4.0 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Chapter 4 discusses the environmental consequences of the alternatives for each of the three actions evaluated in this EIS: describing and identifying EFH (Section 4.1), establishing an approach for HAPC identification (Section 4.2), and minimizing adverse effects of fishing on EFH (Section 4.3). The "no action" alternatives for identifying EFH and establishing an approach for HAPCs differ from the "status quo" alternatives because this EIS is a reevaluation of the 1999 decision that first amended the FMPs to include EFH information. Hence, no action for identifying EFH or HAPCs means EFH or HAPCs would not be identified. Because the Secretary has already approved the description and identification of EFH and HAPCs for the Council's FMPs under the Magnuson-Stevens Act (64 FR 20216; April 26, 1999), selection of the no action alternative would require new FMP amendments to remove the status quo designations. In the alternatives for minimizing adverse effects of fishing on EFH, no action and status quo are treated synonymously because the 1999 action did not include any new management measures. However, today's conditions, including management measures adopted for other purposes between 1999 and the present (e.g., fishery closures to protect Steller sea lions), may protect EFH from potential fishing impacts to a greater degree than the measures existing in 1999 alone. As discussed above in Chapter 2, this EIS evaluates the status quo as 2003 conditions, and it also describes a pre-status quo condition for comparison.

4.1 Effects of Describing and Identifying Essential Fish Habitat

Description and identification of EFH, in accordance with Section 303(a)(7) of the Magnuson-Stevens Act, does not in and of itself have any direct environmental or socioeconomic impacts. EFH description and identification is, however, likely to result in indirect environmental and/or socioeconomic impacts because an EFH designation triggers two types of requirements under the Magnuson-Stevens Act, as discussed below.

First, every FMP must minimize adverse effects of fishing on EFH to the extent practicable. Under Section 303(a)(7) of the Magnuson-Stevens Act and the associated provisions of the EFH regulations (50 CFR 600.815[a][2]), each FMP must contain an evaluation of the potential adverse effects of fishing on EFH. The Council must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature. In determining whether it is practicable to minimize an adverse effect from fishing, the Council should consider the nature and extent of the adverse effect on EFH and the long- and short-term costs and benefits of potential management measures to EFH, associated fisheries, and the nation. Subsequent amendments to an FMP or to its implementing regulations must ensure that the FMP continues to minimize adverse effects on EFH caused by fishing to the extent practicable.

Potential Council measures to minimize adverse effects of fishing on EFH may include fishing gear restrictions, time or area closures, harvest limits, or other measures. Any such measures would be designed to reduce ongoing impacts to fish habitats and/or promote recovery of disturbed habitats. These measures would likely result in economic impacts for the affected sectors of the fishing industry, but the intent behind such measures to protect EFH would be to promote sustainable fisheries and long-term economic and socioeconomic benefits. The environmental consequences of proposed actions would be evaluated in applicable NEPA documents before they are implemented. Section 4.3 of this EIS discusses the environmental consequences of alternative measures to minimize the effects of fishing on EFH. These alternatives are described in Section 2.3.3 and are currently being contemplated by the Council.

The Council may consider additional measures in the future to ensure that its FMPs continue to minimize the adverse effects of fishing on EFH to the extent practicable.

Second, federal and state agency actions that may adversely affect EFH trigger consultations and/or recommendations under Sections 305(b)(2) to (4) of the Magnuson-Stevens Act. Under Section 305(b)(2), each federal agency must consult with NMFS regarding any action authorized, funded, or undertaken by the agency that may adversely affect EFH. The EFH regulations require that federal agencies prepare EFH assessments as part of the consultation process to document anticipated effects to EFH (50 CFR 600.920[e]). Under Section 305(b)(4)(A), NMFS must provide EFH Conservation Recommendations to federal and state agencies regarding any action that would aversely affect EFH. Under Section 305(b)(3), Councils may comment on and make recommendations to federal and state agencies regarding any action that may affect the habitat, including EFH, of a fishery resource under Council authority.

EFH recommendations from NMFS or a Council to federal or state agencies are non-binding. Nevertheless, as a result of EFH coordination, consultations, and recommendations, federal or state agencies may decide to restrict various activities to avoid or minimize adverse effects to EFH. Such restrictions could result in project modifications that lead to higher costs for the applicants for federal or state permits, licenses, or funding, or for the federal or state agencies that undertake actions directly. In the present analysis, it would be speculative to predict the specific economic and socioeconomic consequences of future restrictions on development that might be imposed by agencies that authorize, fund, or undertake actions that may adversely affect EFH. However, such agencies typically evaluate economic and socioeconomic effects and other public interest factors under NEPA and other applicable laws before taking final action on any given activity. Such analyses would likely include information on the monetary costs of proposed restrictions to protect EFH, as well as the long-term ecological and socioeconomic benefits of protecting EFH and supporting sustainable fisheries. Those benefits could include the prevention of habitat damage that would have occurred in the absence of the EFH consultation process, and the associated cost of repairing environmental damage once it has occurred.

