects on feeding. Alternative 1 may have an indirect negative effect on feeding success if EFH descriptions are removed, because these identifications serve as triggers for protective measures, as discussed in Section 4.1.2.2. Alternative 2 would have no effect on the current feeding areas, because there would be no change in the level of protection. Alternatives 3 through 6 involve additional identification of EFH, which could indirectly trigger increased levels of protection for feeding areas. These alternatives, therefore, could indirectly lead to increases in feeding habitat availability, especially in federally managed waters. Under Alternative 6, there would be no additional protection in state waters provided by EFH description and identification. However, there are some existing protection measures for habitat of the GOA and Bristol Bay. If the state chooses to mirror federal closures, then there could be an increase in feeding habitat availability in both state and federal waters under Alternative 6.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPC would also have mixed indirect effects on feeding habitat availability. Alternative 1 would have an indirect negative effect because HAPC identification would be rescinded, which could have triggered potential protection of sensitive areas that provide feeding habitat for some species. Alternative 2 would have no effect on feeding habitat availability, because there would be no change in the current regulations. Alternatives 3 through 5 could indirectly lead to an increase in feeding habitat availability by providing additional triggers for potential protection of sensitive areas that provide habitat for some prey species.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, EFH description and identification has the potential to have indirect positive effects on feeding by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on feeding. There are several alternatives that would have unknown potential effects on many species, but none of the potential effects are currently considered substantial. There would likely be some positive effects from EFH fishing impact minimization alternatives on feeding success for groundfish, due to protection of feeding areas and prey species, but these effects are not expected to be substantial.

Cumulative Effects Summary

Prey species populations and feeding habits for most target species of groundfish are considered stable and have not been substantially affected by past fishing activities. Pollution and non-fishing activities may have negative effects on feeding success for some groundfish species, especially in nearshore areas if water quality has been degraded. In addition, climate cycles may have affected the feeding success and prey availability for some groundfish species by affecting water temperatures, currents, and nutrient availability, which could cause fluctuations in prey populations, but these cycles are part of the natural variability in abundance. Recent management actions have sought to decrease any potential negative effects of fishing on habitat for target species and prey species, and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6) and to identify HAPC (Alternatives 2 through 5) would indirectly augment other future management efforts to prevent potential negative effects on prey species for target groundfish. However, EFH description and identification Alternative 6 would not identify EFH in state waters. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could prevent the potential negative effects from fishing on prey species of target groundfish species by protecting areas used by juvenile groundfish. EFH fishing impact minimization Alternatives 2 through 6 would provide some direct habitat protection, working cumulatively with other current and planned future management actions to provide additional direct protection of areas that may be used by prey species of target groundfish, but these benefits are not expected to be substantial. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) could have indirect negative effects on prey species of target groundfish species, and would not have the cumulatively beneficial direct or indirect effects of preventing potential negative effects on prey populations for target groundfish. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternative 1 would have no direct or indirect effects on feeding trends because they would not change current management regulations. The alternatives that would have positive indirect effects on feeding would help to promote protection of prey populations for target groundfish species and prevent damage to habitat from fishing activities.

4.4.5.1.5 Growth to Maturity

Past and Present Trends Contributing to Cumulative Effects

Many of the target groundfish species are considered to have stable growth to maturity. Included in this group are walleye pollock, Pacific cod, Atka mackerel, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, flathead sole, rex sole, Alaska plaice, and shallow and deep water flatfish. BSAI Pacific ocean perch are currently stable, but could be at risk of decline due to negative effects of fishing. GOA Pacific ocean perch and GOA northern rockfish may be at risk of decline due to negative effects of fishing. For some groups of rockfish, including GOA and BSAI shortraker and rougheye rockfish, BSAI northern rockfish, and pelagic shelf rockfish, the trend in the rate of growth to maturity is unknown. Sablefish requirements for growth to maturity are not well known. Although the population remains above MSST, the potential for impacts on benthic habitat from bottom trawling puts sablefish growth to maturity at risk of decline. A summary of the current status and trend for growth to maturity of groundfish species is included in Section 4.3.1.2.1.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on growth to maturity include non-fishing activities, pollution, and climate. Non-fishing activities could have effects on water quality and hence could affect growth to maturity on groundfish that use nearshore areas. However, the direction and magnitude of these effects is unknown. Pollution may affect growth to maturity if there is an increase in pollutants that affect prey species, or the habitats for those species. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These changes often affect growth to maturity of many species, and would likely affect groundfish as well. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. This change may reduce the time needed for growth to maturity and may increase the size-at-age for some species. In nearshore areas where epibenthic organisms exist, and there is input from freshwater systems, warmer cycles may cause increases in the amount of freshwater input if rainfall and melting increase. This change may alter the distribution of living substrata, which could disrupt growth to maturity for those species which depend on epibenthic organisms for habitat as juveniles. Other species that do not depend on these habitats would not likely be as affected by these changes.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on growth to maturity are not well documented at this time.

Non-fishing activities, pollution, and climate will have effects on groundfish growth to maturity, but the direction and magnitude of these effects is unknown.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by growth to maturity. Actions may include reduction in harvest rates for groundfish due to the F40 report, changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to EFH Description and Identification

The alternatives to describe and identify EFH would be likely to have mixed effects on growth to maturity. Alternative 1 may have a negative effect if EFH descriptions are removed, because these identifications serve as triggers for protective measures, as discussed in Section 4.1.2.2. Alternative 2 would have no effect on the current growth to maturity, because there would be no change in the level of protection. Alternatives 3 through 6 involve additional identification of EFH, which could trigger increased levels of protection for groundfish habitat. These alternatives, therefore, may indirectly lead to improved growth to maturity, especially in federally managed waters. Under Alternative 6, there would be no additional protection in state waters provided by EFH description and identification. However, there are some existing closures to bottom trawling in state waters of the GOA and Bristol Bay. If the state chooses to mirror federal closures, then there could be an improvement in growth to maturity in both state and federal waters under Alternative 6.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPC could also have mixed indirect effects on growth to maturity. Alternative 1 would have a negative effect, because there would be no protection of sensitive areas that provide habitat for some groundfish species without any HAPC identification. Alternative 2 would have no effect on growth to maturity, because there would be no change in the current regulations. Alternatives 3 through 5 could improve growth to maturity by providing additional protection to sensitive areas that provide habitat to some target species.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on growth to maturity by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on growth to maturity. There are several alternatives that have unknown potential effects on many species, but none of these potential effects are currently considered substantial. EFH fishing impact minimization alternatives may have positive effects on growth to maturity for groundfish, however these effects are not expected to be substantial.

Summary of Cumulative Effects

Growth to maturity for most target species of groundfish is considered stable and has not been substantially affected by past fishing activities. However, for some species such as sablefish, GOA Pacific ocean perch, and GOA northern rockfish, bottom trawling may have had detrimental effects on growth to maturity by affecting habitats that are used by juvenile groundfish. Pollution and non-fishing activities may have negative effects on growth to maturity for some groundfish species, especially in nearshore areas if water quality has been degraded. In addition, climate cycles may have affected the growth to maturity for some groundfish species by affecting water temperatures, currents, and nutrient availability, which could cause fluctuations in growth rates, but these cycles are part of the natural variability in abundance. Recent management actions have sought to decrease any potential negative effects of fishing on habitat for target species and prey species, and planned future actions are meant to do the same. In that respect, the action alternatives to describe and identify EFH (Alternatives 3 through 6) and identify HAPC (Alternatives 2 through 5) would indirectly augment other future management efforts to prevent potential negative effects on growth to maturity for target groundfish. EFH description Alternative 6 would not identify EFH in federal waters. EFH and HAPC identification could contribute indirectly by providing triggers for additional protective measures that could prevent the potential negative effects from fishing on growth to maturity of target groundfish species by protecting areas used by juvenile groundfish. EFH fishing impact minimization Alternatives 2 through 6 would provide some direct habitat protection, working cumulatively with other current and planned future management actions to provide additional direct protection of areas that may be used by juvenile target groundfish, but these benefits are not expected to be substantial. Other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) could have indirect negative effects on growth to maturity of target groundfish species and would not have the cumulatively beneficial direct or indirect effects of preventing potential negative effects on juvenile target groundfish. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternative 1 would have no direct or indirect effects on growth to maturity because they would not change current management regulations. The action alternatives that would have positive indirect effects on growth to maturity could help to promote protection of target groundfish species and prevent damage to habitat from fishing activities.

4.4.5.2 Cumulative Effects on Target Salmon Stocks, Crab, and Scallops

4.4.5.2.1 Fishing Mortality and Stock Biomass

Past and Present Trends Contributing to Cumulative Effects

Population levels for salmon, most species of crab, and commercially harvested scallops have been stable, and are not in a declining trend. As stated in Section 4.3.1.2.2.1, all five species of salmon in Alaska have stable populations, and none are considered over-fished. Many stocks of crab are considered stable; however, some stocks of crab, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and the EBS Tanner crab, have been designated as overfished. All three are in the beginning years of 10-year rebuilding plans. Weathervane scallops are the only species in the commercial scallop fishery. The biomass levels for weathervane scallops are at satisfactory levels, and they are not considered overfished, or to be approaching an overfished condition.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on fishing mortality and stock biomass include foreign and subsistence fishing, non-fishing activities, pollution, and climate. Foreign fishing, subsistence fishing, pollution, and climate will continue to affect fishing mortality and stock biomass of salmon. Foreign fishing is not likely to affect crab species. Foreign and subsistence fishing are not likely to substantially affect the fishing mortality and stock biomass of scallops because most of the scallops harvested in areas managed by the FMP are caught in domestic commercial fisheries. Non-fishing activities are likely to have effects on salmon due to the location of many of these activities near freshwater systems. Negative effects on water quality from logging, mining, or other activities could affect the biomass of salmon by reducing the proportion of juvenile salmon that survive to the smolt stage. Crabs and scallops could also be affected by non-fishing activities if these actions affect marine water quality. Crabs and scallops occupy nearshore areas that could be affected by adverse water quality inputs from freshwater systems. Pollution could affect stock biomass of salmon, crab, and scallops if levels of pollution increase in areas that are critical for the survival of salmon, crab, and scallops. Climate cycles such as ENSO and PDO events may continue to affect biomass for salmon, crab, and scallops. Salmon have been documented as having population increases during warmer periods and decreases during colder periods. The populations of salmon in the GOA and those that use the California current are nonsynchronous, meaning that when one population is at high levels, the other is generally at lower levels. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. Thus, increases in crab and scallops could be seen during warmer cycles.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. The effects of this event on crab and scallop fishing mortality and stock biomass are not well documented at this time, however it has been observed that salmon populations benefited from the warm cycle.

In summary, foreign fishing will likely continue to increase fishing mortality and decrease stock biomass for salmon, but will not likely affect crab and scallops. Non-fishing activities, pollution, and climate will continue to affect all three species groups, but the direction and magnitude of these effects is unknown.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on fishing mortality and stock biomass. Measures may include changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternatives to describe and identify EFH would have a neutral effect on the fishing mortality and stock biomass of salmon, crab, and scallops. The absence of EFH description would not result in any changes in total allowable catch and, hence, would not affect fishing mortality.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would not affect fishing mortality or biomass because they would not result in any change in total allowable catch.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternatives 1 through 5B would not likely affect salmon or scallops. Alternative 6 may reduce fishing mortality of scallops. The EFH fishing impacts minimization alternatives could affect crab species in terms of stock biomass. The EFH fishing impacts minimization alternatives would have no significant effects on stock biomass for salmon. Pelagic trawling may increase slightly for rockfish in the GOA, however, it is unlikely that any increase in salmon bycatch would be substantial due to the low amount of increased effort by pelagic trawling for rockfish, and the fact that existing rockfish fisheries do not catch many salmon. The alternatives would have mixed effects on crab fishing mortality and stock biomass. Alternatives 1 through 5B would not directly affect the catch of crabs in directed fisheries. There would be slight reductions in bycatch of crab by groundfish trawl fisheries, but bycatch of crab is very small relative to population size. However, Alternative 6 would provide additional protection to areas where crabs exist in higher concentrations. This protection could increase the stock biomass of crab. The EFH fishing impacts minimization Alternatives 1 through 5B would not be expected to have any significant effects on scallops, due to the small geographic distribution of the scallop fishery and the small area of overlap with areas of scallop concentration. Alternative 6 may increase stock biomass of scallops by limiting fishing and reducing fishing mortality.

Summary of Cumulative Effects

Past effects on factors affecting target species such as fishing mortality have been judged as neutral or negative. Populations of groundfish species, salmon, most species of crab, and scallops are stable. There are a few stocks of crab, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and EBS Tanner crab, that are considered overfished, however. External factors such as climate and non-fishing activities may have negative effects on these species, but the climate cycles are part of natural variation in populations. More recent management actions have sought to maintain the stable populations increase stocks that have declined and provide for additional conservation of target species, and planned future actions are meant to do the same. The EFH description alternatives and HAPC identification alternatives are not expected to affect this criterion due to the lack of triggers for changes in TAC. The EFH alternatives to minimize the effects of fishing on EFH would have neutral to positive effects, in line with other current and planned future management actions. In particular, Alternative 6 could have positive effects for crabs. For the most part, however, the EPH fishing impacts minimization alternatives are expected to have a neutral influence with respect to cumulative effects on target species. Overall, the cumulative effect of the alternatives on salmon, crabs, and scallops is slightly positive, or no substantial effect.

4.4.5.2.2 Spatial/Temporal Concentration of Catch

Past and Present Trends Contributing to Cumulative Effects

Concentration of fishing effort in time and space for salmon, crab, or scallops could potentially alter the genetic diversity of populations through selective fishing. For salmon, the five species harvested in Alaska have different peak fishing seasons. Chinook salmon are caught in May and June, although a Southeast Alaska winter troll fishery operates from October 11 through April 14. Sockeye salmon are generally harvested from mid-June to mid-July, but the earliest commercial sockeye salmon fishery occurs on the Copper River in mid-May. Coho salmon fisheries typically occur from late July to mid-September, but some limited effort may extend through early October. Pink salmon are harvested from late July to late August. Summer chum salmon are harvested from June through early August and fall chum are harvested from early August through mid-September. Taking all Alaskan commercial salmon fisheries together, the largest portion of the statewide catch occurs during the month of August (over 50 percent) when pink salmon are abundant, followed by catches in July (38 percent), which contain large numbers of sockeye salmon (Kruse et al. 2000). Salmon catch concentration in Alaska is currently considered stable with respect to the percentage of escapement available for harvest.

Crab fishing is concentrated in Bristol Bay, Norton Sound, the Pribilof Islands, Southeast Alaska, Kodiak, and St. Matthew Islands. Crab fishing also occurs among the Aleutian Islands, on steep rocky substrate in the AI, on moderately sloping mud/sand sediments in basins in the AI, and on the mid-shelf region of the central portion of the EBS. The distribution of catch has been influenced by reductions in population levels of the St. Matthew blue king crab, Pribilof Islands blue king crab, and the EBS Tanner crab due to overfishing. Crab catch concentration has been slightly reduced due to population-induced restrictions.

Weathervane scallops are distributed from Point Reyes, California, to the Pribilof Islands, Alaska. The highest known densities in Alaska are found in the EBS, near Kodiak Island, and in the eastern GOA from Cape Spencer to Cape St. Elias. Weathervane scallops are found at depths ranging from shallow intertidal waters to 300 m, but abundance tends to be highest at depths from 40 to 130 m on silt, sand, and gravel substrates (Hennick 1973). Distribution of scallops has been stable for the past 10 years.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on spatial/temporal concentration of catch for salmon include foreign and subsistence fishing, non-fishing activities, pollution, and climate. Foreign fishing may have negative effects on salmon populations, because many of the stocks that spawn in Alaska have large migration patterns in the EBS, and may be caught by foreign fisheries. Subsistence fishing in 1994 harvested 1 million fish out of a total catch of 194 million (Council 1998a), a relatively small portion of the total fishing effort. Non-fishing activities could affect the catch concentration of salmon, especially for sport and subsistence fishing in freshwater systems, if the habitat quality or water quality of these systems is affected. Major effects from non-fishing activities have occurred in areas along the Pacific coast and have drastically affected salmon populations. Pollution may affect the spatial and temporal concentration of catch if there is an increase in pollutants that affect salmon survival, or the habitats for salmon. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These changes often affect salmon population levels, and would likely affect spatial and temporal concentration of catch as well. Salmon have been documented as having population increases during warmer periods and decreases during colder periods. Decadal oscillations of nutrient levels in the oceans can increase salmon populations when nutrients are high, or decrease populations when nutrients are low. The populations of salmon in the GOA and those that use the California current are nonsynchronous, meaning that when one population is at high levels, the other is generally at lower levels.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. The effects of this event on crab and scallop fishing mortality and stock biomass are not well documented at this time, however it has been observed that salmon populations benefited from the warm cycle.

External factors for crab and scallops also include foreign and subsistence fishing, non-fishing activities, pollution, and climate. Foreign and subsistence fishing would not likely substantially affect the spatial/temporal concentration of catch of scallops or crab, because most of the scallops and crab harvested in areas managed by FMPs are caught in domestic commercial fisheries. Non-fishing activities may affect crab and scallops if marine water quality is affected by freshwater inputs. Pollution could affect catch concentration of crab and scallops if levels of pollution increase in areas that are critical for the survival of these species. Climate cycles may continue to affect the distribution of crab and scallops, which would, in turn, affect catch concentration for these species. The magnitude and timing of such effects cannot be predicted, however.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on spatial/temporal concentration of catch. Actions may include reduction in harvest rates for groundfish due to the F40 report, changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternatives to describe and identify EFH may have mixed indirect effects on the spatial and temporal concentration of salmon, crab, and scallop catch. Alternative 1 is likely to lead indirectly to a decrease in the concentration of catch by removing existing EFH descriptions that would have likely triggered restrictions on open fishing areas. Alternative 2 would have no effect on the spatial and temporal concentration of salmon, crab, and scallop catch, because there would be no change in the current fishing regulations. Alternatives 3 through 6 would be likely to lead indirectly to an increase in the concentration of fishing in certain areas, because the additional identification of EFH may trigger additional closures to fishing, which would concentrate fishing efforts in the remaining open areas.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs, much like the alternatives to describe and identify EFH, would have mixed indirect effects on the spatial and temporal concentration of salmon, crab, and scallop catch. Alternative 1 would likely lead to an indirect decrease in the concentration of catch by removing existing HAPC identification that would have likely triggered restrictions on open fishing areas. Alternative 2 would have no effect on the spatial and temporal concentration of salmon, crab, and scallop catch, because there would be no change in the current fishing regulations. Alternatives 3 through 5 are likely to lead indirectly to an increase in the concentration of fishing in certain areas, because the additional identification of HAPCs may trigger additional closures to fishing, which would concentrate fishing efforts in the remaining open areas.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The EFH fishing effects minimization alternatives would have differential effects on salmon, crab, and scallops. They would have no effects on the spatial and temporal concentration of salmon catch. Alternatives 1 through 5B would not likely modify the distribution and intensity of fishing effort in crab fisheries, so would be unlikely to affect catch concentrations. Alternative 6 would change the distribution of crab fishing and would concentrate crab catch in remaining open areas. EFH fishing impact minimization Alternatives 1 through 5B would not be expected to affect scallop catch concentrations. Alternative 6 would affect the concentration of scallop catch in the Yakutat and Kayak Island areas, and would likely, as a result, have a negative effect on scallop catch concentrations.

Cumulative Effects Summary

Past effects on factors affecting target species, such as spatial/temporal concentration of catch, have been judged as neutral or negative. Populations of groundfish species, salmon, most species of crab, and scallops are stable. There are a few stocks of crab, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and EBS Tanner crab, that are considered overfished, however. Foreign fishing may affect salmon populations that migrate into foreign waters. Non-fishing activities and climate may also have positive or negative effects on salmon, crab, and scallops, but the magnitude of these effects is unknown. More recent management actions have sought to maintain the stable populations and provide for additional conservation for target species, and planned future actions are meant to do the same. Catch concentrations may be indirectly reduced under EFH description Alterative 1 and HAPC identification Alternative 1. Catch concentrations would not be changed by EFH description Alternative 2 and HAPC identification Alternative 2. Catch concentrations could increase under the indirect influence of EFH description Alternatives 3 though 6 and HAPC identification Alternatives 3 through 5. Alternatives 1 through 5B of the alternatives to minimize the effects of fishing on EFH would have neutral effects on salmon, crab, and scallop catch concentrations. Alternative 6 would have negative effects on catch concentrations for crab and for scallops. Many of the alternatives that would increase triggers for closures and protective measures would also increase catch concentrations unless corresponding reductions in catch effort occur with expected closures and habitat protective measures.

4.4.5.2.3 Productivity (Spawning/Breeding)

Past and Present Trends Contributing to Cumulative Effects

Spawning and breeding requirements for salmon, crab, and scallops are vastly different. The paragraphs below discuss the status of these habitats for each species group.

Spawning and breeding habitat for salmon in freshwater systems in Alaska has been affected by human management actions such as logging, road building, and community development; however, the majority of areas in Alaska support healthy stocks of salmon and there are no ESA-listed salmon species that spawn in Alaska. In fact, the pristine habitats listed in Section 3.2.1.5 of this EIS are one of the reasons for the high abundance of salmon in Alaska rivers.