NMFS conducts approximately 500 EFH consultations and related environmental reviews in Alaska every year and is unaware of substantial project delays or significant cost increases resulting from EFH consultations. NMFS and the Council anticipate that habitat conservation resulting from EFH consultations and recommendations will support healthier fish stocks and more productive fisheries over the long term, with associated environmental, economic, and socioeconomic benefits. EFH consultations may also lead to indirect benefits for other species that use the same habitats as federally managed species of fish and shellfish.

As described further in the Environmental Assessment, Finding of No Significant Impact, and Regulatory Impact Review for the Final Regulations to Implement the Essential Fish Habitat Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (NMFS 2001d), federal agencies will incur costs as a result of conducting EFH consultations, because time and resources will be required to develop EFH assessments, exchange correspondence, and engage in other coordination activities required for effective interagency consultation. In some cases, federal agencies might also request information from applicants for permits, licenses, or funding to assist the agency in completing EFH consultation. However, the EFH regulations in 50 CFR 600.920 encourage agencies to combine EFH consultations with existing environmental review procedures to promote efficiency and avoid duplication of effort. To further streamline EFH consultation, if more than one agency is responsible for a federal action, the consultation requirements may be fulfilled by a single lead agency. State agencies and other non-federal entities are not required to consult with NMFS regarding the effects of their actions on EFH.

4.1.1 Criteria for Evaluating the Effects of Describing and Identifying EFH

The effects of designating EFH are difficult to analyze because they are indirect and dependent on separate future actions by a variety of entities in addition to NMFS and the Council (e.g., federal agencies that may impose conditions on permits they issue for actions that could harm EFH). Those future actions and the associated environmental consequences are hard to predict, although reasonable conclusions about the likely effects can be drawn from experience gained since the first EFH designations took effect in January 1999 (64 FR 20216; April 26, 1999). The following sections provide a qualitative analysis of the effects of designating EFH on habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities. Tables 4.1-1 through 4.1-7 present the criteria used in the following sections to determine whether the likely effects for each issue are negative (E-), neutral (Ø), positive (E+), or unknown (U). The analysis compares these effects to status quo conditions (i.e., Alternative 2).

In general, if the analysis suggests either a potential effect or a known effect, the EIS assigns a rating of E+ or E-. The EIS assigns a rating of Ø if the analysis suggests no discernible effect, and a rating of U if there is no basis for inferring the effect. This rating method results in fewer Ø and U ratings than the more detailed analytical approach used in Section 4.3 for the alternatives to minimize the adverse effects of fishing on EFH, and is appropriate here because the analysis of the EFH description and identification alternatives is necessarily more qualitative. In short, the analysis assumes that designating EFH affords an opportunity to identify and minimize potential adverse effects, which in turn is likely to result in certain positive or negative effects for most of the factors evaluated. The accompanying Regulatory Impact Review and Initial Regulatory Flexibility Analysis (Appendix C) does not further evaluate the regulatory, economic, and socioeconomic effects of describing and identifying EFH, because such effects are indirect consequences that may result from separate future actions and, therefore, cannot be evaluated more specifically in the present analysis.

Although the remainder of this section discusses the environmental consequences of the alternatives for describing and identifying EFH, the results of the analysis are very similar for some of the alternatives, and it can be difficult to distinguish between them. Readers should refer to Section 4.5.1 for a comparison of the effects of the alternatives to highlight similarities and differences.

4.1.2 Effects of Alternative 1 (No EFH Description and Identification)

Under Alternative 1, there would be no EFH description and identification for species managed by the Council. The existing EFH designations that were approved in 1999 would be rescinded.

4.1.2.1 Effects on Habitat

4.1.2.1.1 Prey Species (E-)

Alternative 1 may have a negative effect on prey species. Without EFH description and identification, a variety of human activities, including fishing and non-fishing activities, would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. Many prey species use the same habitats as managed species and, thus, would lose potential benefits that could have been derived from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of negative effect for species such as Pacific herring is unknown.

4.1.2.1.2 Benthic Biodiversity (E-)

Alternative 1 could have a negative effect on benthic biodiversity. Without EFH description and identification, a variety of human activities, including fishing and non-fishing activities, would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. The same perturbations that would decrease habitat complexity (discussed above) would be expected to result in a decrease in the number of species present in those areas that are disturbed, because biodiversity tends to be proportional to habitat complexity.

4.1.2.1.3 Habitat Complexity (E-)

Alternative 1 may have a negative effect on habitat complexity. Without EFH description and identification, there would be no means under the Magnuson-Stevens Act to identify habitats that are necessary to managed species of fish for their basic life functions. A variety of human activities, including fishing and non-fishing activities, would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. Activities such as bottom trawling or navigation dredging would be expected to result in a higher rate of removal or damage of living and non-living substrates than would occur if EFH were designated, because other environmental analyses (e.g., under NEPA) might not afford as much scrutiny of potential impacts to habitat complexity for managed species of fish. This may result in a decrease in habitat suitability over time due to human activities, because reductions in habitat complexity limit the amount of suitable cover habitat available to provide shelter from predators.

4.1.2.2 Effects on Target Species

4.1.2.2.1 Fishing Mortality (Ø)

Alternative 1 would have a neutral effect on fishing mortality. The absence of EFH description and identification means there would be no required measures to minimize the effects of fishing on EFH, but the absence of such regulations does not mean total allowable catch levels would change.

4.1.2.2.2 Spatial/Temporal Concentration of Catch (E+)

Alternative 1 may have a positive effect on the spatial/temporal concentration of catch. Intensive localized harvests would be less likely to occur because there would be less potential for area closures designed to protect habitats (such closures could cause a concentration of catch in remaining open areas).

4.1.2.2.3 Productivity (E-)

Alternative 1 could have a negative effect on the reproductive success of managed fish stocks, although the magnitude of such an effect is unknown. Without EFH description and identification, there would be no trigger under the Magnuson-Stevens Act for specific protections of habitats for spawning or early life history requirements such as hatching, larval development, and rearing.

4.1.2.2.4 Prey Availability (E-)

Alternative 1 may have a negative effect on prey availability. Without EFH description and identification, a variety of human activities, including fishing and non-fishing activities, would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens

Act. Many prey species use the same habitats as managed species and, thus, would lose potential benefits that could be derived from EFH protective measures, potentially leading to less prey available for managed species. EFH designations may not, however, account for the specific habitat requirements of prey species, so the degree of negative effect is unknown.

4.1.2.2.5 Growth to Maturity (E-)

Alternative 1 could have a negative effect on growth to maturity for managed species of fish, although the magnitude of such an effect is unknown. Without EFH description and identification, there would be no trigger for specific protection of habitats that are important for feeding or for shelter from predators, so there could be increased mortality at early life stages and a corresponding decrease in the survival rate of fish to reach maturity.

4.1.2.3 Effects on the Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.1.2.3.1 Passive Use (E-)

Alternative 1 could have negative effects on passive use values. The lack of EFH description and identification may cause some people who do not participate in fisheries to value fisheries less if they perceive that habitats are not protected adequately.

4.1.2.3.2 Gross Revenue (U)

Alternative 1 would have unknown effects on revenues for sectors of the fishing industry. In the short term, the fishing industry might sustain current levels of earning or even experience somewhat higher revenues, because without EFH description and identification, there would be no trigger under the Magnuson-Stevens Act to reduce adverse effects of fishing on EFH, so the industry would avoid the cost of possible new regulations. In the longer term, if fishing activities diminish the productivity of habitats, there would be less fish to catch, which would cause a decrease in gross revenues and an increase in cost per unit catch for the fishing industry. Declining catches would reduce supplies of seafood to the marketplace, increasing prices and reducing consumer welfare. The likely extent of such effects is unknown.

4.1.2.3.3 Operating Costs (E+)

Alternative 1 could, at least in the short term, have a positive effect on operating costs for the fishing industry. 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 certain fishing activities diminish the productivity of habitats, forcing fleets to expend more to catch the same or declining numbers of fish. It would be difficult to estimate the extent of any such effects.

4.1.2.3.4 Costs to Consumers (U)

Alternative 1 would have no immediately discernable effect on costs to consumers for seafood. However, with no trigger under the Magnuson-Stevens Act to reduce adverse effects of fishing on EFH, should certain fishing activities result in substantial declines in habitat productivity, the associated diminished catch could cause higher consumer prices for seafood and other fish-based products from Alaskan waters.