Crab reproduction generally occurs in shallow-water habitats. Females carry eggs for approximately 1 year, at which time the eggs hatch into free-swimming larvae. Larvae eventually settle on the ocean floor and molt into non-swimmers. Red king crabs mate from January through June in waters less than 50 m deep. Eggs generally hatch 11 months later, and larval crabs are free swimming for 2 to 3 months. Juvenile crabs settle into a benthic life stage and require high-relief habitat or coarse substrate, such as boulders, cobble, and shell hash. Laboratory work by Stevens and Kittaka (1998) suggests that crab also prefer living substrates, such as bryozoans and stalked ascidians. Larvae of blue king crab spend about 4 months in the free-swimming stage before settling onto substrate between 40 m and 60 m. Blue king crab juveniles require nearshore shallow habitat with significant protective cover (e.g., sea stars, anemones, microalgae, shell hash, cobble, shale) (Lipcius et al. 1990). Spawning for blue king crab may depend on the availability of nearshore rocky-cobble substrate for protection of females. Brooding of opilio Tanner crabs usually occurs below 50 m. Nearshore areas with living substrates may have been damaged by bottom fishing gear in the past, which potentially could have had effects on the reproductive habitat needed for crab species.

Gametes from scallops are released into the water, where fertilization occurs. If females and males are too distant, fertilization is reduced. Changes in year-class production affect the productivity levels of scallops. These changes occur due to the inter-annual variability in environmental factors. The productivity of scallops has been relatively stable outside of natural variability. The areas where scallops spawn and live are generally quick to recover from disturbance.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on spawning and breeding include foreign and subsistence fishing, non-fishing activities, pollution, and climate. These factors may affect salmon, crab, and scallops at various levels. Foreign fishing may have negative effects on salmon populations because many of the stocks that spawn in Alaska have large migration patterns in the EBS and may be caught by foreign fisheries. Subsistence fishing in 1994 harvested 1 million fish out of a total catch of 194 million, a relatively small percentage of the total catch. Foreign and subsistence fishing are unlikely to have substantial effects on crab breeding areas, because these fisheries make up a small part of the total fisheries that use bottom gear. Foreign and subsistence fishing would not likely substantially affect the spawning/breeding or productivity of scallops, because most of the scallops harvested in areas managed by the FMP are caught in domestic commercial fisheries.

Non-fishing activities likely affect populations of salmon and potentially some populations of crab and scallops. Mining and logging have been shown to have negatively affected salmon populations in many areas due to effects on freshwater habitat quality and water quality that alter the survival rates for salmon eggs and juvenile salmon. Crabs and scallops that inhabit the nearshore areas may also be affected by changes in marine water quality due to freshwater inputs.

Pollution may affect the productivity of salmon, crab, and scallops if there is an increase in pollutants that adversely affect survival or habitats. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These change often affect salmon population levels, and would likely affect the productivity of salmon as well. These cycles may also affect breeding of crab species. Climate cycles may affect distribution of scallops, which would, in turn, affect spawning/breeding success for scallops. Salmon have been documented as having population increases during warmer periods and decreases during colder periods. Decadal oscillations of nutrient levels in the oceans can increase salmon populations when nutrients are high or decrease populations when nutrients are low. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. Thus, increases in crab and scallops could be seen during warmer cycles.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on salmon, crab, and scallop productivity are not well documented at this time.

Future Management Actions

There are a number of potential future management actions that may affect target species, as measured by effects on spawning and breeding. Actions may include reduction in harvest rates for groundfish due to the F40 report, changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo, with associated potential benefits to the spawning and breeding of salmon, crabs, and scallops.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternatives to describe and identify EFH would have mixed indirect effects on the breeding and productivity of salmon, crabs, and scallops. Alternative 1 would remove existing EFH descriptions that could have triggered protections for areas that may be used by spawning and juvenile salmon, crab, and scallops, and would likely have negative effects. Alternative 2 would have no effects on this indicator, because it would not result in any changes to current fishing regulations. Alternatives 3 through 6 are likely to have some beneficial indirect effects on salmon, crab, and scallop breeding and productivity due to the additional identification of EFH, which could trigger protection measures for some areas that may be used by spawning and juvenile salmon, crab, and scallops. Under Alternative 6, EFH would be identified only in federal waters, therefore, in waters managed by the state, there would be no identification of EFH, which would remove triggers for protection of spawning and rearing habitat for salmon, crab, and scallops. However, there are some existing closures in state waters to bottom trawling in areas of the GOA and Bristol Bay. If the state chooses to mirror federal closures, there could be an increase in protection for spawning and rearing habitat in both state and federal waters under Alternative 6.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would have mixed indirect effects on salmon, crab, and scallops, due to differences in life history. These alternatives would not likely have significant effects on the spawning and breeding of salmon because the actions would not be concentrated in freshwater areas. Alternatives to identify HAPCs would have mixed effects on the breeding success and productivity of crab species and scallops. Alternative 1 would remove triggers that may have created protection for areas that may be used by spawning and juvenile crab and scallops, and would likely have indirect negative effects. Alternative 2 would have no effects on this indicator, because it would not result in any changes to current fishing regulations. Alternatives 3 through 5 would be likely to have some beneficial effects on crab and scallop breeding and productivity due to the additional HAPC identification that may trigger additional protection measures for some areas that may be used by spawning and juvenile crab and scallops.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternatives to minimize the effects of fishing on EFH would have various effects on the spawning and breeding of salmon, crab, and scallops based on life history differences. The alternatives would not likely affect salmon species because the alternative actions would not be concentrated in freshwater areas. The alternatives could benefit the spawning and breeding of crab species; however, these effects are not considered substantial within the GOA and BSAI crab populations. Alternative 5B may provide some additional protection to golden king crab in the AI. The potential relationship between coral/sponge habitat and crab nursery areas could also play a role in the potential effects of these alternatives. There would likely be benefits from limiting bycatch in these areas. Blue king crab habitat protection around St. Matthews Island may also increase under Alternatives 4 through 6. Alternatives 1 through 5B would not be expected to affect scallop spawning and breeding. Alternative 6 would affect the concentration of scallop catch in the Yakutat and Kayak Island areas, and would likely, as a result, have a slightly positive effect on scallop spawning and breeding, although this effect is not considered substantial for the entire population.

Summary of Cumulative Effects

Past effects of fishing on factors affecting target species such as spawning, breeding, and productivity have been judged as neutral or negative. Populations of groundfish species, salmon, most species of crab, and scallops are stable. There are a few stocks of crab, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and EBS Tanner crab, that are considered overfished, however. More recent management actions have sought to maintain the stable populations and provide for additional conservation for target species, and planned future actions are meant to do the same. EFH description Alternative 1 and HAPC identification Alternative 1 could have indirect negative effects on spawning and breeding for crab and scallops by removing existing triggers for habitat protection measures but would not affect salmon spawning. EFH and HAPC identification Alternatives 2 would not affect current levels of spawning and breeding. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 could indirectly lead to an increase in spawning and breeding levels by providing additional triggers for habitat protection measures. However, EFH description Alternative 6 would not describe or identify EFH in state waters. The EFH alternatives to minimize the effects of fishing on EFH would have neutral effects overall, with some localized positive effects, in line with other current and planned future management actions. In particular, Alternatives 4, 5A, and 5B could have some positive effects for opilio crabs, but for all crab populations these benefits would not be substantial. Alternative 6 could provide benefits to St. Matthews blue king crab and limited benefits to scallops in the Yakutat and Kayak Island areas. For the most part, the EFH fishing effect minimization alternatives are expected to have a neutral influence with respect to cumulative effects on target species. Overall, the cumulative effects of the action alternatives on spawning and breeding of salmon, scallops, and crab would be neutral or positive.

4.4.5.2.4 Prey Availability (Feeding)

Past and Present Trends Contributing to Cumulative Effects

The availability of prey for salmon, crab, and scallops varies widely due to differences in selected prey species. In marine waters, juvenile pink salmon feed largely on copepods, larval tunicates, and euphausiids. Adults also feed heavily on euphausiids as well as amphipods, squid, and small schooling fish. The diet of juvenile Chinook salmon is highly variable depending on region and life stage. In estuarine habitats chironomid larvae and amphipods are important dietary components, while amphipods and juvenile herring are commonly fed upon once the juveniles move out to sea. Adults feed heavily on schooling fish, especially Pacific herring, sand lance, and juvenile walleye pollock and Pacific cod. Chum salmon in marine waters are generally planktonic feeders. Copepods and amphipods comprise a substantial part of the diet of both juvenile and adult chums, while pteropods and euphausiids are also important to adults. Juvenile coho salmon feed largely on larval crabs (especially dungeness crabs) and juvenile fish (including anchovy, surf smelt, sand lance, and Pacific herring). Adults prefer larger herring and sand lance. Both juvenile and adult sockeye salmon feed on a variety of larval fish (capelin, Pacific herring, walleye pollock, sand lance), amphipods, euphausiids, and squid. Adult sockeye also feed heavily on adult sand lance. Most of the prey species of salmon are common and not affected by fishing, so the trend for these is stable; however, herring stocks are currently depressed, so this decline may affect the prey availability for Chinook, coho, and sockeye salmon.

Prey availability for crab species includes the availability of prey for all life stages of crab. Larval crab consume zooplankton and phytoplankton, which are available nearly everywhere in the water column. Juveniles feed on diatoms, protozoa, hydroids, crabs, and other benthic organisms. Prey items for adult crab include a wide assortment of worms, clams, mussels, snails, brittle stars, sea stars, sea urchins, sand dollars, barnacles, fish parts, and algae. Bairdi and opilio Tanner crabs feed on an extensive variety of benthic organisms, including bivalves, brittle stars, other crustaceans, polychaetes and other worms, gastropods, and fish (Lovrich and Sainte-Marie 1997). In general, prey items for crab species are very common in the BSAI and the GOA, and their availability has probably not been compromised by the current and past management of ocean habitat in these areas. However, fishing impacts to prey availability for most crab species are unknown.

Scallops are filter feeders and feed primarily on suspended particles in the water such as phytoplankton. Localized plankton blooms affect the availability of food resources for scallops. These food resources may be affected positively or negatively by scallop dredging, because the dredging may increase the suspension of organic particles in the water column, thereby increasing food availability, but may also introduce particles with low organic content that would negatively affect the food resources available to scallops. In general, the availability of phytoplankton is high, and this indicator is considered stable for scallops.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on prey availability include foreign and subsistence fishing, non-fishing activities, pollution, and climate. Foreign fishing may have negative effects on salmon populations because many of the stocks that spawn in Alaska have large migration patterns in the EBS and may be caught by foreign fisheries. Additionally, foreign fisheries may affect the availability of prey for salmon that migrate into foreign waters. Subsistence fishing in 1994 harvested 1 million fish out of a total catch of 194 million, which is a relatively small percentage of the total catch. Subsistence harvest is more likely to directly affect adult salmon population levels than the feeding habits of salmon, because the fishery targets adult fish. Current and past levels of fishing (which include foreign and subsistence fishing) have not likely had significant effects on the prey availability for crab species, because these prey items are very common. Foreign and subsistence fishing would not likely substantially affect the prey availability for scallops, because most of the scallops harvested in areas managed by the FMP are caught in domestic commercial fisheries.

Non-fishing activities likely negatively affect populations of salmon and potentially some populations of crab and scallops. Mining and logging have been shown to have affected salmon populations in many areas due to effects on freshwater habitat quality and water quality that reduce the survival rates for juvenile salmon and may affect prey for juvenile salmon. Crabs and scallops that inhabit the nearshore areas may also be affected by changes in marine water quality due to freshwater inputs. For example, benthic prey species for crab may be buried if large sediment pulses are delivered to nearshore areas from freshwater systems. Any reduction in nutrient inputs to nearshore areas from freshwater systems could also reduce the levels of phytoplankton available for scallops.

Pollution may affect the feeding habits and prey availability of salmon, crab, and scallops. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These changes often affect salmon, crab, and scallop prey as well, and would likely affect the feeding habits of these species. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. Thus, increases in crab and scallops could be seen during warmer cycles. Climate events can have significant effects on prey species distribution and survival and can affect recruitment and other processes in ways that are not yet understood.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on prey species for salmon, crab, and scallop are not well documented at this time.

In summary, foreign fishing may negatively affect feeding abilities of salmon due to direct mortality, but is not likely to affect crab or scallops. Non-fishing activities, pollution, and climate will continue to affect salmon, crab, and scallops, but the direction and magnitude of these effects is unknown.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on feeding. Actions may include reduction in harvest rates for groundfish due to the F40 report, changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternatives to describe and identify EFH would have mixed indirect effects on prey availability and the feeding habits of salmon, crab, and scallops due to differences in preferred prey species. For salmon, Alternative 1 would likely have negative indirect effects on prey availability, because it would remove existing EFH descriptions that would likely have triggered protection for nearshore areas that are essential for salmon rearing and feeding, and for salmon prey. Alternative 2 would have no effect, because it would not change the existing regulations. Alternatives 3 through 6 would increase the identification of EFH, which could trigger additional protection of salmon feeding areas and could have indirect positive effects on the productivity of salmon species in Alaska.

The alternatives to describe and identify EFH are unlikely to have substantial effects on prey availability for crab, due to the fact that prey species for crab are common. These alternatives would also not likely affect prey availability for scallops, because the levels of phytoplankton would not be affected by describing and identifying EFH.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would have mixed indirect effects on the prey availability and the feeding habits of salmon, crab, and scallops due to differences in preferred prey species. For salmon, Alternative 1 would likely have indirect negative effects, because it would remove existing HAPC identification that would likely have triggered protection measures for nearshore areas that are essential for salmon rearing and feeding, and for salmon prey species. Alternative 2 would have no effect, because it would not change the existing regulations. Alternatives 3 through 6 would provide additional HAPC identification which could trigger additional protection for salmon feeding areas. These potential protection measures would likely have positive effects on the productivity of salmon species in Alaska.

The alternatives to identify HAPCs are unlikely to have substantial effects on prey availability for crab due to the fact that prey species for crab are very common. These alternatives would also not likely affect prey availability for scallops, because the levels of phytoplankton would not be affected by describing and identifying EFH.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The alternatives to minimize the effects of fishing on EFH would not likely affect salmon species, because the alternative actions are not specific to salmon feeding areas. These alternatives would be unlikely to have substantial effects on prey availability for most crab species, due to the fact that prey species for crab are very common, although fishing impacts to king crab and deepwater Tanner crab prey are unknown. The EFH fishing effects minimization alternatives would also not likely have any substantial effects on prey availability for scallops due to the lack of expected effects on phytoplankton levels.

Summary of Cumulative Effects

Past effects on factors affecting target species such as feeding and prey availability have been judged as neutral or negative. Prey availability and feeding habits of most species of salmon, crab, and scallops are considered stable, although fishing impacts to king crab and deepwater Tanner crab prey are unknown. However, those species and life stages of salmon that rely on herring may be experiencing reductions in prey availability due to declines in herring populations. Non-fishing activities, pollution, and climate may have effects on prey availability for salmon, crab, and scallops, but the specific direction and magnitude of these effects is unknown. More recent management actions have sought to maintain the stable populations and provide for additional conservation of feeding habitat for target species, and planned future actions are meant to do the same. EFH description Alternative 1 and HAPC identification Alternative 1 could have indirect negative effects on feeding habitat by removing existing trends in the triggers for habitat protection measures. EFH and HAPC identification Alternatives 2 would not affect current trends in the level of feeding or prey availability, because they would maintain the status quo.

EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 would indirectly increase feeding success by providing additional triggers for habitat protection measures. The EFH alternatives to minimize the effects of fishing on EFH would have neutral effects overall, with some localized positive effects, in line with other current and planned future management actions. In particular, Alternatives 4, 5A, and 5B could have some positive effects for opilio crabs, but for overall crab populations these effects would not be substantial. For the most part, the EFH fishing effects minimization alternatives are expected to have a neutral influence with respect to cumulative effects on target species. Overall, the cumulative effects of the action alternatives on feeding of salmon, scallops, and crab would be neutral or positive.

4.4.5.2.5 Growth to Maturity

Past and Present Trends Contributing to Cumulative Effects

Growth to maturity for salmon, crab, and scallops varies due to large differences in life history. Salmon growth to maturity in Alaska has been well documented and continues to occur at the normal rate. Specific year-classes may have increased or decreased growth rates due to changes in local conditions, but overall, the rate of growth to maturity for salmon is not changing significantly.

Crabs are relatively long-lived species, and growth to maturity can take several years. For crab stocks that are listed as below MSST, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and the EBS Tanner crab, there may have been a negative effect of trawl gear on juvenile crab that live in sensitive benthic environments. The geographic extent of the crab fishery is quite small and is unlikely to have substantial direct effects on crab growth to maturity. Currently, growth to maturity for crabs is, therefore, considered stable.

Growth to maturity for weathervane scallops occurs over 3 years. Juvenile mortality caused by fishing could occur due to siltation from dredging activity and contact with bottom fishing gear. The level of impact from these types of activities is not thought to be substantial at this time, and growth to maturity for scallops is considered stable.

External Factors Contributing to Cumulative Effects

External factors that may contribute to cumulative effects on growth to maturity include foreign and subsistence fishing, non-fishing activities, pollution, and climate. Foreign fishing may have effects on salmon populations, because many of the stocks that spawn in Alaska have large migration patterns in the EBS and may be caught by foreign fisheries. Additionally, foreign fisheries may affect the growth to maturity for those that migrate into foreign waters, either by affecting prey species or by direct mortality. Subsistence fishing in 1994 harvested 1 million fish out of a total catch of 194 million, a relatively small percentage of the total catch. Subsistence harvest is more likely to directly affect adult salmon populations than the growth rates of salmon, because the fishery targets adult fish. Foreign and subsistence fishing do not likely have effects on the growth to maturity for crab species, because these fisheries represent a small portion of the overall fishing effort. Foreign and subsistence fishing would not likely substantially affect growth to maturity for scallops, because these fisheries do not disturb the ocean substrate significantly.

Non-fishing activities could affect salmon, crabs, and scallops. Non-fishing activities such as logging, mining, and construction could affect the growth to maturity of salmon if the fine sediment or disturbance from these activities causes mortality to juvenile salmon in freshwater or nearshore areas.

Crab and scallop growth to maturity could be negatively affected if inputs of sediment from freshwater systems affect nearshore areas that are inhabited by juvenile crabs and scallops.

Increasing pollution may affect the growth to maturity of salmon, crab, and scallops. Climatic cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. These changes affect growth rates of salmon, crab, and scallops, and long-term climate change could have significant impacts on the average growth to maturity of these species groups. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. Thus, increases in salmon, crab, and scallops could be seen during warmer cycles.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on growth to maturity for salmon, crab, and scallops are not well documented at this time.

In summary, foreign fishing will negatively affect salmon growth to maturity through direct mortality, but will not likely affect growth to maturity for crab and scallops. Non-fishing activities, pollution, and climate will affect growth to maturity of salmon, crab, and scallops, but the direction and magnitude of these effects is currently unknown.

Future Management Actions Contributing to Cumulative Effects

There are a number of potential future management actions that may affect target species, as measured by effects on growth to maturity. Actions may include reduction in harvest rates for groundfish due to the F40 report, changes in harvest rates of crab due to rebuilding plans and re-examination of the MSST levels, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, changes in mortality and effort associated with changes in the IR/IU program, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. All of these measures would be expected to provide for additional conservation for target species compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternatives to describe and identify EFH would have mixed indirect effects on the growth to maturity for salmon, crab, and scallop species. Alternative 1 would remove existing EFH description that could trigger protection for areas that may be used by spawning and juvenile salmon, crab, and scallops, and would likely have indirect negative effects on growth to maturity. Alternative 2 would have no effects on this indicator, because it would not result in any changes to current fishing regulations. Alternatives 3 through 6 would be likely to have some indirect beneficial effects on salmon, crab, and scallop growth to maturity due to the additional identification of EFH. This identification would likely trigger additional protection for some areas that would be used by spawning and juvenile salmon, crab, and scallops. Under Alternative 6, protection would occur only in federal waters; in waters managed by the state, no EFH would be identified. However, there are some existing closures in state waters to bottom trawling in areas of the GOA and Bristol Bay. If the state chooses to mirror federal closures, there could be an equal level of protection in both state and federal waters under Alternative 6.

Contributions to Cumulative Effects Related to HAPC Identification

Alternatives to identify HAPCs would also have mixed indirect effects on growth to maturity of salmon, crab, and scallop species. Alternative 1 would likely have indirect negative effects by removing existing EFH descriptions that could have triggered protection for areas that may be used by spawning and juvenile salmon, crab, and scallops. Alternative 2 would have no effects on this indicator, because it would not result in any changes to current fishing regulations. Alternatives 3 through 5 would be likely to have some indirect beneficial effects on salmon, crab, and scallop growth to maturity, due to the additional EFH descriptions that could trigger protection for some areas that may be used by these species.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The EFH fishing impact minimization alternatives would have varying effects on growth to maturity of salmon, crab, and scallops. These alternatives would have no effect on the growth to maturity of salmon. They would have mixed effects on growth to maturity for crab species. Alternatives 1 through 3 would not likely have any effect on crab growth to maturity, because they would not affect crab habitat or juvenile survival. Alternatives 4 and 5A would have beneficial effects on crab growth to maturity due to protection measures for juvenile crab. Alternative 5B would likely have some benefit to opilio crab growth to maturity because the closures would be in areas of high concentration for opilio crab and the requirement for large bobbins and rollers on bottom gear would reduce disturbance of juvenile crab. Alternative 5B would also provide additional protection for habitat for golden king crab in the AI. Alternative 6 would also be likely to benefit crab growth to maturity because the closure areas in this alternative overlap with crab EFH areas for Pribilof Island and St. Matthews blue king crab, Pribilof Islands red king crab, AI red king crab, Bristol Bay red king crab, and EBS Tanner crab. Many of these areas include existing protection measures such as the nearshore Bristol Bay Red King Crab Savings Area and the Pribilof Islands Conservation Area. However, these alternatives would add protection to the west and north of existing closures. Additionally, the requirement for large bobbins and rollers on bottom gear would reduce disturbance of juvenile crab. The results of bobbin regulation on habitat are discussed on page 4.3-94. The alternatives to minimize the effects of fishing on EFH would not be expected to have any substantial effects on scallop growth to maturity due to the small geographic distribution of the scallop fishery and the small area of overlap with areas of scallop concentration.

Summary of Cumulative Effects

The past trend in growth to maturity for salmon, crab, and scallops has been one of stability. Non-fishing activities, pollution, and climate could affect growth to maturity for these species groups, but the direction and magnitude of these effects is unknown. More recent management actions have sought to maintain the stable populations and provide for additional conservation of habitat for the juvenile stages of target species, and planned future actions are meant to do the same. EFH description Alternative 1 and HAPC identification Alternative 1 could have indirect negative effects on growth to maturity by removing existing triggers for habitat protection measures. EFH and HAPC identification Alternatives 2 would not affect current rates of growth to maturity because they would maintain the status quo. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 would indirectly benefit growth to maturity of salmon, crab, and scallops by providing additional triggers for habitat protection measures. The EFH alternatives to minimize the effects of fishing on EFH would have neutral or positive effects overall, in line with other current and planned future management actions. In particular, Alternatives 4 through 6 would have positive effects for growth to maturity of crabs. All other EFH fishing impact minimization alternatives would have neutral effects on growth to maturity. Overall, the cumulative effects of the action alternatives on growth to maturity of salmon, scallops, and crab are neutral or positive.

4.4.6 Cumulative Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.4.6.1 Passive Use Value and Future Use Benefits

Past and Present Trends Contributing to Cumulative Effects

Studies have shown significant willingness on the part of the general public to pay for the passive use of some species and at least some types of habitat that the individuals never expect to directly use. One can plausibly assume that any habitat considered for regulation has such a non-use value; otherwise, it would not likely become a subject for protective regulations. However, it is unclear whether such passive use values associated with this EFH action are increasing, decreasing, or remaining static.

External Factors Contributing to Cumulative Effects

External factors affecting EFH include foreign fisheries and subsistence fishing, as well as non-fishing activities such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase. It is likely that the interested public's perception of the long-term health of EFH will continue to be the dominant factor in determining its passive use value.

Future Management Actions Contributing to Cumulative Effects

All future management actions taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. Passive use values and the potential for future productivity gains would likely be increased with implementation of no-take marine reserves, and to a lesser extent, marine managed or protected areas.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternative 1 could have negative effects on passive use values. The lack of EFH descriptions may cause some people who do not participate in fisheries to incur a welfare loss if they perceive that habitats are not protected adequately. The action alternatives to describe and identify EFH (Alternatives 3 through 6) could have positive effects on passive use values. Describing and identifying EFHs may cause some people who do not participate in fisheries to enjoy a welfare increase if they perceive that habitats are protected adequately. Alternative 2 represents a continuation of status quo conditions and, therefore, would have no effect relative to current passive use values.

Contributions to Cumulative Effects Related to HAPC Identification

Alternative 1 could have a near-term negative effect on passive use values if the absence of HAPCs makes it less likely that there would be new restrictions on certain fisheries to protect habitats. In the long term, the protection of valuable habitats under the action alternatives (Alternatives 3 through 5) could be beneficial from a passive use perspective because this may cause some people who do not participate in fisheries to enjoy a welfare increase if they perceive that habitats are protected adequately. Alternative 2 represents a continuation of status quo conditions and, therefore, would have no effect relative to current passive use values.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

To the extent that this analysis measures passive use in terms of the expected reduction in fishery impacts on EFH, EFH fishing effects minimization Alternatives 2 through 6 would be expected to have positive effects on passive use values, with the values increasing with the size of the impact reduction. Only the no action alternative (Alternative 1) would have no effect on current passive use values.

Summary of Cumulative Effects

While it is plausible to assume that any habitat considered for regulation has passive use or non-consumptive use value, it is unclear whether these types of values have been increasing, decreasing, or remaining static in the context of EFH. External factors including foreign fisheries and subsistence fishing, as well as non-fishing activities such as mining, dredging, and fill, have affected the quantity and quality EFH. It is likely that the interested public's perception of the long-term health of EFH will continue to be the dominant factor in determining its passive use value. In that respect, the action alternatives to describe EFH (Alternatives 3 through 6), identify HAPC (Alternatives 3 through 5), and minimize the effects of fishing on EFH (Alternatives 2 through 6) would be expected to have positive effects on passive use values. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternative 1 would have no effect relative to existing conditions. EFH description Alternative 1 and HAPC identification Alternative 1 could have negative effects on passive use values because the lack of EFH protections may cause some people who do not participate in fisheries to incur a welfare loss if they perceive that habitats are not protected adequately. It is difficult to assess potential cumulative effects with respect to passive use values because the effects of past actions on these values are unknown. To the extent that the action alternatives are likely to result in positive effects on passive use values, these alternatives would contribute to potentially positive cumulative effects.

4.4.6.2 Gross Revenue Effects

Past and Present Trends Contributing to Cumulative Effects

Historical trends in the Alaska groundfish fisheries and to a lesser extent, the crab, halibut, and salmon fisheries, are well documented in the Steller Sea Lion SEIS (NMFS 2001b) and the Programmatic Groundfish SEIS (NMFS 2004). Key issues include the following:

- Concerns regarding overcapitalization of fisheries and growth of the offshore sector in the late 1980s led to management actions based on avoiding preclusion of different fishing-related sectors. Inshore/Offshore allocative splits changed fisheries in both the GOA and BSAI.

- The AFA changed the nature of pollock quota allocations between and among sectors. Co-ops were formed both offshore (1999) and onshore (2000), and fishery participants are still adapting to the new context. Significant capital was removed (that is, vessels retired) from the offshore fleet, the race for fish was essentially eliminated, and new types of operational relationships were formed between processors and their harvesting fleets. Ownership structures changed, with increased American ownership overall. A specific trend of note has been increased investments in the fishery by CDQ groups.

- Management measures directed toward Steller sea lion protection have had a significant impact on some fisheries. Some of the more restrictive measures were imposed in 2000, and a full suite of alternative measures were analyzed by NMFS in 2001 (NMFS 2001b). Given the recent nature of these developments and the interactive nature of Steller sea lion-related management changes with other management initiatives, impacts are still unfolding, and are expected to vary significantly from community to community and region to region.

In general, these sources point to the following trends:

- A decline in the number of participating catcher vessels
- A decline in the number of participating catcher-processors
- A decline in the number of inshore processors and motherships, with the exception of a slight increase in Alaska Peninsula and AI inshore plants and a stable number of EBS pollock inshore plants

Total groundfish catch in commercial fisheries off Alaska in 2001 was 2.1 million metric tons, which is lower than the peak harvest years of 1991 to 1997, but only slightly lower than the 16 year annual average. Ex-vessel values for the total catch in the domestic salmon and groundfish fisheries off Alaska between 1990 and 2001 have varied from year-to-year, with salmon values (adjusted to constant dollars) showing an overall downward trend. Groundfish total ex-vessel values have also shown considerable variation from year-to-year, but the overall trend has remained fairly constant (Hiatt et al. 2002).

External Factors Contributing to Cumulative Effects

External factors that have influenced the subject fisheries and may continue to do so include foreign fishing, state-managed fisheries, certain market factors, and subsistence fishing. With respect to groundfish, foreign fisheries have historically had a significant cumulative influence on fishing stocks, which led to many fisheries being over-harvested and to long-term effects on stocks and the sustainable yield of specific fisheries. Foreign vessels also used Alaska ports for services, leading to the expansion or development of commercial services and marine infrastructure in many coastal communities. Foreign ownership in inshore fish processing is significant. Both historically and currently, foreign ownership influences the form of the fish product, specific processing lines and equipment, and transport and distribution of the processed product. However, the AFA now requires 75 percent United States ownership of vessels participating in the EEZ fisheries. Foreign fisheries currently provide groundfish for many of the same domestic and foreign markets supplied by Alaska fishermen, and compete for market share. If harvest levels of Alaska groundfish fall as a result of EFH regulation, foreign seafood suppliers could capture market share currently being served by Alaska product.

The Alaska scallop fishery has a history of being sporadic due to exploitation of limited stocks, market conditions, and the availability of more lucrative fisheries. The scallop industry has undergone a number of recent changes, with the establishment of a moratorium on new licenses and then a license limitation program.

The state commercial salmon fisheries harvest has been extremely variable, as exemplified by a nearly-record high catch in 1999, and a very low harvest level in 2000. Although ADF&G considers most of the commercial fishery stocks to be healthy, declining prices and periodic low harvest levels have had a negative effect on both harvesters and processors. The worldwide supply of farmed salmon originating outside of Alaska will continue to increase supply and depress salmon prices for both state-managed and FMP salmon fisheries.

Market factors also affect certain fisheries. Seafood prices constantly fluctuate, and product prices influence the fishing schedules of some fleets; this changes fisheries, target species, and product mixes depending on prices set in the global marketplace. External market forces for many products (e.g., rock sole with roe and yellowfin sole kirimi) have been and will continue to be a dominant factor in determining gross revenue for those fisheries.

Subsistence fishing makes up a sufficiently small percentage of current total fishing activity that it is unlikely to affect the harvest volume or value of FMP species.

Non-fishing activities such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH could also affect fishing revenues to the extent that they affect ABC, TAC, or CPUE for the affected fisheries. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase.

Future Management Actions Contributing to Cumulative Effects

All future management actions taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries as measured by effects on gross revenue. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. With the exception of the rationalization programs, most future measures cited above may have negative effects (to some degree) on gross revenues.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

All of the alternatives to describe and identify EFH would have unknown net effects on the fishing industry in terms of gross revenue. In the short term, certain sectors of the fishing industry could experience decreased revenues under Alternatives 3 through 6, because the alternatives would trigger the Magnuson-Stevens Act requirements to reduce the adverse effects of fishing on EFH. However, the true effects of identification are unclear at this time. Under Alternative 1, there would be no EFH description and therefore no trigger to reduce the adverse effects of fishing on EFH, so the industry would avoid the possibility of related regulation. In the longer term, if reducing the effects of fishing on sensitive habitats leads these habitats to produce greater numbers of fish, fishing industry revenues could increase. However, both the short-term and long-term effects of identification are unclear at this time. Alternative 2 represents status quo conditions and, therefore, would have no effect relative to existing conditions.

Contributions to Cumulative Effects Related to HAPC Identification

All of the alternatives to identify HAPC are expected to have no short-term effect on the fishing industry in terms of gross revenue. Because it is describing and identifying EFH rather than HAPC identification that could trigger the Magnuson-Stevens Act to reduce the adverse effects of fishing on EFH, HAPC identification is likely to have no additional effect, at least in the short term. In the longer term, if designating HAPCs leads these habitats to produce greater numbers of fish, fishing industry revenues could increase. However, the long-term effects of identification are unclear at this time.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

No substantial changes in revenues to the fishing fleet or processing sector are expected under Alternatives 1 and 2. There would be no direct industry revenue at risk[1] under Alternative 1 because there would be no additional measures put in place to minimize the effects of fishing on EFH. Catch and revenues at risk under Alternative 2 could probably be compensated for by deploying fishing efforts into adjacent areas not directly affected by the alternative. Alternatives 3 through 6 are expected to result in reductions in harvest and gross revenue, although the extent of the negative impact cannot be measured at this time. Revenue placed at risk would range from $0.90 million under Alternative 2 to $237.20 million under Alternative 6. Although some of the catch and revenue at risk could likely be made up by fishing in other locations, with other gear, at other times, and/or for other species, it is probable that the higher the revenue at risk (e.g., Alternative 6), the less likely it is that all catch and revenue could be replaced.

Summary of Cumulative Effects

Current and historic trends related to gross revenue include a decline in the number of participating catcher vessels and catcher-processors, as well as a general decline in the number of inshore processors and motherships. Ex-vessel values for the total catch in the domestic salmon and groundfish fisheries off Alaska between 1990 and 2001 have varied from year to year. Total salmon ex-vessel values show an overall downward trend over this period, while the overall trend for groundfish total ex-vessel values has remained fairly constant. External factors, including effects of foreign fishing, state-managed fisheries, market factors, and subsistence fishing, may impact harvest, price, and revenues. The potential effects of the alternatives to describe and identify EFH and HAPC on the fishing industry in terms of harvest, price effects, and gross revenue are generally neutral or unknown. Restricting fishing grounds could affect the flexibility of those fleets that respond to world market conditions by changing their fishing schedules. No substantial changes in revenues to the fishing fleet are expected under EFH fishing impact minimization Alternatives 1 and 2. EFH fishing impact minimization Alternatives 3 through 6 are expected to result in reductions in harvest and gross revenue, but the extent of the negative impact cannot be measured at this time. The cumulative effect of all actions – past, present, and future – on gross revenue is difficult to predict.

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[1] "Revenue at risk" should be regarded as an upper-bound estimate. That is, it represents a projection, based upon historical effort and landings data, of the gross value of the catch that would be foregone as a result of one or more provisions of the proposed action, *assuming* none of that displaced catch could be made up by shifting effort to another area. In many cases, this will not be the case. Therefore, the true impact on gross revenue is likely to be smaller than the estimated revenue at risk, although that is not assured.

4.4.6.3 Operating Costs

Past and Present Trends Contributing to Cumulative Effects

Fixed and variable operating costs such as fuel, insurance, and labor have been increasing over time (NMFS 2001a). Fuel ranks at or near the top of the list of operating expenses in the fisheries under consideration in this action. Fuel costs nearly doubled between 1999 and 2001 in some regions, including Western Alaska and the states of California, Oregon, and Washington (NMFS 2001a; Appendix C). Fuel prices declined between 2001 and 2002 in all regions, but were higher in most regions than they were in 1999. Prices in Western Alaska and the Seattle area were still notably higher in 2002, than they were in 1999 (Pacific States Marine Fisheries Commission 2003).

External Factors Contributing to Cumulative Effects

The external factors that have affected and will continue to affect the operating costs for the FMP fisheries relate primarily to the forces that affect the cost of inputs to the fisheries. For example, the prices paid by fishermen for fuel in Alaska are very directly influenced by the world market for petroleum and petroleum products. Similarly, the costs of insurance, labor, and so forth are subject to market forces far beyond the borders of Alaska. The direction of these economic changes may vary from year to year, but the overall trend is likely to continue upward, implying increasing costs to the industry over time.

Non-fishing activities such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH could also affect operating costs to the extent that they affect CPUE for the affected fisheries. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase.

Future Management Actions Contributing to Cumulative Effects

Virtually all of the future management actions that may be taken by the Council and the NMFS Alaska Region have the potential to affect operating costs of fishermen. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Programmatic Groundfish SEIS (NMFS 2004); costs associated with changes in the IR/IU program; and changes in operating costs provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. With the exception of the rationalization programs, most future measures may have negative effects (to some degree) on operating costs as fisheremen alter their current operations to attempt to minimize revenue losses associated with these management actions.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternative 1 could result in short-term reductions in operating costs for the fishing industry because existing EFH descriptions would be rescinded; there would be no relocation of fishing effort to avoid impacts to habitat and no additional monitoring costs. In the longer term, operating costs could increase if fishing activities diminish the productivity of habitats, and fleets have to fish harder to catch the same or declining numbers of fish. Alternative 2 would have no effect on operating cost trends because it represents the status quo. Alternatives 3 through 6 could have indirect negative effects for certain sectors of the fishing industry by establishing triggers that could cause temporal displacement and/or spatial relocation of fishing effort, or changes in gear to avoid impacts to habitats identified as EFH. Describing and identifying EFH could also impose additional monitoring costs.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs would be likely to have both positive and negative effects on industry operating costs. Alternative 1 could have a near-term, indirect positive effect on fishing industry operating costs if the absence of HAPCs makes it less likely that there would be new restrictions on certain fisheries to protect habitats. Alternative 2 would have no effect on operating cost trends because it represents the status quo. Alternatives 3 through 5 could have a near-term, indirect negative effect on operating costs if the HAPC identification trigger new restrictions on certain fisheries, with a potential long-term positive effect if the protection of valuable habitats promotes healthier fish stocks.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

There would be no impacts on operating costs under Alternative 1 because there would be no additional measures put in place to minimize the effects of fishing on EFH. The other alternatives would be likely to have negative effects on operating costs relative to Alternative 1. There would likely be minimal changes in operating costs for the catcher vessel fleet under Alternative 2, but catcher-processor costs might increase due to the necessary redeployment of fishing effort to other areas. Operating costs would likely be greater overall for both the catcher vessel and catcher-processor fleet components under Alternative 3. There would likely be minimal changes in operating costs for the catcher vessel fleet under Alternative 4, but catcher-processor costs might increase due to the necessary redeployment of fishing effort to other areas. Catcher-processors operating in the EBS NPT flathead sole fishery may have increased operating costs due to increased running time to reach northern fishing areas when the more southerly areas are closed. The required use of bobbins and disks on NPT footropes, trawl sweeps used in open areas, and the switch to pelagic trawls for small boats under Alternative 4 may also result in increased operating costs. It may be that operations confronted by these NPT restrictions will choose to switch to PTR, if (1) the vessel is capable of using that gear type (e.g., has sufficient horsepower), (2) the cost of PTR acquisition and operation is not too great, and (3) if CPUE using PTR, in lieu of NPT, is sufficient to cover operating costs and yield some net revenues. Operating cost impacts under Alternatives 5A, 5B, and 5C may be greater overall for both the GOA catcher vessel component and the catcher-processor fleet components in all areas. Alternative 6 would likely have significant adverse impacts on the operational costs of most, if not all, of the bottom contact gear groups as a result of increased running times, increased fishing effort, and increased costs associated with exploring unfamiliar fishing grounds.

Summary of Cumulative Effects

Fixed and variable operating costs have been increasing over time. External factors, such as the world market for petroleum and petroleum products, market forces beyond the region that affect the costs of insurance, labor, and so forth, and localized non-fishing activities, will continue to affect operating costs. The action alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 3 through 5), and minimize the effects of fishing on EFH (Alternatives 2 through 6) are expected to have negative effects on operating costs for certain sectors of the fishing industry at least in the short term. The action alternatives to describe and identify EFH could have negative indirect effects for certain sectors of the fishing industry by establishing triggers that could cause temporal displacement and/or spatial relocation of fishing effort, or changes in gear to avoid impacts to habitats identified as

EFH. Describing and identifying EFH could also impose additional monitoring costs. HAPC identification Alternatives 3 through 5 could prompt new restrictions on certain fisheries, but may provide healthier fish stock in the long term. With respect to the action alternatives to minimize the effects of fishing on EFH, effects to operating costs would vary by alternative. EFH description Alternative 1 and HAPC identification Alternative 1 could have short-term, indirect positive effects on operating costs with existing EFH descriptions rescinded and the absence of HAPC identification. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impacts minimization Alternative 1 would have no effect on existing operating cost trends. The cumulative effect of all actions – past, present, and future – is toward an overall increase in operating costs. Alternatives that would increase operating costs would contribute directly to this trend, at least in the short run. The other alternatives would have no effect on the cumulative effects of all actions.

4.4.6.4 Costs to United States Consumers

Past and Present Trends Contributing to Cumulative Effects

The EBS, AI, and GOA fisheries provide high and relatively stable levels of seafood products to domestic and foreign markets. United States consumption of fish products has been increasing as fish products appear in the fast food industry, in packaged meals, and in institutional markets. Absolute United States consumption of fillets and steaks, measured in pounds, increased by approximately 25 percent between 1990 and 2001, with per capita consumption also increasing over this period. United States consumption of fish sticks and portions decreased over this period both in absolute terms and on a per capita basis (Hiatt et al. 2002). A review of consumer price index information compiled from data collected by the United States Bureau of Labor Statistics indicates that the cost of fish for United States consumers has increased over the past two decades. The cost of fish experienced an annual average increase between 1976 and 2001 slightly above the annual average cost increase for all items, with noticeably large increases occurring in 1986, 1987, and 1989. The cost of fish did, however, increase at a much lower rate than the cost of all items between 2000 and 2001 (Hiatt et al. 2002).

External Factors Contributing to Cumulative Effects

Costs to United States consumers of products from the FMP fisheries are influenced by the demand for all types of foreign and domestically produced seafood products and both the foreign and domestic supplies of such products. In other words, Alaska seafood products are part of a world market, of which the FMP fishery products are a small part in most cases. However, FMP fishery products have high value in seafood markets and, in some cases, provide the dominate supply of some types of seafood products. External market effects can occur as a result of specific markets in specific countries. Another factor that can affect the supply of and demand for the products of the FMP fisheries is the value of the dollar against the currencies of other countries that are consumers and/or suppliers of fish/seafood products. A strong dollar will tend to increase imports to the United States from other countries and decrease the demand for United States exports overseas. A weaker dollar will have the opposite effect, increasing the demand for United States exports and decreasing the attractiveness of foreign imports to the United States These factors will continue to play a major role in the cost consumers pay for fish and fish products from the FMP fisheries.

Non-fishing activities such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH could also affect costs to consumers to the extent that supplies of seafood products are reduced due to non-fishing-related EFH impacts. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase.

Future Management Actions Contributing to Cumulative Effects

Virtually all of the future management actions that may be taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries as measured by effects on consumer costs. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. With the exception of the rationalization programs, most future measures may have neutral to negative effects on consumer costs if operational cost increases can be passed on to consumers or if there are changes in the product mix, product quality, and supply of various species and products.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

The potential effects of the alternatives to describe and identify EFH on consumer costs is unclear. Alternative 1 would have no immediately discernable effect on costs to consumers of seafood, but if substantial declines in habitat productivity were to occur in the future, a potentially diminished catch could cause consumers to experience higher prices for seafood and other fish-based products from Alaskan waters. Alternative 2 would have no effect on consumer cost trends because it represents the status quo. Alternatives 3 through 6 would also have no immediately discernable effect on costs to consumers for seafood, but could indirectly result in increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices in the future, if productivity were enhanced as a result of protection measures that could be triggered as a result of the identification of EFH. The likelihood of such an improvement cannot, however, be determined based on current information.

Contributions to Cumulative Effects Related to HAPC Identification

Conservation of HAPCs is expected to support healthier fish stocks and more productive fisheries over the long term. The alternatives to identify HAPCs are not, however, expected to affect consumer costs.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternative 1 is not expected to affect costs to consumers. Alternatives 2 though 6 could increase costs to consumers if operational cost increases can be fully or partially passed on to consumers, or if there are changes in the product mix, product quality, or supply of various species and products. The operational cost increases could apply to both the fisheries that are directly affected by the alternatives to minimize the effects of fishing on EFH, as well as fisheries indirectly affected by redeployment of other vessels. However, the extent to which these changes could actually affect prices to consumers is unknown, because most products compete in a world market where substitutes are available.

Summary of Cumulative Effects

The FMP fisheries provide high and relatively stable levels of seafood products to domestic and foreign markets and United States consumption of fish products has been increasing. External markets can affect supply and demand of FMP fishery products and their costs to United States consumers, as can the value of the dollar against the currencies of other countries that are consumers and/or suppliers of fish/seafood products and marine hardware such as nets, winches and electronics. Exchange rates will similarly impact the prices paid by domestic fishermen for imported marine hardware, nets, winches, electronics, etc. Most future management actions are expected to have negative effects on consumer costs (i.e., resulting in an increase). The effects of the alternatives to describe and identify EFH are unclear, with none of the alternatives expected to have immediately discernable effects on costs to consumers of seafood. EFH description Alternatives 3 through 6 could, however, indirectly result in increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices in the future, if productivity were enhanced as a result of protection measures that could be triggered as a result of the identification of EFH. EFH description Alternative 2, the alternatives to identify HAPCs, and EFH fishing effects minimization Alternative 1 are not expected to affect consumer costs. The action alternatives to minimize effects of fishing on EFH (Alternatives 2 through 6) could increase costs to consumers if operational cost increases can be passed on to consumers or if there are changes in the product mix, product quality, or supply of various species and products. The cumulative effect of all actions – past, present, and future – is toward an overall increase in costs to consumers. Alternatives that could potentially increase costs could directly contribute to this trend, but only to the extent that costs can be passed on to consumers.

4.4.6.5 Safety

Past and Present Trends Contributing to Cumulative Effects

Commercial fishing is a dangerous occupation. During most of the 1990s, commercial fishing appeared to become relatively safer, with an apparent decline in the annual occupational fatality rate. This improvement was due in part to the allocation of TAC to various harvesting and processing sectors, which reduced the race for fish that raised the risks in an already high-risk profession. Other safety enhancements include increased use of position-indicating radio beacons, immersion suits, and life rafts; improved crew training; and forward placement of long-range search helicopters. These factors have effectively reduced deaths associated with capsized or sinking vessels, both by keeping crew members afloat and warm and by speeding search and rescue efforts.

External Factors Contributing to Cumulative Effects

Improvements in technology are likely to continue to reduce the risks associated with fishing in the EBS, AI, and GOA, both by reducing the number of incidents and by speeding search and rescue efforts.

Future Management Actions Contributing to Cumulative Effects

Virtually all of the future management actions that may be taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries with respect to safety. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. Some of these actions may reduce the safety of the fishing fleet by focusing fishing in smaller and/or more remote areas, but most should improve the safety of the fleet by slowing and rationalizing the fisheries. Future management actions would therefore make both positive and negative contributions to cumulative effects on safety.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

The alternatives to describe and identify EFH are not likely to affect safety of the fishing fleet because the actual process of identification would not likely trigger changes in safety regulations.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs are not expected to affect the safety of the fishing fleet because the process of identification would not likely trigger changes in safety regulations.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Safety-related issues considered with respect to the EFH fishing impact minimization alternatives include fishing farther offshore, reduced profitability, and changes in risk. Changes in fishery management regulations that result in vessels, particularly smaller vessels, operating farther offshore appear likely to increase the risk of property loss, injury to crew members, and possibly loss of life. Reduced profitability could be an indirect cause of higher accident rates. For example, fishermen facing a profit squeeze could defer needed maintenance on vessels and equipment, reduce operating costs by cutting back on safety expenditures, or scale back on the size of their crew in order to reduce crew share and expenses. These factors are examples of increases in risk. These potential increases in risk may be offset to some extent by changes in fleet behavior, such as reduced levels of participation by smaller vessels.

Alternative 1 would not affect fishing fleet safety, because it would maintain the status quo. Alternative 2 might not affect safety in the catcher vessel fleet component, but there could be an increase in safety concerns related to the catcher-processor component. Alternatives 3, 4, 5B and 6 could affect safety in those fleet components that would experience significant operational change and possibly increased fishing effort. In general, the potentially increased risks would be related to fishing for longer periods and/or farther from port, which could increase the chance of encountering adverse weather and decrease the speed and efficiency of rescue efforts if needed. Alternative 3 would likely affect safety in all fleet components of the GOA slope rockfish fishery. Alternative 4 could adversely affect safety for catcher-processors targeting flathead sole, other flatfish, and Pacific cod in the EBS. Alternative 5A would not likely affect fleet safety in the GOA or the Aleutian Islands because fishing effort would be redeployed to adjacent fishing areas with similar distances to the fleet's home port. In the BS, some closures may increase travel distance and decrease safety, but the overall effect is not considered substantial. Alternatives 5B and 5C would likely negatively affect the safety of the catcher vessel and catcher-processor fleet components in the AI. Alternative 6 would increase safety costs in many of the affected fleet components and fisheries.

Some factors would tend to have the opposite effect with respect to safety. Any operational changes or redeployment that tended to shift crews from smaller vessels to larger vessels or out of the more dangerous fisheries would have an incrementally positive effect with respect to safety.

Summary of Cumulative Effects

The safety record of vessels engaged in commercial fishing appeared to be improving during most of the 1990s, with an apparent decline in the annual occupational fatality rate. Improvements in technology are likely to continue to reduce the risks associated with fishing in the EBS, AI, and GOA, both by reducing the number of incidents and by speeding search and rescue efforts. The potential effects of future management actions on safety are mixed. Focusing fishing in smaller areas may reduce the safety of the fishing fleet, while the formation of cooperatives could improve safety by reducing the number of independent vessels operating. The alternatives to describe and identify EFH, the alternatives to identify HAPCs, and EFH fishing effects minimization Alternatives 1 and 5A are not expected to affect the safety of the fishing fleet. EFH fishing effects minimization Alternative 2 could result in an increase in safety concerns related to the catcher-processor component, while EFH fishing effects minimization Alternatives 3, 4, 5A, and 6 could affect safety in those fleet components that would experience significant operational change and possibly increased fishing effort. While the effects of future management activities are likely to have a mixed effect on safety, the cumulative effect of all actions – past, present, and future – is likely to continue toward an improvement in safety of the fishing fleets. This overall trend is likely to continue under all alternatives, even though the EFH fishing effects minimization action alternatives could adversely affect safety in certain fisheries.

4.4.6.6 Socioeconomic Effects on Existing Communities

Past and Present Trends Contributing to Cumulative Effects

Many of the communities of coastal Alaska adjacent to the BSAI and GOA are engaged in, and highly dependent upon, the commercial fisheries in the adjacent EEZ. The nature of engagement varies from community to community and from fishery to fishery. Some communities have fish processing facilities, others are homeport to harvest vessels, and many have both processors and harvesters. Some of the larger communities also have relatively well-developed fishing support sectors. Sixty-five communities in the CDQ region and numerous Alaska non-CDQ communities (including Unalaska/Dutch Harbor, Sand Point, King Cove, Chignik, Cordova, Seward, Homer, Adak, Sitka, Petersburg, Yakutat, and Kodiak) are most clearly and directly engaged in and dependent upon multiple BSAI and/or GOA fisheries.

Other economic activities that have historically influenced some of the regional economies are military bases, site cleanup, and municipal construction projects. With the closure of Adak Naval Air Station, near completion of the Adak and Amchitka site clean-up, and reductions in municipal construction projects, these other economic activities have been exerting a declining influence on the communities. Thus, for the dependent Alaska communities, there are very few economic opportunities available as an alternative to commercial fishing related activities. For many of these communities (and especially the CDQ communities), unemployment is chronically high, well above the national average, and the potential for economic diversification of these largely remote, isolated, local economies is very limited. Fishing is the economic base in many of these communities. Moreover, these communities are generally very fragile, in the sense that they do not have well-developed secondary economic sectors. The cost of doing business in these communities is high and few retail or other firms find it economically advantageous to locate in them. As a result, local residents often have no choice but to spend a large part of their incomes outside their communities. In addition, many who work in the fishing and/or processing sector in these communities are transient laborers who take a large part of their incomes home with them at the end of the season.

In addition to the Alaska communities, Seattle, Washington (and the adjacent Puget Sound area), has a substantial and direct involvement in many of these fisheries. Harvest vessels from Oregon, especially from Newport, also account for a significant portion of the total catch in a number of the larger groundfish and crab fisheries. These communities have more diversified economies than most of the Alaska communities, however, and are less vulnerable to the vicissitudes of the fisheries. They are not discussed further in this consideration of cumulative effects.

External Factors Contributing to Cumulative Effects

External factors affecting the socioeconomic status of affected communities include other economic development activities and other sources of revenue. Other economic development activities may interfere with the fisheries by competing for labor, services, and facilities, but they also provide additional employment and revenue opportunities for the local communities. The economic development activities that have the greatest potential for cumulative effects are mining, oil and gas exploration/production, military projects (such as contaminated site clean-up and missile defense projects in the Alaska Peninsula and AI), tourism, and marine or air-related transportation projects.

Municipal and state revenue funds local facilities and services. Within Alaska, regions and communities participating in the fishing industry generate revenue and/or receive shared state revenue from taxes on fishing and from non-fishing sources. The revenues that have the greatest potential for cumulative effects are power cost equalization and municipal revenue sharing programs from the State of Alaska, including shared education funding. During recent years, all three revenue sources have been declining.

Non-fishing activities, such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH could also have socioeconomic effects on existing communities to the extent that they affect employment and income in the FMP fisheries. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase.

Future Management Actions Contributing to Cumulative Effects

All future management actions that may be taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries with respect to community impacts. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. The specific cumulative interaction of these management actions with EFH-related actions are discussed in more detail below under Cumulative Effects Related to Minimizing the Effects of Fishing on EFH.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

The alternatives to describe and identify EFH would probably lead to negative socioeconomic effects for some fishing communities. Alternative 1 would have an indirect positive effect in the short run because there would be no EFH descriptions that could trigger protection measures that would force relocation of fishing effort to avoid impacts to habitat, and there would be no associated costs. Operating costs could, however, increase in the future if fishing activities diminish the productivity of habitats and fleets have to fish harder to catch the same or declining numbers of fish. This could place economic and social stresses on fishing communities. Alternative 2 would not affect existing community trends because it represents the status quo. Under Alternatives 3 through 6, the identification of EFH could trigger protection measures that could cause spatial and temporal dislocation of fishing effort to avoid impacts to EFH, which would impose associated costs on the affected communities. In the longer term it is conceivable that adverse social and economic effects on Alaska fishing communities as a whole could decrease if protecting sensitive areas of EFH results in higher production rates of target species, thereby making fisheries more profitable. The likelihood of this effect cannot be predicted, however.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs would have effects similar to the identification of EFH. Alternative 1 would have a positive effect in the short run with potential negative effects in the long run. These potential effects would be essentially reversed under Alternatives 3 through 5, with indirect negative effects potentially triggered in the short run and potential positive effects in the long run. Alternative 2 would not affect existing community trends because it represents the status quo.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

No substantial impacts to dependent communities are foreseen under Alternative 1. Communities currently dependent on the relevant fisheries would continue to engage in fishing and related activities in the same manner as is occurring under existing conditions. Direct impacts to communities are expected to be small under Alternatives 2, 3, and 4. Although individual vessels and operations could be adversely affected, the effects would not be expected to be significant in the context of these communities. Under Alternatives 5A and 5B, the communities of King Cove and Sand Point may experience substantial impacts from the effects of restrictions on fishing in the GOA on local catcher vessel fleets. Related impacts on shore processors could have significant adverse impacts on some of the smaller communities in the WG area, but the magnitude of these potential impacts will depend on the success of the local fleets' efforts to redeploy into other areas or other fisheries. The redeployment strategies that fishermen would choose and the potential for the success of those strategies are not known at this time.

Significant direct adverse impacts on dependent communities would result from Alternative 6. Groundfish catcher vessel-related community impacts would be largely concentrated in King Cove, Sand Point, Kodiak, and Homer. Halibut catcher vessel impacts would be felt in many communities of various sizes throughout the GOA and BSAI regions, but would likely be most adverse in the comparatively small communities of Sand Point and St. George. Crab fleet associated impacts would be most prominent in Kodiak, although some of the smaller community fleets may also feel effects. Seattle catcher vessels would experience the greatest level of impact of any community fleet, but effects would be insignificant at the community level, due to the scale of the community. Catcher-processor impacts would be largely concentrated in Kodiak and Washington communities. Shoreside processor impacts would be largely concentrated in Unalaska, St. Paul, and Kodiak, although other communities would be affected. Overall, multi-sector impacts that may be significant at the community level would occur in Kodiak, Sand Point, King Cove, St. George, and St. Paul. Other communities with substantial, but likely less than significant impacts would be Homer, Seward, Sitka, Petersburg, Unalaska, and Seattle. Additional impacts related specifically to small vessel fleets due to substantial nearby closures are likely for a number of communities. Based on 2001 data, St. George is the most obvious example, but similar (if less intense) effects would likely be felt in St. Paul, the Chigniks, and Port Alexander. A number of other communities would experience indirect impacts through permanent local closures, serving to make any future small vessel fisheries development difficult, if not impossible.

Alternative 6 would also have cumulative effects in conjunction with existing management measures and ongoing dynamics, such as closures near communities undertaken in combination with Steller sea lion protection measure closures recently put in place near a number of those same communities, because both serve to effectively limit the areas available to small boat fleets. Another source of cumulative impacts for a number of communities would be seen in the fishery management measures under active consideration for implementation in the immediate or foreseeable future. These include BSAI crab and GOA fisheries rationalization. At least some of the communities that would experience adverse impacts under Alternative 6 could also experience profound adverse impacts under BSAI crab rationalization. These communities would most obviously include St. Paul and St. George in the Pribilofs but could also include a number of other communities, such as those in the Aleutians East Borough, depending on the features of the particular rationalization approach adopted. In the case of the Pribilofs, adverse cumulative effects on crab processing, local fleet halibut fishing, and local waters halibut fishing by distant water vessels that land catch locally could tip the balance, rendering local processing of local catch untenable, if not processing in general which, in turn, would cause a collapse of local catcher vessel effort.

Another type of cumulative effect that would influence the magnitude of impacts felt under Alternative 6 would be the confluence of direct impacts and current dynamics seen in the crab and salmon fisheries. In the case of the crab fisheries, not only would Alternative 6 have direct adverse impacts on the crab fleets or processors in some communities through the closures themselves, but it would also worsen the decline of the crab fishery over the past several years, which has already resulted in adverse impacts to a number of communities. Further, while Alternative 6 would not have any direct impact on salmon fisheries, the fact that salmon fisheries have been in a state of economic difficulty (to the point of some affected regions being formally declared economic disaster areas in recent years) means that, for a number of communities, the local impacts of Alternative 6 would be amplified. Many communities that are relatively dependent upon salmon are facing bleak economic situations, and any impacts that would accrue to these communities as a result of EFH closures under Alternative 6 would be all the more strongly felt. An example of this type of vulnerability can be seen in the community of King Cove in the Aleutians East Borough.

Beyond impacts to communities directly engaged in the groundfish fisheries through the presence of local catcher vessels, catcher-processors, processors, or support service businesses, Alternative 6 also has the potential for generating adverse impacts in the region's CDQ communities. These impacts could occur in a number of different forms, with impacts to royalties, vessels that have had CDQ investment, employment and income for fishery-related positions, and other CDQ investments such as infrastructure and fleet development in communities that may be adversely affected by area closures under this alternative. An example of the latter type of impact would be the investments by Aleutian Pribilof Islands Community Development Association in the St. George halibut fleet and port development, and analogous investments by Central Bering Sea Fishermen's Association in St. Paul.

Direct impacts to one or more fishing sectors in a community could also result in indirect or cumulative impacts to a number of apparently unconnected services available in the dependent communities. For example, for a given community the frequency of air service may decrease (along with the capacity of the planes used for this service), and the costs of air passenger and cargo service may increase, if commercial fishing-related demand decreases significantly or ceases. This is perhaps most evident in the Pribilofs and Adak, because they are perhaps the communities furthest from frequently served transportation routes, but it holds true as well for many of the smaller communities in the GOA. Similarly, surface shipping-related services are also affected by the presence of local processing. In the case of St. Paul, for example, the container shipping operation that serves the local processor's needs also serves the community. Ships returning to the community with empty containers for the processor also bring non-fishing related goods at reduced cost. If local processing were discontinued, special cargo deliveries would have to be arranged to meet community needs, and the costs of shipping goods would increase significantly. This is also a common situation for other small communities, and these types of air and sea transportation-related impacts have an effect on the cost of living as well as the general quality of life in these communities.

It is assumed that small vessel subsistence activity would not be directly affected by EFH closures under Alternative 6. Some indirect or cumulative impacts to subsistence may accrue, however, through loss of joint production opportunities if vessels used for both commercial and subsistence purposes are affected (or if income derived from commercial fishing that otherwise would be used to facilitate subsistence production were unavailable).

Summary of Cumulative Effects

There are very few economic opportunities available as an alternative to commercial fishing-related activities for dependent Alaska communities. For many of these communities (and especially the CDQ communities), unemployment is very high, and these communities are generally fragile, in the sense that they do not have well-developed secondary economic sectors. External factors affecting the socioeconomic status of affected communities include other economic development activities and other sources of revenue. Most future management actions are expected to have negative socioeconomic effects on existing communities. The action alternatives to describe and identify EFH (Alternatives 3 through 6) and identify HAPC (Alternatives 3 through 5) could trigger protection measures that could cause spatial and temporal dislocation of fishing effort, with associated indirect costs to affected communities. In the long term, these effects could decrease if protection measures result in higher production rates of target species. EFH description Alternative 1 and HAPC identification Alternative 1 would likely have positive effects in the short run, with the potential for negative effects in the future. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impacts minimization Alternative 1 represent the status quo and are not expected to have any substantial impact on dependent communities. EFH fishing impacts minimization Alternatives 2, 3, and 4 are also not expected to have substantial effects on dependent communities. The communities of King Cove and Sand Point may experience substantial impacts under EFH fishing impacts minimization Alternatives 5A and 5B. Substantial dependent community impacts would result from the EFH fishing impacts minimization Alternative 6. Past, present, and future management actions have for the most part had negative socioeconomic effects on communities. The alternatives that would have no substantial socioeconomic effects would have no effect on this trend, while those alternatives with potentially negative effects would directly contribute to cumulative negative effects. It is possible that those alternatives that preserve habitat in the short term could have long-term positive effects in the future, but not enough is known about future conditions and potential trends to project cumulative effects that far into the future.

4.4.6.7 Effects on Regulatory and Enforcement Programs

Past and Present Trends Contributing to Cumulative Effects

Increasing regulation of fisheries has created a need for more complicated and costly regulatory and enforcement programs, including more complex closed areas, daily catch limits and other quotas, and seasonal restrictions. Recent management actions that have increased the complexity of regulatory and enforcement programs have increased the cost of some programs.

External Factors Contributing to Cumulative Effects

The primary external factors associated with regulatory and enforcement programs include the continued monitoring and enforcement of the foreign fishing effort. That effort will continue into the future, but the magnitude of that effort is unclear.

Non-fishing activities, such as mining, dredging, fill, impoundment, discharge, water diversions, and thermal additions that may affect water quality and hence EFH also have effects on regulatory and enforcement programs. To the extent that these external factors are subject to other environmental regulations and conservation measures, their adverse effects on EFH could be avoided, minimized, mitigated, or otherwise offset. To the extent that other environmental regulations are relaxed or that the other activities increase overall, their impacts on EFH could increase.

Future Management Actions Contributing to Cumulative Effects

Virtually all future management actions that may be taken by the Council and the NMFS Alaska Region are likely to affect federally managed fisheries with respect to regulatory and enforcement programs. Reasonably forseeable management measures include a variety of potential actions, including: reduction in harvests of groundfish due to the F40 report; reductions in harvests of crab due to rebuilding plans and re-examination of the MSST levels; costs associated with closure areas or gear modifications due to future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS; costs associated with changes in the IR/IU program; and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries and BSAI crab fisheries. With the exception of the rationalization programs, most future measures may have negative effects (to some degree) on regulatory and enforcement programs because they would generally increase the complexity and cost of administering and enforcing fishery management programs.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternative 1 would have a positive effect on regulatory and enforcement programs, because removal of existing EFH descriptions would result in a reduction in the associated management measures to be administered or enforced. Alternative 2 would have no effect on current regulatory and enforcement program trends because it represents the status quo. Alternatives 3 though 6 to describe and identify EFH would have direct and indirect negative effects on regulatory and enforcement programs because they would directly increase the costs associated with these programs. Describing and identifying EFHs would trigger the requirement to minimize the adverse effects of fishing on EFH. The resulting management measures could increase the complexity and cost of fishery management administration and enforcement.

Contributions to Cumulative Effects Related to HAPC Identification

Alternative 1 could have a near-term positive effect on regulatory and enforcement programs if the absence of HAPCs makes it less likely that there would be new restrictions on certain fisheries to protect habitat. Alternative 2 would have no effect on current regulatory and enforcement program trends because it represents the status quo. Alternatives 3 through 6 could have a near-term negative effect on regulatory and enforcement programs if the HAPC identification prompt new restrictions. However, the Magnuson-Stevens Act requirement to minimize adverse effects of fishing on habitat applies to all of EFH, not just HAPCs.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternative 1 would have no effect on regulatory and enforcement programs because no new management measures would be taken at this time. Alternatives 2 through 6 would have negative effects on regulatory and enforcement programs because they would increase the complexity and cost of administering and enforcing fishery management programs. Alternatives 2 through 6 would all require some level of increase in staff and budget for NMFS Enforcement and the In-Season Management Branch of the Alaska Regional Office's Sustainable Fisheries Division. The alternatives would all require increased enforcement of complex closed areas, directed fisheries, and gear modification/restrictions.

Alternatives 2 through 6 would also affect the fishery monitoring efforts of the Coast Guard. However, that agency has consistently reported that it considers all activities to support the commercial fisheries off Alaska as part of a national budget and does not estimate additional costs associated with specific management alternatives.

If minimization measures associated with Alternatives 2 through 6 that were imposed in federal waters were also imposed by the State of Alaska in state waters, there may be additional management and enforcement costs imposed on the ADF&G and Alaska State Troopers.

Summary of Cumulative Effects

Increasing regulation of fisheries has created a need for more complicated and costly regulatory and enforcement programs, including more complex closed areas, daily catch limits and other quotas, and seasonal restrictions. The primary external factors associated with regulatory and enforcement programs include the continued monitoring and enforcement of foreign fishing effort, although the direction of its influence on cumulative impacts is unclear. Future management actions are expected to have negative effects on regulatory and enforcement programs. The action alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 3 through 5), and minimize effects of fishing on EFH (Alternatives 2 through 6) would have negative effects on regulatory and enforcement programs because they would increase the complexity and cost of administering and enforcing fishery management programs. EFH description Alternative 2, HAPC identification Alternative 2, and EFH effect minimization Alternative 1 would have no effects on current regulatory and enforcement program trends because they represent the status quo. The other alternatives (EFH description Alternative 1 and HAPC identification Alternative 1) would have positive near-term effects on regulatory and enforcement programs because there would be a reduction in management measures to be administered and enforced. The cumulative effect of all actions – past, present, and future – on regulatory and enforcement programs is negative. The action alternatives considered here would directly contribute to this trend, while the no action alternatives would have no noticeable effect.

4.4.7 Cumulative Effects on Other Fisheries and Fishery Resources

4.4.7.1 State-managed Groundfish Fisheries

Past and Present Trends Contributing to Cumulative Effects

State-managed fisheries are largely limited to territorial waters (less than 3 nm from shore) except where blue and black rockfish populations extend outside territorial waters and to crab populations that are managed under a state fisheries management plan developed in coordination with federal fisheries management plans. State-managed groundfish are primarily Pacific cod, walleye pollock, and sablefish harvested in nearshore waters or inland waters such as Cook Inlet or Prince William Sound. Other groundfish with state-managed fisheries include lingcod and rockfish.

Cod, sablefish, and pollock populations are considered to be either declining (cod and sablefish) or stable, but at depressed levels (pollock). Lingcod and rockfish populations managed by the state are apparently stable.

External Factors Contributing to Cumulative Effects

External factors such as non-fishing activities, pollution, and climatic or oceanographic changes directly affect fish resources and only indirectly affect fisheries for those resources. Indirect effects on state-managed groundfish fisheries could occur if non-fishing activities, pollution, or climate cycles substantially affect population levels or distribution of groundfish species. The direction and magnitude of these potential effects are currently unknown. Refer to Section 4.4.5.1 for a discussion related to cumulative effects on groundfish resources.

Future Management Actions Contributing to Cumulative Effects

Many future management actions may directly or indirectly affect other fisheries not managed under an FMP, including state-managed groundfish fisheries. Reasonably foreseeable management measures include a variety of potential actions, including costs associated with closure areas or gear modifications due to future HAPC measures and any no-take marine reserves implemented under the Draft Programmatic Groundfish SEIS, and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. These actions may positively affect the conservation for particular species, as well as the fisheries for state-managed groundfish.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

State-managed fisheries for groundfish would be indirectly adversely affected by Alternative 1 because of the loss of indirect benefits that EFH descriptions could have to the general marine environment. Alternative 2 would have no effect because it represents the status quo. Alternatives 3 through 5 would have indirect beneficial impacts to state-managed groundfish fisheries because these fisheries operate in many of the same habitats used by fish for which EFH would be designated. Alternative 6 could have similar indirect benefits to the fishery if federal closures are mirrored in state waters. Refer to Section 4.4.5.1 for a discussion related to cumulative effects on groundfish resources.

Contributions to Cumulative Effects Related to HAPC Identification

Under Alternative 1 any HAPC approvals would be rescinded, resulting in an indirect adverse effect on groundfish because of the loss of benefits that HAPCs could provide to the general marine environment (habitat). Alternative 2 represents the status quo and, therefore, would have no effect on the existing conditions. Alternatives 3 through 5 would have indirect beneficial impacts to state-managed groundfish fisheries because of the potential for HAPC identification to trigger additional protection for groundfish habitat.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, EFH description Alternatives 3 through 5 have the potential for indirect positive effects on state-managed fisheries by triggering increased levels of protection for habitat. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct or indirect effects on state-managed species. The possible exception is Alternative 6, which would protect several strips of seafloor from bottom-contact fishing gear, including some areas in state territorial waters. The State of Alaska would likely close these waters to groundfish fishing to mirror federal actions.

Summary of Cumulative Effects

The criteria associated with other fisheries and fishery resources offer a mixed set of positive, negative, and neutral contributions to cumulative effects. With respect to the state-managed groundfish fishery, the past trend is relatively unknown. As with federally managed groundfish, changes in non-fishing activities, pollution, and climate could have effects on the state-managed groundfish fishery, but the direction and magnitude of these effects is unknown. Current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects. EFH description Alternative 1 and HAPC identification Alternative 1 would have indirect negative effects on conservation and indirect positive effects on costs for groundfish fisheries. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternative 1 would have no effect because these alternatives represent the status quo. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 would likely have positive indirect effects on conservation for groundfish, but negative indirect effects on the operating costs of the state-managed groundfish fishery. Most of the action alternatives to minimize the effects of fishing on EFH would have no influence. The exception is Alternative 6, where federal closures to bottom-contact gear could prompt similar state actions, which would have positive effects for the conservation of groundfish, but negative effects for the operating costs of groundfish fisheries. The cumulative effects of the action alternatives would be to indirectly and directly increase the conservation of groundfish species habitat, which could benefit the fishery in the long term, but to directly and indirectly increase the operating costs of state-managed groundfish fisheries, which would have negative short-term effects on the fishery.

4.4.7.2 State-managed Crab and Invertebrate Species

Past and Present Trends Contributing to Cumulative Effects

The State of Alaska manages fisheries for crabs, scallops, sea urchins, and other invertebrates. The state primarily manages king and Tanner crab resources in the GOA, Korean hair crab in the EBS, and King and Tanner crab fisheries in BSAI. Dungeness crab fisheries in Prince William Sound and the southern district of Cook Inlet have been closed for a decade following the collapse of these populations. King, Tanner, and Korean hair crab populations are severely depressed from overharvest. Weathervane scallop harvest is closely regulated at presumably stable levels.

External Factors Contributing to Cumulative Effects

External factors such as foreign fisheries, subsistence fisheries, non-fishing activities, pollution, and climatic or oceanographic changes directly affect fish resources and only indirectly affect fisheries for those resources. Indirect effects on state-managed crab and invertebrate species could occur if non-fishing activities, pollution, or climate cycles substantially affect population levels or distribution of these species. The direction and magnitude of these potential effects is currently unknown. Refer to Section 4.4.5.2 for discussion related to cumulative effects on target crab and invertebrate resources.

Future Management Actions Contributing to Cumulative Effects

Many future management actions may directly or indirectly affect other fisheries not managed under an FMP, including state-managed crab and invertebrate fisheries. Reasonably forseeable management measures include a variety of potential actions, including costs associated with closure areas or gear modifications due to future HAPC measures and any no-take marine reserves implemented under the Draft Programmatic Groundfish SEIS, and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. These actions may affect the conservation for specific species, as well as the fisheries for state-managed crabs and invertebrates.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

State-managed fisheries for crabs and other invertebrates would be adversely affected by Alternative 1 because of the loss of indirect benefits that EFH descriptions could have on the general marine environment. Alternative 2 would have no effect because it represents the status quo. Alternatives 3 through 6 would have indirect beneficial impacts to crabs and other invertebrates because they share many of the same habitats used by species for which EFH is designated.

Contributions to Cumulative Effects Related to HAPC Identification

Under Alternative 1, any HAPC approvals would be rescinded, resulting in an indirect adverse impact to crabs and other invertebrates because of the loss of potential benefits that HAPC identification would provide to the general marine environment (habitat). Alternative 2 represents the status quo and, therefore, would have no effect. Alternatives 3 through 5 would have indirect beneficial effects on crabs and other invertebrates because of the potential benefits HAPC identification could provide their habitat.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternative 1 would have no effect on state-managed crab and other invertebrate fisheries because it represents the status quo. Alternatives 2 through 5B would enact bottom trawl restrictions that are anticipated to benefit Tanner crab and potentially some golden king crab. Alternatives 4 and 5A may have some negative effects on localized shrimp fisheries. Alternative 6 would likely benefit the conservation of crab, would have substantially negative effects on the Korean hair crab fishery in the Pribilof Islands in the EBS, and may have some negative effects on localized shrimp fisheries.

Summary of Cumulative Effects

The state-managed crab fishery has clearly been negatively affected by past management actions. As with federally managed crab, changes in non-fishing activities, pollution, and climate could have effects on the state-managed crab and invertebrate fishery, but the direction and magnitude of these effects is unknown. Current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects. EFH description Alternative 1 and HAPC identification Alternative 1 would have indirect negative effects on conservation by removing existing identifications, but would indirectly reduce the operating costs of state-managed crab and invertebrate fisheries. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternative 1 would have no effects because they represent the status quo. EFH description Alternatives 3 through 6, HAPC identification Alternatives 3 though 5, and EFH fishing impact minimization Alternatives 2 though 5B would likely indirectly and directly increase the conservation of crab species but also increase the operating costs of the fisheries. EFH fishing impact minimization Alternative 6 would have some conservation benefits to crab and invertebrate species, but would have substantially negative effects on the Korean hair crab fishery in the Pribilof Islands. Most of the action alternatives would add cumulatively to the conservation effects of other management actions, but may also add to the cumulatively negative effects on the operating costs of some crab and invertebrate fisheries.

4.4.7.3 Herring Fisheries

Past and Present Trends Contributing to Cumulative Effects

Twenty separate herring fisheries are managed by the State of Alaska in the GOA and BSAI. Herring harvests in the GOA are currently 40 percent of the harvest in 1936, but have slowly increased since a harvest low in 1967. Herring harvests in the EBS declined over 80 percent in the 1970s, but have steadily increased since then. The majority (90 percent) of the harvest is roe-bearing herring, with the remainder as food-and-bait herring. Overall, the current trend for herring is depressed, but increasing.

External Factors Contributing to Cumulative Effects

Several external factors directly affect herring populations, which subsequently affect the herring fishery. The 1970s decline of herring stocks in the EBS was precipitated by foreign Japanese fisheries that began in the 1960s. Currently, foreign herring fisheries are limited and do not substantially affect herring. Non-fishing activities are less likely to affect herring than some other species due to the mobility of herring in the water column. Pollution may affect herring populations if there are acute or chronic increases in pollutants. Herring are both adversely and beneficially affected by long- and short-term changes in climate and oceanography. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on herring fisheries is not well documented at this time, though reasonable predictions can be made. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for herring and other species.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on herring fisheries are not well documented at this time. Non-fishing activities, pollution, and climate are likely to continue to have some effects on herring, but the magnitude and direction of these effects cannot be predicted.

Future Management Actions Contributing to Cumulative Effects

Many future management actions may directly or indirectly affect other fisheries not managed under an FMP, including herring fisheries. Reasonably forseeable management measures include a variety of potential actions, including costs associated with closure areas or gear modifications due to future HAPC measures and any no-take marine reserves implemented under the Draft Programmatic Groundfish SEIS, and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. None of the future actions are likely to have substantial effects on herring or the herring fishery.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

State-managed fisheries for herring would be indirectly adversely affected by Alternative 1 because of the loss of indirect benefits that EFH descriptions would potentially trigger for the general marine environment. Alternative 2 would have no effect on herring trends because it represents the status quo. Alternatives 3 through 6 would have indirect beneficial effects for herring because they share many of the same habitats used by species for which EFH is designated.

Contributions to Cumulative Effects Related to HAPC Identification

Under Alternative 1, any HAPC approvals would be rescinded, resulting in an indirect adverse impact to herring because of the loss of benefits that HAPC identification would potentially trigger for the general marine environment (habitat). Alternative 2 represents the status quo and, therefore, would have no effect. Alternatives 3 through 5 would have indirect beneficial effects on herring because of the benefits HAPC identification could potentially provide by triggering protection measures for their habitat.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on herring fisheries by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on herring fisheries. None of the alternatives are likely to affect the herring fishery, because the action alternatives would occur outside the nearshore habitats where herring are found, and the EFH descriptions that could trigger protection measures would not affect fishing gear used in herring fisheries.

Summary of Cumulative Effects

Currently, herring populations are depressed (from past fishing), but they are slowly recovering. Non-fishing activities, pollution, and climate may also have effects on the herring populations, but the direction and magnitude of those effects is not known. Current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects. EFH description Alternative 1 and HAPC identification Alternative 1 would have indirect negative effects on conservation by removing existing identifications, but would indirectly reduce the operating costs of herring fisheries. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternative 1 would have no effects because they represent the status quo. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 though 5 would likely indirectly increase the conservation of herring and increase the operating costs of the fisheries. EFH fishing impact minimization alternatives would not affect the herring fishery. Most of the action alternatives for EFH and HAPC identification would add cumulatively to the conservation effects of other management actions, but may also add to the cumulatively negatively effect in operating costs of some herring fisheries. EFH fishing impact minimization alternatives would have no cumulative effects because they would have no direct or indirect effects.

4.4.7.4 Halibut Fisheries

Past and Present Trends Contributing to Cumulative Effects

Because of halibut's migratory nature, halibut fisheries are managed through a treaty with Canada and the United States following recommendations from the IPHC. The halibut resource is healthy, and the total catch has recently been at near record levels. Bycatch limits for halibut taken in the BSAI and GOA trawl and hook and line fisheries have been set to protect populations from over-exploitation.

External Factors Contributing to Cumulative Effects

Several external factors may directly affect halibut populations that subsequently affect the halibut fishery. Subsistence fisheries for halibut are probably not significant at the population level, and there is no foreign fishery for this species. There is a small amount of bycatch of halibut in foreign fisheries, but not enough to impact United States halibut stocks. Increases in sport fishing levels may affect the halibut fishery. Commercial halibut harvests represented 70 percent of the halibut catch in 2000. Non-guided sportfishing represented 8 percent of the total halibut catch in 2000, and guided sport fishing accounted for 11 percent. Other fishing (e.g., subsistence) accounted for 11 percent (Council 2003). Non-fishing activities are unlikely to directly affect habitat unless marine water quality is affected. Pollution may affect halibut populations if pollutants are concentrated in areas that halibut use. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on halibut fisheries are not well documented at this time, though it is reasonable to predict that changes in food source for halibut will accordingly affect halibut populations. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers, and many of the zooplankton species that serve as major food resources for target species.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on halibut are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Many future management actions may directly or indirectly affect other fisheries not managed under an FMP, including halibut fisheries. Reasonably foreseeable management measures include a variety of potential actions, including costs associated with closure areas or gear modifications due to future HAPC measures and any no-take marine reserves implemented under the Draft Programmatic Groundfish SEIS, and changes in operating costs and safety provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. None of the future actions are likely to have substantial effects on halibut or the halibut fisheries.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

State-managed fisheries for halibut would be adversely affected by Alternative 1 because of the loss of indirect benefits that describing and identifying EFHs would potentially have for the general marine environment. Alternative 2 would have no effect because it represents the status quo. Alternatives 3 through 6 would have indirect beneficial effects for halibut because they share many of the same habitats used by fish for which EFH would be designated.

Contributions to Cumulative Effects Related to HAPC Identification

Under Alternative 1, any HAPC identification would be rescinded, resulting in an indirect adverse impact to halibut because of the loss of indirect benefits that HAPC identification would provide through triggers for additional protection for the general marine environment (habitat). Alternative 2 represents the status quo and, therefore, would have no effect. Alternatives 3 through 5 would have indirect beneficial effects on halibut because of the indirect benefits HAPC identification would provide through potential triggers for protection of habitat.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Alternatives 1 through 5C are not likely to have effects on halibut fishing, because these alternatives do not have actions that would affect the longline fisheries. Alternative 6 could negatively affect the halibut fishery by displacing sectors of the fishery and increasing the concentration of catch in smaller areas. Alternative 6, however, would require an amendment to the Pacific Halibut Regulations to prohibit the use of bottom tending gear, including longlines, in 20 percent of the GOA and BSAI.

Summary of Cumulative Effects

Halibut population levels are stable, with recent high levels of catch. External factors such as non-fishing activities, pollution, and climate may have effects on halibut populations, but the direction and magnitude of these effects is unknown. Future management actions are not likely to have substantial effects on halibut populations. EFH description Alternative 1 and HAPC identification Alternative 1 may have indirect negative effects by removing triggers for potential habitat protection measures that could protect habitat for halibut or halibut prey. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternatives 1 through 5B are not likely to substantially affect the halibut fishery. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 may provide indirect benefits from the additional identification, which may trigger habitat protection measures. EFH fishing impact minimization Alternative 6 would likely have negative effects on the halibut fishery though fishing closures and increased catch concentrations. Most action alternatives would have a neutral or positive cumulative effect on halibut fisheries. The exception is EFH fishing impact minimization Alternative 6, which would have a negative direct effect, but no additional cumulative effect on halibut.

4.4.8 Cumulative Effects on Protected Species

4.4.8.1 ESA-listed Marine Mammals

Past and Present Trends Contributing to Cumulative Effects

Eight species of marine mammals currently listed under ESA inhabit the GOA and BSAI, including the fin, bowhead, blue, sei, North Pacificnorthern right, sperm, and humpback whales, and the Steller sea lion. Populations of all the listed whale species are depleted due to past commercial whaling. The western arctic stock of bowhead whales, which winter in Alaska, has shown some signs of recovery, as they have been increasing annually at a rate of about 1 to 3 percent and currently number about 8,200 animals. Alaska Native subsistence hunters are currently allowed a harvest quota of 67 whales annually, which is below the potential biological removal of this population. Bowhead whales formerly summered in the Bering and Chukchi seas; they may represent a stock that has since been extirpated.

Feeding aggregations of blue, sei, and North Pacificnorthern right whales formerly occurred in the GOA and BSAI waters. These stocks, however, have been so reduced by past whaling that sightings are rare in Alaska. The GOA may once have supported a stock of blue whales that has since been eliminated. However, acoustical evidence suggests that a remnant stock of blue whales that summer south of the AI, and winter offshore of Hawaii, may currently exist. Sei whales have also been severely depleted in the North Pacific, such that there have been too few recent sightings for developing any reliable estimates. Reports of sei whales inhabiting the EBS during summer are now considered suspect, with the possibility that this species may never have been a regular inhabitant of Alaska waters. North Pacific right whale populations have been so depleted that only 100 to 200 individuals may still exist. A small (fewer than 20) feeding aggregation in Bristol Bay has been monitored since 1998. During the 2002 NOAA survey, a female with a calf was cited in the EBS, which was the first reliable evidence that these animals are breeding (Sue Moore, NMML 2003 personal communication). Sperm whales (male groups only) do inhabit the deeper waters of the BSAI and GOA; however, there are no reliable estimates of abundance or trend.

Fin whales remain a viable component of the baleen whale community in the GOA and the central BS. However, there are no reliable estimates of the population size of the fin whale stock found in Alaska (other than an estimate of about 4,000 summering in the BS), and there is no indication that this stock is recovering since its protection from whaling. Humpback whales summering in Alaska are now identified as part of the central Pacific stock that winters in Hawaiian waters. Alaskan humpbacks are primarily found in the GOA, but recent surveys have found viable populations using the central BS. This stock is currently estimated at about 3,700 animals, and it is assumed to be growing but at an undefined rate.

Steller sea lion populations in Alaska have been separated into two stocks. Those east of Cape Suckling (long. 144° W) are part of the eastern United States stock (federally listed as threatened) that extends to California. This population, currently estimated at 31,000 (of which about 16,700 are found in Southeast Alaska), has increased approximately 30 percent since 1979. The western United States stock (west of Cape Suckling) has, on the other hand, continuously declined since the mid-1970s. Past contributions to this decline include foreign/joint venture fisheries, other fisheries, commercial harvest, subsistence harvest, and climate-based changes in prey populations. This stock (federally listed as endangered), estimated at about 140,000 animals in the 1950s, is currently estimated at 34,600. Since 1990, it has declined 40 percent at an annual rate of 5 percent. Although the overall trend is still in decline, the 2002 survey numbers for non-pups increased by 5.5 percent from 2000. This change is the first region-wide increase observed during more than two decades of surveys (ADF&G 2002 Survey Report).

External Factors Contributing to Cumulative Effects

Long- and short-term climate changes and regime shifts can have positive or negative impacts to listed whales depending on impacts to prey populations. Foreign/JV fisheries can have a negative effect on Steller sea lion population recovery via mortality in fishing nets. However, the effects of foreign fisheries outside the United States EEZ are probably negligible because these sea lions rarely venture outside the EEZ. Subsistence harvest is a major source of Steller sea lion mortality, especially in the Aleutian and Pribilof islands. Pollution has not been identified as a factor contributing to Steller sea lion population changes. Short-term climatic effects, such as ENSO, probably do not induce population level effects to Steller sea lions because they are long-lived. However, long-term climatic effects and regime shifts have been postulated as a primary factor in recent declines. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on ESA-listed marine mammals are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect protected species (including ESA marine mammals) include TAC reductions for non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. For the most part, these measures would be expected to increase protection of these species compared to the status quo. However, closure areas may compress fishing effort, thus increasing the potential for increased interactions of fisheries and marine mammals at specific locales.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

The alternatives to describe and identify EFH can indirectly affect listed marine mammals where they have indirect effects on the marine habitat, including foraging habitat, of these animals. The identifications may trigger protection measures that could also reduce the potential encounters of listed marine mammals with fishing fleets. Alternative 1 is likely to have an indirect negative effect on listed marine mammals because it could indirectly increase adverse effects to the general habitat and potential negative encounters between marine mammals and fishing vessels by decreasing current EFH description that could have triggered protective measures. Alternative 2 represents the status quo; thus it would cause no change to listed marine mammal habitat or fishing vessel encounter rates. Alternatives 3 through 6, however, would increase EFH descriptions, thereby increasing triggers for protective measures that would have positive effects on listed marine mammal habitat and encounter rates. Simultaneously, depending upon where and how large EFH areas are, these actions could force fishing into remaining open areas, concentrating gear and increasing encounters with ESA-listed marine mammals.

Contributions to Cumulative Effects Related to HAPC Identification

Identification of HAPCs can indirectly affect the overall ecosystem, including protection of key habitats used by listed marine mammals. Alternative 1 would likely indirectly negatively affect listed marine mammals because it would remove the existing HAPC identification that would have triggered protection of these ecologically important areas. Alternative 2 represents the status quo; thus it would cause no change to listed marine mammal habitat. Alternatives 3 through 5, however, would afford additional identification of HAPCs, which could trigger additional protection of ecologically important areas, thereby contributing to the overall health of listed marine mammal. As noted just above, depending upon where and how large HAPC areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with ESA-listed marine mammals.

Contributions to Cumulative Effects Related Minimizing the Effects of Fishing on EFH

Proposed actions for minimization of effects of fishing on EFH generally involve limiting fishing in some areas and concentrating it in others. Alternative 1 (status quo) and Alternatives 2 through 5A were judged to have no effect on listed marine mammals because proposed changes would not be significant relative to distributions of these species. Alternatives 5B, 5C, and 6, however, could increase localized concentrations of fishing vessels in key listed marine mammal habitat, especially Steller sea lion habitat in the AI, resulting in increased risk of harassment, entanglement, collision, and potential depletion of prey species. Consequently, Alternatives 5B, 5C, and 6 may have a slight negative impact on listed marine mammals at specific locales.

Summary of Cumulative Effects

The general effect of past harvest activity on ESA-listed marine mammals has been negative. External factors such as foreign fishing have negatively affected the population levels through high numbers of incidental takes. Future management actions may provide additional protection to listed marine mammals such as Steller sea lion, but may also concentrate catch, which would increase the likelihood of vessel encounters with marine mammals. EFH description Alternative 1, HAPC identification Alternative 1, and EFH fishing impact minimization Alternatives 5B and 6 would likely have negative indirect and direct effects on marine mammals. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing impact minimization Alternatives 1 though 5A would have no effect on marine mammals. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 may be expected to have indirect beneficial effects on marine mammals. Cumulatively, most of the action alternatives would not have substantial adverse effects on marine mammals. Those alternatives with negative effects could potentially have a negative cumulative effect on ESA-listed marine mammals.

4.4.8.2 Other Marine Mammals

Past and Present Trends Contributing to Cumulative Effects

At least 18 species of marine mammals not protected under ESA at least seasonally inhabit the GOA or BSAI. All are protected, however, under the Marine Mammal Protection Act (16 USC 1361-1421h). Data on population abundance and trends are unavailable for Alaska populations of minke whale, Baird's beaked whale, Cuvier's beaked whale, Stejneger's beaked whale, bearded seal, northern elephant seal, and ribbon seal, because of their small population size, infrequent presence in Alaska, or difficulty in surveying. Beluga whale populations in the Beaufort Sea, Bristol Bay, and eastern Chukchi Sea appear to be stable or increasing, and in Cook Inlet, the population has declined over the past several years, but is now stable. Trends in EBS beluga stocks are unknown. The Dall's porpoise stock in Alaska has been estimated at 83,400 animals, but there are no reliable trend data. The eastern North Pacific gray whale population, currently estimated at over 26,000 animals, continues to increase at a rate of about 2.5 percent per year. Population estimates are available for the EBS, GOA, and Southeast Alaska stocks of harbor porpoise, but there are no reliable trend data. No reliable trend data are available for the eastern North Pacific resident or transient stocks of killer whale and the North Pacific stock of Pacific white-sided dolphin, or for the ringed seal, spotted seal, and Pacific walrus, although population estimates have been made. Harbor seal populations in Southeast Alaska appear to be stable or increasing, while the GOA and EBS stocks continue to decline. The northern fur seal population, which declined dramatically in the 1970s, continues to decline on the Pribilof Islands, but the population on Bogoslof Island, while much smaller than on the Pribilofs, did increase during the 1990s. The Alaskan sea otter population in general continues to increase, although localized populations have experienced declines particularly in the southwest stock, where a rapid population decline has prompted possible ESA listing.

External Factors Contributing to Cumulative Effects

Foreign fisheries have the ability to impact marine mammals susceptible to entanglement in fishing gear, including Dall's porpoise and Pacific white-sided dolphins. Several species of marine mammals are harvested during subsistence hunts, including bearded seals, ringed seals, spotted seals, harbor seals, northern fur seals, beluga whales, walrus, and sea otters. Subsistence harvest of belugas in Cook Inlet was great enough in the mid-1990s for Congress to impose a moratorium on harvest. Climate change events that impact the abundance and distribution of marine mammal prey can have a negative or positive effect on marine mammal populations. Global warming in particular may pose a significant risk to ice-dependent marine mammals. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on marine mammals are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect protected species (including other marine mammals) include TAC reductions for non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. For the most part, these measures would be expected to increase protection of these species as compared to the status quo. However, closure areas may compress fishing effort, thus increasing the potential for increased interactions of fisheries and marine mammals.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

Like listed marine mammals, the alternatives to describe and identify EFH could indirectly affect other marine mammals where they provide triggers for protections that would affect the marine habitat, including foraging habitat, of these animals. The identifications could also serve as triggers for measures that would reduce the potential encounters of other marine mammals (mainly porpoise and dolphins) with fishing fleets. Alternative 1 is likely to have an indirect negative effect on other marine mammals, because it could increase adverse effects to the general habitat by decreasing current EFH descriptions which would remove triggers for protective measures. Alternative 2 represents the status quo, thus that effect no change to other marine mammal habitat. Alternatives 3 through 6, however, would increase EFH descriptions, which would increase the potential triggers for habitat measures, thereby increasing the potential positive effects on other marine mammal habitat. As discussed in respect to ESA-listed species, depending upon where and how large EFH areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected species.

Contributions to Cumulative Effects Related to HAPC Identification

Identification of HAPCs could affect the overall ecosystem, including providing triggers for the protection of key habitats used by other marine mammals. Alternative 1 would likely indirectly negatively affect other marine mammals, because it would remove the existing triggers for protection of these ecologically important areas. Alternative 2 represents the status quo; thus, it would cause no change to other marine mammal habitat. Alternatives 3 through 5, however, would afford additional identification of HAPCs, which could trigger additional protection of ecologically important areas, thereby contributing to the overall health of marine mammal habitat. Once again, depending upon where and how large HAPC areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected species.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

Proposed actions for minimization of effects of fishing on EFH generally involve limiting fishing in some areas and concentrating it in others. Alternatives 1 through 5C were judged to have no effect on other marine mammals because proposed changes would not be significant relative to distributions of these species, and there would be less likelihood of potential take of these species relative to Steller sea lions. Alternative 6, however, could increase localized concentrations of fishing vessels in key harbor seal and northern fur seal habitat, especially in the AI, resulting in increased risk of harassment and entanglement. The extent of this impact, however, is currently unknown. Consequently, the potential effects of Alternative 6 on other marine mammals are unknown.

Summary of Cumulative Effects

The current population status and trends are unknown for many marine mammals that use the GOA or the BSAI as habitat. Known current trends include stable or increasing populations for some groups of Beluga whales, increases in North Pacific whales, increases in Southeast harbor seal populations, decreases in GOA and EBS harbor seal populations, decreasing populations of northern fur seal, and increases in Alaska sea otters except in the western GOA and the AI, where declines have been noted. Factors such as foreign and subsistence fishing and climate continue to affect marine mammals. Future management actions are expected to increase the overall protection of marine mammals relative to the status quo, but also may cause increases in encounters between marine mammals and fishing vessels. EFH description alternatives and HAPC identification alternatives that increase the current identification will likely indirectly benefit marine mammals by potentially triggering additional habitat protection. EFH fishing impact minimization alternatives would have no effect or unknown effects on marine mammals. Cumulatively, the action alternatives are likely to have positive or neutral effects on marine mammals.

4.4.8.3 ESA-listed Pacific Salmon and Steelhead

Past and Present Trends Contributing to Cumulative Effects

Twelve listed stocks (evolutionarily significant units) of salmonids likely range into the marine waters of Alaska. They include stocks of Chinook salmon, sockeye salmon, and steelhead. None of these fish originate in Alaska. Overharvest and spawning habitat loss are the prime past factors that have contributed to the decline of these stocks. Thousands of salmon are currently taken as bycatch in trawl and groundfish fisheries, including some listed stocks (primarily Chinook). However, incidental take of these listed salmonids is not considered substantial.

External Factors Contributing to Cumulative Effects

Direct catch and bycatch by foreign, JV, and domestic fisheries have had a negative impact on listed salmon and steelhead in the past. To a lesser extent, these continue today in several domestic fisheries. Subsistence harvest is likely restricted to unlisted salmonids originating in Alaska. Non-fishing activities may also have some effect on these fish; however, many of the listed fish rear in habitats to the south of Alaska, so the local effects of non-fishing activities are likely to be less substantial for these fish. Climate variability can have both an adverse and a beneficial impact on listed salmonids and their prey. ENSO events, in particular, have been implicated in short-term productivity impacts to listed salmon. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect protected species (including ESA-listed salmon and steelhead) include TAC reductions for non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. For the most part, these measures would be expected to increase protection of these species compared to the status quo. However, closure areas may compress fishing effort, thus increasing the potential for interactions of fisheries and listed salmon and steelhead.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

The alternatives to describe and identify EFH could indirectly affect listed salmonids where they affect the marine habitat, especially foraging habitat, of these fish. Alternative 1 is likely to have an indirect negative effect on listed salmonids because it could indirectly increase adverse effects on fish habitat by decreasing current EFH descriptions that could have triggered habitat protection measures. Alternative 2 represents the status quo; thus it would cause no change to current trends in fish habitat. Alternatives 3 through 6 would increase EFH description, which could trigger increased habitat protection measures, thereby increasing the indirect positive effects they may have on listed salmonid habitat. Here again, depending upon where and how large EFH areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected salmonid species.

Contributions to Cumulative Effects Related to HAPC Identification

Identification of HAPCs could indirectly benefit the overall ecosystem, including protection of key habitats used by listed salmonids. Alternative 1 would likely indirectly negatively affect listed salmonids because it would remove the existing HAPC identification that could trigger protection measures for these ecologically important areas. Alternative 2 represents the status quo; thus it would cause no change to current trends in fish habitat. Alternatives 3 through 5, however, would afford additional identification of HAPCs that could trigger additional protection of ecologically important areas, thereby contributing to the overall health of listed salmonid habitat. As with EFH, depending upon where and how large HAPC areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected salmonid species.

Contributions to Cumulative Effects Related Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on listed salmonids by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on listed salmonids. The incidental take of listed salmonids by the fisheries affected by these alternatives is probably not substantial.

Summary of Cumulative Effects

ESA-listed salmon and steelhead populations have declined to the point of being threatened or endangered due to effects from harvest, impacts to habitat, and potentially the influence of hatcheries and dams. External factors such as foreign fishing and climate continue to affect populations. Future management actions will likely benefit habitat used by salmon species in Alaska, but may also concentrate fishing efforts, which could increase the local bycatch of listed salmon and steelhead. EFH description alternatives and HAPC identification alternatives that increase the current identification would likely indirectly benefit listed salmon and steelhead by potentially triggering additional habitat protection. EFH fishing impact minimization alternatives would have no effect or unknown effects on listed salmon and steelhead. Cumulatively, the action alternatives would be likely to have positive or neutral effects on listed salmon and steelhead.

4.4.8.4 ESA-listed Seabirds

<u>Past and Present Trends Contributing to Cumulative Effects</u>

ESA-listed seabirds in Alaska include short-tailed albatross and spectacled and Steller's eider. Short-tailed albatross were dramatically reduced by commercial harvest in the early 1900s. Currently, they nest at only two Japanese islands, where the current population is estimated at 1,600 birds. Since 1980, the breeding population has increased annually at a rate of 7 to 8 percent, yet it still remains quite vulnerable because of its small size. In contrast, spectacled and Steller's eiders have recently experienced a fairly steep decline. Both species breed on the North Slope and in the Yukon-Kuskokwim Delta. In the Yukon-Kuskokwim Delta, spectacled eiders declined from 48,000 pairs in the 1970s to approximately 3,700 pairs today, although the population has remained stable or increased slightly during the past decade. The North Slope spectacled eider population of about 4,700 pairs, however, is annually declining about 2.6 percent. Of a world population of 150,000 to 200,000 Steller's eiders, only about 1,000 now nest in Alaska. The Yukon-Kuskokwim Delta population now includes only a very small number of pairs, and the range of the North Slope population is reduced. Reliable population estimates and trends for Alaska populations are not yet available, but a significant contraction in its breeding range has been quantified. Ingestion of lead shot, increased predation, and climate change impacts to food resources have been postulated as factors in the decline of both eider species.

<u>External Factors Contributing to Cumulative Effects</u>

Potential foreign fishing effects on short-tailed albatross would be similar to effects on albatross from other fisheries occurring in oceanic waters. Short-tailed albatross could be killed from collisions with vessels and transducer wires, or entanglement or capture in active and derelict fishing gear. Because of their oceanic distribution, they are unlikely to encounter nearshore subsistence fisheries or pollutants emanating from terrestrial sources or non-fishing activities. Nevertheless, high concentrations of pollutants have been found in the body burdens of Laysan and black-footed albatross. A possible source is the consumption of plastics discarded from vessels, including fishing fleets. These plastics may contain concentrated levels of PCBs, furans, and dioxans. Further, hundreds of Laysan and black-footed albatross chicks die each year from plastic ingestion, leading to starvation. Plastic ingestion has been identified as a major concern for short-tailed albatross as well. Climate change that impacts the abundance and distribution of albatross prey could have a positive or negative effect on the population. Also, one of the two main nesting colonies is at risk from local volcanic activity.

There is too little geographical or seasonal overlap in eider marine habitat use and foreign or subsistence fisheries for a substantial impact to occur. Climate change, as it affects eider foraging resources, can have a positive or negative impact. Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on ESA-listed seabirds are not well documented at this time. Poisoning of eiders from ingestion of lead shot and exposure to hydrocarbons spilled from fishing vessels in harbor and embayment waters is considered a high enough risk to warrant current investigations.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect protected species (including ESA-listed seabirds) include TAC reductions for non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. For the most part, these measures would be expected to increase protection of these species compared to the status quo. However, closure areas may compress fishing effort, thus increasing the potential for increased interactions of fisheries and seabirds.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

The alternatives to describe and identify EFH could indirectly affect listed seabirds where they have the potential to trigger protection for the marine habitat, especially the foraging habitat, of these birds. Alternative 1 is likely to have an indirect negative effect on listed seabirds because it could trigger reduction in protection for seabird habitat by decreasing current EFH descriptions. Alternative 2 represents the status quo; thus it would cause no change to current trends in seabird habitat. Alternatives 3 through 6, however, could increase EFH descriptions, thereby increasing the indirect positive effects from triggering protection measures for listed seabird habitat. As in the case of marine mammals and salmonids, depending upon where and how large EFH areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected seabirds.

Contributions to Cumulative Effects Related to HAPC Identification

Identification of HAPCs could indirectly affect the overall ecosystem, including triggering protection of key habitats used by seabirds. Alternative 1 would likely indirectly negatively affect listed seabirds because it would remove the existing HAPC identifications that would have triggered protection of these ecologically important areas. Alternative 2 represents the status quo; thus it would effect no change to current trends in listed seabird habitat. Alternatives 3 through 5 would, however, provide additional identification of HAPCs, which could trigger additional protection measure for ecologically important areas, thereby contributing to the overall health of listed seabird habitat. And again, depending upon where and how large HAPC areas are, these actions could force fishing into remaining open areas, concentrating gear and effort, and increasing encounters with protected seabirds.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on listed seabirds by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on listed seabirds. Steller's and spectacled eiders largely do not use the marine waters where these alternatives would be implemented. While short-tailed albatross risks of wire collision or net/hook entanglement might increase in some areas where fisheries are concentrated, they would be offset by reduced risk in areas where fishing is limited.

Summary of Cumulative Effects

The population trends for listed seabirds have been negative due to the effects of pollutants and climate change. These external factors will likely continue to affect listed seabirds. Future management actions are intended to reduce the potential impacts of fishing on listed seabird populations, which will cumulatively interact with the action alternatives evaluated in this EIS. EFH description alternatives and

HAPC identification alternatives that increase the current identifications will likely indirectly benefit listed seabirds by potentially triggering additional habitat protection. EFH fishing impact minimization alternatives would have no effect on listed seabirds. Cumulatively, the action alternatives are likely to have positive or neutral effects on listed seabirds.

4.4.8.5 Other Seabirds

Past and Present Trends Contributing to Cumulative Effects

Seabirds most associated with commercial fishing include the northern fulmar, black-footed and Laysan albatross, short-tailed and sooty shearwaters, kittiwakes and other gulls, and murres. The northern fulmar population in the North Pacific is estimated at between 4 million and 5 million, and the EBS population is believed to be gradually increasing. Albatross have suffered past declines from commercial harvest, population control at island military bases, and incidental catches in fisheries. Although fishery bycatch has been much reduced, these populations continue to decline from other factors, including ingestion of plastics. Significant declines of shearwaters have been observed over the past 30 years from a combination of factors, including overharvest of chicks, variable oceanographic conditions, overfishing of prey species, and fishery bycatch. While gull populations in general have increased, kittiwake populations have been in gradual decline since the mid-1970s. Reasons for decline are not completely known, but appear to be centered around insufficient prey during the breeding season. Murre populations in Alaska are, for the most part, stable, although die-offs occur during anomalous oceanographic events. Like listed eiders, common and king eider populations have declined significantly over the past few decades. Reasons for decline are unknown, but may be related to increased predation, ingestion of lead shot, overharvest, and climatic impacts to winter prey.

External Factors Contributing to Cumulative Effects

Past adverse external factors that have affected seabirds include incidental take in foreign/JV fisheries, high sea driftnet fisheries, and other fisheries. In particular, large numbers of northern fulmars were likely killed in these foreign/JV fisheries, and diving seabirds such as murres, auklets, and puffins have been lost in driftnets. Fulmars, albatross, and shearwaters are also greatly attracted to offal waste from fish processing ships. The extent of impact from these past factors is unknown; current impacts are judged to be insignificant. Long- and short-term climate changes and regime shift effects to seabird prey resources can be positive or negative. This has especially been true for kittiwakes, where anomalous oceanographic conditions frequently produce large late summer die-offs, and for sooty shearwaters, where a 90 percent decline in use of the California Current coincided with rising sea temperatures.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on seabirds are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect protected species, including seabirds, include TAC reductions for non-target species, closure areas or gear modifications associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS, and effort reduction provided by formation of cooperatives and/or issuance of quota shares to harvesters in the GOA groundfish fisheries. For the most part, these measures would be expected to increase protection of these species compared to the status quo. However, closure areas may compress fishing effort, thus increasing the potential for increased interactions of fisheries with seabirds.

Contributions to Cumulative Effects Related to Describing and Identifying EFHs

The alternatives to describe and identify EFH could indirectly affect seabirds where they have the potential to trigger protection measures for marine habitat, especially foraging habitat, of these birds. Alternative 1 is likely to have an indirect negative effect on seabirds because it could indirectly increase adverse effects on seabird habitat by decreasing current EFH descriptions that would likely trigger protective habitat measures. Alternative 2 represents the status quo, and thus would cause no change to current trends in seabird habitat. Alternatives 3 through 6, however, would increase EFH descriptions that could trigger protective habitat measures, thereby increasing the positive effects EFH descriptions may have on seabird habitat. Depending upon where and how large EFH areas are, these actions could concentrate gear and effort, and increase adverse encounters with seabirds.

Contributions to Cumulative Effects Related to HAPC Identification

Identification of HAPCs could indirectly affect the overall ecosystem by providing identifications that could trigger the protection of key habitats used by seabirds. Alternative 1 would likely indirectly negatively affect seabirds because it would remove the existing identification of HAPCs that could have triggered protection of these ecologically important areas. Alternative 2 represents the status quo, thus would cause no change to current trends in seabird habitat. Alternative 3 through 5, however, would afford additional HAPC identification that could trigger additional protection of ecologically important areas, thereby contributing to the overall health of seabird habitat. Note once more that, depending upon where and how large HAPC areas are, these actions could concentrate gear and effort, and increase encounters with adverse seabirds.

Contributions to Cumulative Effects Related Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on listed seabirds by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on listed seabirds. While seabird risks of wire collision or net/hook entanglement might increase in some areas where fisheries are concentrated, these risks would be offset by reduced risk in areas where fishing is limited. For those species that follow fishing fleets (fulmars, albatross, shearwaters), any increase in mortality because of concentrating fishing fleets is deemed insignificant, given the size of these birds' populations.

Summary of Cumulative Effects

The trends in seabirds from past actions vary by species. Northern fulmars and gulls generally are increasing in population size. Albatross populations are decreasing due to pollution and harvest. Shearwater populations are decreasing potentially due to harvest, changes in ocean conditions, harvest of prey species, and fishing bycatch. Kittiwake populations are also decreasing due to lack of prey during the breeding season. Common and king eiders are also decreasing potentially due to predation, ingestion of lead shot, overharvest, and climate effects on winter prey. Murre populations are currently considered stable. As shown by the trends above, external factors continue to affect seabird populations. In a cumulative sense, future management actions would tend to decrease the negative effects of fishing on seabirds. EFH and HAPC identification alternatives that have the potential to trigger additional protective measures for habitat and would likely provide indirect benefits to seabirds. EFH fishing impact minimization alternatives are not likely to have substantial effects on seabird populations. Cumulatively, the action alternatives for EFH would have positive or neutral effects on seabird populations.

4.4.9 Cumulative Effects on Ecosystem and Biodiversity

4.4.9.1 Predator-Prey Relationships

Past and Present Trends Contributing to Cumulative Effects

Fisheries can alter predator-prey relationships by selectively removing predators, prey, or competitors from an ecosystem relative to an unfished system. Some fishing practices remove piscivorous predators, while others may remove fish that feed on plankton, causing imbalance in the ecosystem trophic structure. The trophic levels of the fish and invertebrate catch from the BSAI and the GOA were estimated for the period from the 1960s to the present (Queirolo et al. 1995, Livingston et al. 1999) to determine if changes in trophic structure were occurring. Trophic levels of the BSAI and GOA were found to be relatively high and stable over the last 40 years.

Data from the BSAI and the GOA show that factors other than fishing have a much greater effect on the predator-prey relationships in these systems. Livingston (1999) reviewed the trends in the fisheries and potential impacts to the EBS ecosystems. The study showed cyclic fluctuations in abundance over the last two decades for both fished and unfished species. Study results also show a stable trophic level of catch and stable populations overall. The trophic level in the EBS has risen slightly since the early 1950s, and it appeared stable as of 1994. Anderson and Piatt (1999) found that changes in climate were the controlling factors in trophic changes in the GOA. Evidence suggests that the inshore community was reorganized after the 1977 climate regime shift and that the large geographic scale of changes across so many taxa is a strong argument that climate change is responsible.

External Factors Contributing to Cumulative Effects

Pollution levels in the past have not been documented to have significant effects on trophic structure, but the effects could increase in the future. Climate has been the controlling factor in many of the large-scale changes in the trophic communities in these systems, and it is likely to continue to have a significant impact on the trophic organization. Continuing climate cycles, such as ENSO and PDO events, can cause changes in ocean temperature, salinity, and nutrient availability. The specific effects of these changes on predator-prey relationships are not well documented at this time, though it is reasonable to predict that changes in food source for target species will accordingly affect species populations. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers, and many of the zooplankton species that serve as major food resources for target species.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on predator-prey relationships are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect North Pacific marine ecosystems, as indicated by predator-prey relationships, include changes in the harvest of rockfish, crabs, and non-target species, as well as closure areas associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS. All of these measures would be expected to have neutral to positive effect on the predator-prey relationships compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

All of the alternatives to describe and identify EFH except Alternative 2 would have unknown effects on the predator-prey relationships in the BSAI and the GOA; however, due to the overwhelming influence of climate changes on these systems compared to fishing activities, it is unlikely that there would be significant changes as a result of the EFH descriptions. Alternative 2 would not have any additional effect on predator-prey relationships, since it represents the status quo.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs may have mixed indirect effects on predator-prey relationships in the BSAI and the GOA. Alternative 1, or no HAPC identification, would have an indirect negative effect on predator-prey relationships compared to the other alternatives. If HAPC identification were removed and triggers to protect sensitive habitat areas were also removed, there would be a greater chance of negative impacts to trophic communities in those sensitive habitats. If these habitats are key to the ecological balance of the ecosystem, the issue of protecting the areas would have important implications for the BSAI and the GOA. For Alternative 2, there would be no additional effect on predator-prey relationships, since this alternative represents the status quo. For Alternatives 3 through 5, the identification of HAPCs could trigger protection measures that would likely improve or protect the natural trophic structure in those sensitive habitats and maintain it under natural conditions. Although the largest agent of change in predator-prey relationships is climate, the protection of habitat areas that are critical to the ecology of the ecosystem would likely benefit the natural predator-prey relationships in the BSAI and the GOA.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

As noted above, describing and identifying EFH has the potential to have indirect positive effects on predator-prey relationships of the BSAI and the GOA by triggering increased levels of protection for EFH. However, none of the fishing impact minimization alternatives considered in this analysis are expected to have substantial direct effects on predator-prey relationships of the BSAI and the GOA. These alternatives are focused in small areas and would not be likely to compare substantially to the influence of climate on predator-prey relationships and trophic structure.

Summary of Cumulative Effects

The current trend of predator-prey relationships in both the GOA and the BSAI is healthy and stable. External factors such as climate play a major role in controlling predator-prey relationships. Future management actions are intended to maintain these relationships. The EFH description and HAPC identification alternatives that provide additional identification would be likely to have indirect benefits for predator-prey relationships by triggering additional habitat protection measures. EFH fishing impact minimization alternatives would not be likely to substantially affect predator-prey relationships. In summary, there would not likely be any substantial cumulative effects on predator-prey relationships on the ecosystem scale for the BSAI and the GOA.

4.4.9.2 Energy Flow and Balance

Past and Present Trends Contributing to Cumulative Effects

Energy flow and balance in an ecosystem can by affected by fishing practices if fisheries discard or return fish processing wastes to the system. This process takes energy, in the form of returned biomass, and transports it to other parts of the system, relative to unfished areas. As discussed in Section 4.3, the overall portion of the total biomass in the EBS that is discarded from fishing is less than 1 percent. Queirolo et al. (1995) found that the total offal and discard production for the BSAI and the GOA was about 1 percent of the unused detritus already going to the bottom. The total fishing removals are a small portion of the energy budget and do not have substantial effects on energy flow and balance in the Alaska ecosystems.

External Factors Contributing to Cumulative Effects

Pollution and climate change may affect energy flow and balance within the BSAI and the GOA. Increases in ocean pollution may cause organisms to die and would alter the natural energy flow if die-offs occurred in large numbers. Natural climate cycles affect energy flow on an ecosystem level and will continue to do so. Continuing climate cycles such as ENSO and PDO events can cause changes in ocean temperature, salinity and nutrient availability. The specific effects of these changes on energy flow and balance are not well documented at this time, though it is reasonable to predict that changes in food source for target species will accordingly affect species populations. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers, and many of the zooplankton species that serve as major food resources for target species.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on energy flow and balance are not well documented at this time. Increases in temperature would likely lead to more nutrient availability in terms of primary productivity, which would benefit primary consumers and many of the zooplankton species that serve as major food resources for target species. In addition to decadal-scale shifts, interannual events such as the ENSO can have significant impacts on fish and benthic species distribution and survival, and can affect reproduction, recruitment, and other processes in ways that are not yet understood.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect North Pacific marine ecosystems (as indicated by energy flow and balance) include changes in the harvest of rockfish, crabs, and non-target species, as well as closure areas associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS. All of these measures would be expected to have neutral to positive effects on energy flow and balance compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

The alternatives to describe and identify EFH would not likely have an effect on energy flow and balance in the BSAI and GOA. These identifications would not change the overall flow of energy through the BSAI and GOA ecosystems.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs would also have no significant effect on energy flow and balance in the BSAI and GOA ecosystems. These identifications would not change the overall flow of energy through the BSAI and GOA ecosystems.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The EFH fishing impact minimization alternatives would have no effect on energy flow and balance in the BASI and GOA ecosystem, because they are not likely to change the flow of energy or the trophic structure in these systems.

Summary of Cumulative Effects
Energy flow and balance in the GOA and BSAI are considered stable. Climate likely affects the processing of energy through these systems and will continue to do so. EFH description alternatives, HAPC identification alternatives, and EFH fishing impact minimization alternatives are not likely to affect energy flow and balance throughout the GOA and the BSAI. In summary, there would not likely be any substantial cumulative effects on energy flow and balance from the actions taken in conjunction with this EIS.

4.4.9.3 Diversity

Past and Present Trends Contributing to Cumulative Effects

Diversity in an ecosystem can be defined as the number of species, functional or trophic diversity, structural habitat diversity in living substrata, and genetic level diversity. The EBS contains 300 species of fish, 150 species of crustaceans and mollusks, 50 species of seabirds, and 25 species of marine mammals (Livingston and Tjelmeland 2000). The GOA has a more diverse community of commercial bottomfish species than the BSAI. Mueter (1999) found that groundfish community diversity in the GOA peaked at 200 to 300 m depth. Higher abundance and lower species richness and diversity were found in the western GOA compared to the eastern GOA. These differences were found to be due to different levels of upwelling between the two areas.

There are no conclusive data on the level of effect of fishing on diversity at the ecosystem level. There are no data that suggest fishing-induced extinctions in Alaska in the last 30 years, but evidence exists for fishing-induced extinctions for skate species in the North Atlantic. Systematic work is being conducted on diversity and distribution of living substrata in the BSAI and GOA, but results are not conclusive. Genetic diversity in the BSAI and GOA has not been extensively studied. However, heavy exploitation of commercial species, and larger individuals within a species, may reduce the genetic diversity in fished versus unfished systems. Species richness (the number of species per unit area) and evenness (the relative abundance of resident species) – two measures of species diversity– can decline in response to bottom trawling, but not all communities show reduced diversity (NRC 2002). Also, bottom trawling can damage benthic and epibenthic habitats, thereby reducing localized diversity of the living substrate. Diversity of benthic invertebrates was significantly lower in a chronically trawled area of the EBS as compared to an adjacent untrawled area. Lower diversity in the heavily trawled area was the direct result of greater dominance by the sea star *Asterias amurenesis* (McConnaughey et al. 2000).

External Factors Contributing to Cumulative Effects

External factors such as foreign fishing and subsistence fishing would slightly increase the risk to diversity at the ecosystem level, but this risk is not significant, due to the low amount of catch in these fisheries. Non-fishing activities could locally affect the diversity of species in nearshore areas that may be affected by these activities. Pollution levels may affect diversity of species, trophic levels, habitats, or genetic diversity if there is an increase in pollution that targets a certain species, trophic level, or segment of the population. Climate does, and will continue to, affect diversity, but at a naturally slow time-scale, consistent with evolutionary change.

Alaska may be entering into a new cool PDO regime that could profoundly affect the marine ecosystem. The 1997 to 1998 ENSO event, one of the largest of the century, significantly changed fish stock distributions in the GOA. However, the effects on species diversity are not well documented at this time.

Future Management Actions Contributing to Cumulative Effects

Potential future management actions that may affect North Pacific marine ecosystems (as indicated by diversity) include changes in the harvest of rockfish, crabs, and non-target species, as well as closure areas associated with future HAPC measures and marine protected areas implemented under the Draft Programmatic Groundfish SEIS. All of these measures would be expected to have neutral to positive effects on the diversity of the ecosystem compared to the status quo.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

The alternatives for identification of EFH would not likely affect extinction rates, trophic level structure, or selective fishing patterns that would affect diversity.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs may indirectly affect the overall diversity of the ecosystem, because the areas that would be designated would have been identified as areas of important ecological function and would likely have high biodiversity. Alternative 1 would likely have an indirect negative effect on diversity because existing HAPC identification would be removed, which would remove triggers for protection measures for ecologically important areas. Alternative 2 would have no additional effect on diversity because it represents the status quo. Alternatives 3 through 5 could indirectly increase the diversity of species by providing additional HAPC identification, which could trigger additional protection of ecologically important areas.

Changes to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The EFH fishing impact minimization alternatives would likely have mixed indirect effects on biodiversity. Alternatives 1 and 2 would have neutral effects on diversity in the BSAI and GOA ecosystems. For Alternative 1, no evidence is available to support changes in biodiversity under current management. Under Alternative 2, there would be little change in species diversity. Structural habitat is mostly found in the AI, and this alternative would not protect living substrata in the AI. Changes are expected to be minimal under this alternative because less than 5 percent of the catch comes from areas closed under this alternative. Alternatives 3 through 6 would result in potential increases in the level of diversity in the Alaska ecosystem. Protection of slope habitat and living substrate could increase the overall level of biodiversity and genetic diversity in the BSAI and the GOA.

Summary of Cumulative Effects

The level of biodiversity in the GOA and BSAI is known, but the trends are not well established. Localized effects of fishing and other activities may have reduced the levels of diversity in some areas. External factors such as climate and pollution likely affect biodiversity and will continue to do so. Future management actions are intended to protect and enhance current levels of biodiversity. EFH description alternatives are unlikely to affect biodiversity. HAPC identification alternatives that provide additional identification would likely indirectly benefit local biodiversity by triggering protection measures for ecologically diverse areas. EFH fishing impact minimization Alternatives 3 through 6 would also likely increase biodiversity by providing protection to slope habitat, which provides habitat to a high number of species. The cumulative effects of the actions analyzed in this EIS and future management actions would likely increase biodiversity over the long term, based on the protection of areas of ecological significance and limitations on fishing practices.

4.4.10 Cumulative Effects on Non-fishing Activities

4.4.10.1 Costs to Federal and State Agencies

Past and Present Trends Contributing to Cumulative Effects

NMFS has authority under the Fish and Wildlife Coordination Act, NEPA, and other laws to comment on non-fishing activities that impact living marine resources and their habitats. Additionally, the Magnuson-Stevens Act requires federal agencies to consult with NMFS on all actions or proposed actions that are permitted, funded, or undertaken by the agency that may adversely affect EFH. Federal agencies do this by preparing and submitting an EFH assessment to NMFS. The EFH Assessment is a written assessment of the effects of the proposed federal action on EFH. Regardless of federal agency compliance with this directive, the Act requires NMFS to recommend conservation measures to federal as well as state agencies once it receives information or determines from other sources that EFH would be adversely affected. The EFH conservation recommendations are provided to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. Proposed activities do not automatically require EFH consultation with NMFS. Consultations are triggered only when the proposed action may adversely affect EFH, and then, only federal actions require consultation. In any event, both federal and state agencies bear their internal cost for any consultation that takes place. Costs to federal and state agencies have increased over time with the development of regulations intended to protect endangered species and habitat.

External Factors Contributing to Cumulative Effects

External factors related to cumulative effects on costs to federal and state agencies include the costs imposed by other regulations, the level of economic activity to which those regulations apply, and the costs of handling appeals and lawsuits associated with those regulations. The amount of regulation and level of economic activity can be quite variable, and tend to shift with the changing political and economic climate. A higher degree of regulation and/or a higher level of economic activity would tend to increase costs to agencies. Fewer regulations and/or a lower level of activity to which the regulations apply would tend to lower costs to the agencies.

A related external factor is the agencies' budgets. With some agencies facing reduced budgets, their ability to fulfill their mission can be adversely affected even if their costs remain the same.

Future Management Actions Contributing to Cumulative Effects

As discussed above in Section 4.4.3.3, the Council and NMFS plan to review the EFH provisions of Council FMPs periodically, and revise or amend them as warranted based on available information. Such reviews could result in changes to the EFH descriptions as additional information becomes available. These changes may result in either more or fewer non-fishing activities being subject to EFH consultations and conservation recommendations. Thus, the direction and magnitude of its effect on cumulative costs to federal and state agencies cannot be determined.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

Alternative 1 would have a positive effect on costs to federal and state agencies. With existing EFH descriptions rescinded, there would be no requirement for federal agencies to consult with NMFS regarding actions that may adversely affect EFH, and NMFS could not use EFH descriptions as the impetus to provide conservation recommendations to federal or state agencies to protect fish habitat. Nevertheless, NMFS would continue to have authority under the Fish and Wildlife Coordination Act, NEPA, and other laws to comment on non-fishing activities that impact living marine resources and their habitat. Alternative 2 would have no effect on existing federal and state cost trends because it represents the status quo.

Alternatives 3 through 5 could have negative effects on costs to federal and state agencies because describing and identifying EFHs would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitat for non-fishing activities. Federal agencies would be required to consult with NMFS regarding actions that may adversely affect EFH, and NMFS would provide conservation recommendations to federal and state agencies to protect fish habitats. Federal agencies would be required by the Magnuson-Stevens Act to provide detailed written responses to such recommendations from NMFS.

Alternative 6 would have a positive effect on costs to most federal and state agencies. Without describing and identifying EFHs in state waters, including freshwater areas, estuaries, or nearshore marine waters, there would be no requirement for federal agencies to consult with NMFS regarding actions that may adversely affect EFH in those areas, and NMFS could not use EFH descriptions as the impetus to provide conservation recommendations to federal or state agencies to protect fish habitats. Describing and identifying EFHs in federal waters would, however, trigger Magnuson-Stevens Act requirements under Alternative 6. Regardless of the level of EFH description, NMFS would continue to have authority under the Fish and Wildlife Coordination Act, NEPA, and others laws to comment on non-fishing activities that impact living marine resources and their habitats.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs could also affect costs to state and federal agencies. Alternative 1 could have a positive effect on federal and state agencies that authorize, fund, or undertake actions affecting fish habitat. Without HAPC identification, EFH consultations could not focus additional attention on especially valuable or vulnerable subsets of EFH. Alternative 2 would have no effect on existing federal and state cost trends because it represents the status quo. Alternatives 3 through 5 could have negative effects on costs to state and federal agencies because HAPC identification could focus additional attention on those same subsets of EFH, potentially leading the responsible agencies to restrict development that would otherwise adversely affect such habitats.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The alternatives designed to minimize the effects of fishing on EFH are not expected to affect costs to federal and state agencies other than those regulatory and enforcement programs discussed under Section 4.4.6.7.

Summary of Cumulative Effects

Costs to federal and state agencies regulating, permitting, funding, or undertaking non-fishing activities have increased over time with the development of regulations intended to protect endangered species and habitat. External factors affecting these costs include the costs imposed by other regulations, the level of economic activity to which those regulations apply, and the costs of handling appeals and lawsuits associated with those regulations. The potential effects of future management actions on non-fishing costs to federal and state agencies are unknown. EFH description Alternatives 1 and 6 and HAPC identification Alternative 1 would likely have positive effects on costs to federal and state agencies. Existing EFH descriptions would be rescinded under EFH description Alternative 1 and there would be no EFH descriptions in state waters under EFH description Alternative 6. Existing consultation requirements and associated costs would be reduced under both alternatives. HAPC identification Alternative 1 could have a relatively positive effect because without HAPC identification, EFH consultations would not focus additional attention on especially valuable or vulnerable subsets of EFH. EFH description Alternatives 3 through 5 and HAPC identification Alternatives 3 through 6 are expected to have negative effects on costs to federal and state agencies because additional consultation would be required under these alternatives. EFH description Alternative 2 and HAPC identification Alternative 2 would not affect existing federal and state agencies cost trends because they represent the status quo. The EFH fishing effects minimization alternatives are not expected to affect costs to federal and state agencies. The cumulative effect of all actions – past, present, and future – is toward an overall increase in costs to federal and state agencies. The alternatives that would result in increased costs would contribute directly to this trend, while those alternatives expected to have no effect or a relatively positive effect are not likely to result in a reversal of these trends.

4.4.10.2 Costs to Non-fishing Industries and Other Proponents of Affected Activities

Past and Present Trends Contributing to Cumulative Effects

Non-fishing industries and other proponents of affected activities are currently subject to many forces that cumulatively affect their cost of doing business. First, they are subject to competitive market forces that may affect the supply of and/or demand for their product or service, the supply of and/or demand for substitute products or services, and the price of inputs to their production process. They are also subject to environmental regulations not associated with fishing, including NEPA, the Endangered Species Act, Clean Water Act, Clean Air Act, Coastal Zone Management Act, and others. Additionally, they are subject to other regulations such as zoning laws, tax laws, labor laws, and so forth. In general, economic forces have tended to increase competition and reduce profit margins in many industries, including timber, mining, and other resource-based industries. With respect to environmental regulations, industries may be requested by permitting agencies to fund all or part of the agencies' costs associated with evaluating the permit application and administering the permit. When federal or state agencies deny or condition permits to fulfill their regulatory obligations, project costs for the proponents generally increase. Overall, the cost of regulatory compliance has been increasing. While it is difficult to generalize, it is likely that costs incurred by most potentially affected non-fishing industries and other project proponents have tended to increase over recent years.

External Factors Contributing to Cumulative Effects

As noted above, non-fishing industries are subject to several forces that cumulatively raise their cost of doing business, including external market forces, environmental regulations, and other regulations. These same factors are expected to continue affecting non-fishing industries and other proponents of affected activities.

Future Management Actions Contributing to Cumulative Effects

As discussed above in Section 4.4.3.3, the Council and NMFS plan to review the EFH provisions of Council FMPs periodically, and revise or amend them as warranted based on available information. Such reviews could result in changes to the EFH descriptions as additional information becomes available. These changes may result in either more or fewer non-fishing activities being subject to EFH consultations and conservation recommendations. Thus, the direction and magnitude of its effect on cumulative costs to federal and state agencies cannot be determined.

Contributions to Cumulative Effects Related to Describing and Identifying EFH

By rescinding existing EFH descriptions, Alternative 1 would have a positive effect on costs for the industries and other entities that sponsor non-fishing activities that have the potential to harm fish habitats. The absence of EFH descriptions and associated consultations under Alternative 1 may result in a decrease in the cost of obtaining permits or funding from federal agencies. Alternative 2 would have no effect on existing trends in costs to non-fishing industries and other proponents of affected activities because it represents the status quo.

The action Alternatives 3 through 5 to describe and identify EFH would have negative effects on costs to non-fishing industries and other proponents of affected activities. Describing and identifying EFHs would trigger interagency consultations regarding the effects of proposed actions on EFH. In some cases, permitting or funding agencies may ask applicants to provide pertinent information to facilitate such consultations, which could increase the cost of obtaining the permits or funding. When federal or state agencies deny or condition permits or funding to protect EFH, project costs for the proponents could increase.

Alternative 6 would have a positive effect on costs for the industries and other entities that sponsor non-fishing activities that have the potential to harm fish habitats in state waters because there would be no EFH descriptions in these waters. Identifications would, however, occur in federal waters and would have the types of negative effects on costs outlined above for Alternatives 3 through 5. As previously noted, NMFS and other agencies can provide habitat recommendations under other authorities, and restrictions can be imposed on development for environmental reasons other than EFH conservation. The monetary costs specifically attributable to EFH would be difficult to discern.

Contributions to Cumulative Effects Related to HAPC Identification

The alternatives to identify HAPCs could also affect costs to non-fishing industries and other proponents of affected activities. Alternative 1 could have a positive effect on these costs because without HAPC identification, EFH consultations could not focus additional attention on especially valuable or vulnerable subsets of EFH. Alternative 2 would have no effect on existing trends in costs for the industries and other entities that sponsor non-fishing activities because it represents the status quo. Alternatives 3 through 5 could have negative effects on costs to non-fishing industries and other proponents of affected activities because HAPC identification may focus additional attention on those same subsets of EFH, potentially leading the responsible agencies to restrict development that would otherwise adversely affect such habitats.

Contributions to Cumulative Effects Related to Minimizing the Effects of Fishing on EFH

The alternatives designed to minimize the effects of fishing on EFH are not expected to affect the costs of non-fishing industries and other proponents of affected activities.

Summary of Cumulative Effects

Costs incurred by most potentially affected non-fishing industries and other proponents of such projects, have tended to increase over recent years. External factors, such as external market forces, environmental regulations, and other regulations, are expected to continue to affect costs. The potential effects of future management actions on costs to non-fishing industries and other project proponents are presently unknown. EFH description Alternatives 1 and 6 and HAPC identification Alternative 1 would likely have positive effects on costs to non-fishing industries and other project proponents. Existing EFH descriptions would be rescinded under EFH description Alternative 1 and there would be no EFH descriptions in state waters under EFH description Alternative 6, which could result in a decrease in the cost of obtaining permits or funding from federal agencies. HAPC identification Alternative 1 could have a relatively positive effect because without HAPC identification, EFH consultations would not focus additional attention on especially valuable or vulnerable subsets of EFH. EFH description Alternatives 3 through 5 and HAPC identification Alternatives 3 through 6 are expected to have negative effects on costs to non-fishing industries and other project proponents because additional consultation would be required under these alternatives, which could increase the cost of obtaining permits or federal funding. EFH description Alternative 2 and HAPC identification Alternative 2 would not affect existing trends in costs to non-fishing industries and other project proponents because they represent the status quo. The EFH fishing effects minimization alternatives are not expected to affect costs to federal and state agencies. The cumulative effect of all actions – past, present, and future – is likely toward an overall increase in costs to non-fishing industries and other potentially affected project proponents. The alternatives that would result in increased costs would contribute directly to this trend, while those alternatives expected to have no effect or a relatively positive effect are not likely to result in a reversal of these trends.

4.4.11 Cumulative Socioeconomic Effects

Section 4.4.6 of this Cumulative Effects section presents a discussion of the cumulative effects of the alternatives on various criteria associated with federally managed species, including passive use values and future use benefits, gross revenue, operating costs of fishermen and processors, costs to United States consumers, safety, socioeconomic effects on existing communities, and effects on regulatory and enforcement programs. Section 4.4.10 presents a discussion of the cumulative effects of the alternatives on criteria defined for non-fishing activities, including costs to federal and state agencies and costs to non-fishing industries and other proponents of affected activities. This section creates a composite of both sets of criteria to present a more holistic approach to identifying cumulative socioeconomic effects related to the alternatives.

Table 4.4-1 provides a summary of the potential effects on the various economic and socioeconomic criteria of the EFH description alternatives, the HAPC identification alternatives, and the alternatives to minimize the effects of fishing on EFH. There are several notable areas of positive or neutral effects:

- First, the no action alternatives tend to have either positive effects on the criteria (EFH identification Alternative 1 and HAPC-identification Alternative 1) or no effect (EFH fishing impact minimization Alternative 1). This is anticipated because EFH description Alternative 1 and HAPC identification Alternative 1 would rescind existing identifications. Both would tend to reduce the costs of regulatory compliance for both fishing and non-fishing interests in the short run. The caveat is that in the long term, if the lack of action leads to these habitats producing fewer fish, then the effect could be reversed.

- Second, EFH description Alternative 6 is expected to have positive short-term effects on non-fishing interests because EFH would not extend to state waters, reducing the comparative cost of complying with regulations. Again, however, the long-term effect could be negative if the lack of protection in these waters leads to the production of fewer fish and subsequent increased protective legislation.

- Third, EFH description Alternatives 3 through 5 and HAPC identification Alternatives 3 through 5 may have positive long-term socioeconomic effects on communities (although negative short-term effects). The positive long-term effect would occur if identifying EFH and HAPC provides sufficient habitat protection that larger populations of fish and a greater harvest can be sustained in the long run.

- Finally, the action alternatives designed to minimize the effects of fishing on EFH (that is, Alternatives 2 through 6) are expected to have positive effects on the passive use value for EFH. This conclusion can be thought of in the following way: protecting EFH provides a benefit to people who value EFH for its own sake. This argument is self-limiting at some level of protection because of the laws of diminishing marginal returns. As more and more habitat is protected, the passive use value of each additional km^2 of protected habitat could fall.

At least in the short term, the identification of EFH and HAPC could increase costs to both fishing and non-fishing industries and to both fishing and non-fishing regulatory and enforcement agencies, with a corollary negative effect on fishing communities. The alternatives to minimize the effects of fishing on EFH would also have negative effects on the fishing industry, regulatory and enforcement agencies, and fishing communities, but would not affect non-fishing industries and agencies. These expected negative effects would certainly be anticipated in the short term because of the industry and agency needs to adapt to new regulations, closed fishing areas, redeployment of fishing effort to other areas and/or other gears, and the possible loss of some fisheries.

The long-term effects of the action alternatives are less clear. If the habitat protection related to the action alternatives leads to improved fisheries in the long term, it could lead to reduced costs, more harvest, and/or more fishing revenue. As noted elsewhere in this document, however, there is no clearcut linkage between habitat changes and changes in future production or yield. Future accumulation of knowledge and improved models should improve scientists' ability to examine such linkages.

4.4.12 Summary of Cumulative Effects

Effects on Habitat

Much of the past history GOA, EBS, and AI fish habitat has been influenced by active foreign and domestic trawl fisheries that may have had a negative effect on habitat. More recent management actions have sought to reverse that trend, and planned future actions are meant to do the same. EFH description and HAPC identification alternatives would have indirect positive effects on habitat by providing additional triggers for habitat protection measures. EFH description Alternative 1 and HAPC identification Alternative 1 would remove existing identifications and would be likely to have indirect negative effects on habitat because they would remove triggers for potential habitat protection measures. EFH description Alternative 2 and HAPC identification Alternative 2 would not affect current trends in habitat, because they represent the status quo. The EFH action alternatives to minimize the effects of fishing on EFH fit in with other current and future management plans in seeking to protect habitat from damage. Alternative 1, no action, would maintain the status quo. Alternative 2, while providing some level of protection, would not have any substantial positive impact. Alternatives 3 through 5 would provide progressively more habitat protection, working cumulatively with other current and planned future management actions to reverse the negative trends of the past. Alternative 6 would provide intermediate improvement in habitat protection compared to the status quo.

Effects on Target Species

Past effects on factors affecting target species (fishing mortality, spatial/temporal concentration of catch, productivity, prey availability, and growth to maturity) have been judged as neutral or negative. Populations of groundfish species, salmon, most species of crab, and scallops are stable. However, there are a few stocks of crab, such as the St. Matthew blue king crab, Pribilof Islands blue king crab, and EBS Tanner crab, that are considered overfished. More recent management actions have sought to maintain the stable populations and provide for additional conservation for target species, and planned future actions are meant to do the same. For the majority of target species factors, EFH description Alternative 1 and HAPC Alternative 1 would have indirect negative effects by removing triggers for habitat protection measures. EFH description Alternative 2 and HAPC identification Alternative 2 would have no effect, because they represent the status quo. EFH description Alternatives 3 through 6 and HAPC identification Alternatives 3 through 5 would have indirect positive effects on target species by triggering additional habitat protection measures. For catch concentration, the reverse effects would be seen from the alternatives. Those identification alternatives that could trigger increased habitat protection would likely also increase catch concentration. Those alternatives that would decrease triggers for habitat protection would also likely decrease concentration of fishing effort and catch. The alternatives to minimize the effects of fishing on EFH would have neutral to positive effects, in line with other current and planned future management actions. In particular, Alternatives 4, 5A, and 5B could have positive effects for opilio crabs. For the most part, however, the EFH fishing impact minimization alternatives are expected to have a neutral influence with respect to cumulative effects on target species. Cumulatively, the action alternatives under this EIS would have positive or neutral effects on target species.

Effects on the Economic and Socioeconomic Aspects of Federally Managed Species

The criteria used to evaluate effects on the economic and socioeconomic aspects of federally managed species offer a mixed set of cumulative effects. In terms of passive use values, the past trend was likely negative, while current and planned future management actions, as well as the action alternatives to describe and identify EFH, identify HAPCs, and minimize the effects of fishing on EFH, would be positive. One factor, safety, has been exhibiting a positive trend that is expected to continue, although the EFH fishing impact minimization alternatives could have the negative effect of pushing some smaller fishing vessels farther from shore in search of fish. The alternatives to describe and identify EFH and HAPC are not expected to affect the safety of the fishing fleet. Most of the other factors used to evaluate federally managed species are in a downward trend that would be accentuated by current and future management plans, including the action alternatives to describe and identify EFH, identify HAPCs, and the EFH fishing impact minimization alternatives. These negative trends include decreasing harvests, decreasing gross revenue for fishermen, increased operating costs for fishermen, increased costs to consumers, adverse socioeconomic effects on fishing-related businesses and their communities, and increased costs for regulatory and enforcement programs.

The potential effects of the alternatives to describe and identify EFH and HAPC on the fishing industry in terms of harvest, price effects, and gross revenue are unknown. EFH fishing effects minimization Alternatives 3 through 6 are expected to result in reductions in harvest and gross revenue, but the extent of the negative impact cannot be measured at this time. The alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 3 through 5), and minimize the effects of fishing on EFH (Alternatives 2 through 6) are expected to have negative effects on operating costs for certain sectors of the fishing industry, at least in the short term. These alternatives also have the potential to negatively affect costs to United States consumers, as well as regulatory enforcement programs. The alternatives to describe and identify EFH (Alternatives 3 through 6), identify HAPC (Alternatives 3 through 5), and EFH minimization Alternatives 5A, 5B, 5C, and 6 are also expected to have negative effects on communities. EFH description Alternative 1 and HAPC identification Alternative 1 are for the most part expected to have short-term positive effects on the criteria used to evaluate effects on federally managed species with existing EFH descriptions rescinded and the absence of HAPC identification. EFH description Alternative 2, HAPC identification Alternative 2, and EFH fishing effects minimization Alternative 1 represent the status quo and are not expected to affect existing trends.

In some cases, the negative effects that would be directly or indirectly associated with the three sets of action alternatives are near-term effects that could be reversed over time if the proposed measures result in healthier fish stocks and more productive fisheries in the long term. These potential long-term effects are, however, very difficult to predict.

Effects on Other Fisheries and Fishery Resources

The criteria associated with other fisheries and fishery resources offer another mixed set of positive, negative, and neutral cumulative effects. With respect to the state-managed groundfish fishery, the past trend is relatively unknown, while current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects. The EFH and HAPC identification alternatives that would provide additional identification would likely indirectly benefit the conservation of target species in state-managed fisheries, but may also indirectly increase the operating costs for these fisheries. The EFH and HAPC identification alternatives that decrease the level of identification would have indirect adverse effects on conservation of target species, but indirect benefits to the operating costs for fisheries. Most of the action alternatives to minimize the effects of fishing on EFH would have no influence. The exception is Alternative 6, where federal closures to bottom-contact gear could prompt similar state actions, although there is no assurance of this outcome.

The state-managed crab fishery, on the other hand, has clearly been negatively affected by past trends. Like the situation with groundfish, current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects. The EFH and HAPC identification alternatives that would provide additional identification would likely indirectly benefit the conservation of target species in state-managed fisheries, but may also indirectly increase the operating costs for these fisheries. The EFH and HAPC identification alternatives that decrease the level of identification would have indirect adverse effects on conservation of target species, but indirect benefits to the operating costs for fisheries. The action alternatives to minimize the effects of fishing on EFH would add cumulatively to the beneficial effects of other management actions, although there is no assurance of this outcome.

The herring and halibut fisheries both appear to be healthy, with herring rebounding from earlier declines and halibut at near record catch levels. The EFH and HAPC identification alternatives that provide additional identification would likely indirectly benefit the conservation of target species in state-managed fisheries, but may also indirectly increase the operating costs for these fisheries. The EFH and HAPC identification alternatives that decrease the level of identification would have indirect adverse effects on conservation of target species, but indirect benefits to the operating costs for fisheries. None of the EFH measures to minimize the effects of fishing on EFH, or other planned future management actions, are expected to have any substantial effects on herring or halibut or the fisheries for these species.

Cumulatively, the action alternatives could have positive or neutral effects on conservation of species, but may have negative effects on operating costs for fisheries.

Effects on Protected Resources

The past trend has been generally negative for ESA-listed mammals, salmon, and seabirds, as well as other marine mammals and seabirds. In terms of cumulative effects, several potential future management actions may increase protection of these species, including TAC reductions for non-target species, closure areas, and effort reductions. The EFH and HAPC identification alternatives that would provide additional identification would likely indirectly benefit the conservation of protected resources. The EFH and HAPC identification alternatives that decrease the level of identification would have indirect adverse effects on conservation of protected resources. Most of the action alternatives to minimize the effects of fishing on EFH are expected to have a neutral effect in this regard. The exceptions are Alternatives 5B, 5C, and 6, which could increase localized concentrations of fishing vessels in key listed marine mammal habitat, especially Steller sea lion habitat in the AI, increasing the potential for increased interactions of fisheries and marine mammals. Thus, while most of the EFH fishing impact minimization alternatives would have no substantial effect on marine mammals and seabirds, Alternatives 5B, 5C, and 6 could add cumulatively to the existing negative trend. The cumulative effects of the EFH definition alternatives that increase identification would be positive, but those that would decrease existing protection would add cumulatively to the existing negative trend.

Effects on Ecosystems

The effects of past trends have been generally neutral or unknown with respect to the criteria considered in the evaluation of effects on ecosystems (predator-prey relationships, energy flow and balance, and biodiversity). Potential future management actions, including changes in the harvest of rockfish, crabs, and non-target species, as well as various marine closures, would be expected to have neutral to positive effects on these criteria. The EFH and HAPC identification alternatives would not likely affect predator-prey relationships or energy flow and balance. The EFH description alternatives would also not likely affect biodiversity. Although, geographically, HAPCs are a subset of EFH, the additional emphasis on conservation from the HAPC identification may lead to effects that are not present under EFH description. Alternatives that extend HAPC identification would indirectly benefit biodiversity, while those that decrease identifications would have indirect negative effects on biodiversity. The alternatives to minimize the effects of fishing on EFH would act with other management actions in having neutral or cumulatively positive effects. In particular, Alternatives 3 through 6 would be expected to have positive effects on biodiversity. Cumulatively, the EFH alternatives would have neutral or positive effects on ecosystems.

Effects on Non-fishing Activities

Costs to federal and state agencies regulating, permitting, funding, or undertaking non-fishing activities have increased over time with the development of regulations intended to protect endangered species and habitat. In addition, the costs associated with addressing appeals and lawsuits have been increasing for many agencies. Costs incurred by most potentially affected non-fishing industries and other project proponents have tended to increase over recent years. The potential effects of future management actions on non-fishing costs to federal and state agencies and costs to non-fishing industries and other project proponents are unknown.

EFH description Alternatives 1 and 6 and HAPC identification Alternative 1 would likely reduce associated regulatory costs to federal and state agencies and non-fishing industries and other project proponents. Existing EFH descriptions would be rescinded under EFH description Alternative 1 and there would be no EFH descriptions in state waters under EFH description Alternative 6. Existing consultation requirements and associated costs would be reduced under both alternatives. HAPC identification Alternative 1 could have a relatively positive effect because without HAPC identification, EFH consultations would not focus additional attention on especially valuable or vulnerable subsets of EFH. EFH description Alternatives 3 through 5 and HAPC identification Alternatives 3 through 6 are expected to have negative effects because additional consultation would be required under these alternatives. EFH description Alternative 2 and HAPC identification Alternative 2 would not affect existing cost trends because they represent the status quo. The EFH fishing effects minimization alternatives are not expected to affect costs to federal and state agencies or non-fishing industries and other project proponents. The cumulative effect of all actions – past, present, and future – is generally toward an overall increase in costs. The alternatives that would result in increased costs would contribute directly to this trend, while those alternatives expected to have no effect or a relatively positive effect are not likely to result in a reversal of these trends.