4.1.2.3.5 Safety (Ø)

Alternative 1 would have no discernable effect on safety for the fishing fleet.

4.1.2.3.6 Socioeconomic Effects on Fishing Communities (E+/E-)

Alternative 1 could have a positive socioeconomic effect for fishing communities, at least in the short term. There would be no forced relocation of fishing effort to avoid impacts to habitat, and no associated costs. In the longer term, it is conceivable that 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. Such increased effort per unit of catch would place economic and social stresses on fishing communities, especially in the smaller, more fishery dependent and remote communities of coastal Alaska. It would be difficult to estimate the timing or extent of any such effects in the present analysis.

4.1.2.3.7 Regulatory and Enforcement Programs (E+)

Alternative 1 could have a positive effect on regulatory and enforcement programs. Without EFH description and identification, there would be no associated management measures for federally managed fisheries, thereby simplifying program administration and enforcement.

4.1.2.4 Effects on Other Fisheries and Fishery Resources (E-)

Alternative 1 could have a negative effect on fisheries for halibut and state-managed groundfish, crab, herring, salmon, and forage fish. EFH cannot be described and identified for these fisheries under the Magnuson-Stevens Act, but many of the species targeted by these fisheries use the same habitats as Magnuson-Stevens Act-managed species and, thus, would lose potential benefits that could be derived from EFH protective measures. The absence of EFH designations might also affect these fisheries indirectly insofar as some vessels and people participate in Magnuson-Stevens Act fisheries as well as fisheries managed under other authorities, but any such effects would not result in substantial changes in catch for these fisheries.

4.1.2.5 Effects on Protected Species (E-)

Alternative 1 may have a negative effect on protected species of salmon, marine mammals, and seabirds. Without EFH description and identification, a variety of human activities, including fishing and non-fishing activities, would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. Many protected species use the same habitats as managed species and, thus, would lose potential benefits that could be derived from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of protected species, so the degree of negative effect for these species is unknown.

4.1.2.6 Effects on Ecosystems and Biodiversity

4.1.2.6.1 Predator-Prey Relationships (U)

Alternative 1 would have unknown effects on predator-prey relationships. The absence of EFH description and identification may have negative consequences for prey species, as discussed above, but it is unclear whether such effects would change trophic dynamics.

4.1.2.6.2 Energy Flow and Balance (Ø)

Alternative 1 would have no discernable effect on total catch or discards and, thus, no determinable effect on energy flow in the ecosystem.

4.1.2.6.3 Biodiversity (Ø)

Alternative 1 would have no discernable effect on extinction rates, trophic level changes, or selective fishing patterns that could affect biodiversity.

4.1.2.7 Effects on Non-fishing Activities

4.1.2.7.1 Costs to Federal and State Agencies (E+)

Alternative 1 could have a positive effect on costs to federal and state agencies. Without EFH description and identification, 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 designations as the impetus to provide conservation recommendations to federal or state agencies to protect fish habitats. 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 habitats.

4.1.2.7.2 Costs to Non-fishing Industries or Other Proponents of Affected Activities (E+)

Alternative 1 may 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 designations and associated consultations could result in a decrease in the cost of obtaining permits or funding from federal agencies. Without the requirement for NMFS to provide conservation recommendations for actions that would harm habitats for managed species, there could be a decrease in project costs that might otherwise be required by the permitting or funding agency to protect fish habitat. However, NMFS and other agencies could still provide habitat recommendations under other authorities, and the permitting or funding agencies could still impose restrictions on development to curtail losses of valuable habitats.

4.1.2.8 Summary of the Effects of Alternative 1

Alternative 1 would result in the elimination of EFH description and identification in Alaska. Overall, Alternative 1 could have positive effects for the industries and other entities that may currently face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats. Such positive effects could be short-term for the fishing industry; longer-term effects are less certain. Alternative 1 would likely have negative effects for the habitats and species that could be protected by measures resulting indirectly from EFH description and identification. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 1 to the other EFH description and identification alternatives is presented in Section 4.5.1 and Table 4.5.1-1.

4.1.3 Effects of Alternative 2 (Status Quo EFH Description and Identification)

Under Alternative 2, EFH description and identification would remain exactly as they were approved in FMP Amendments 55/55/8/5/5 in 1999. EFH would remain described and identified as all habitats within a general distribution for a life stage of a species, for all information levels and under all stock conditions. EFH would be a subset of the geographic range of each life stage, encompassing an area that contains about 95 percent of the population.

Alternative 2 represents a continuation of status quo conditions and, therefore, would have no effect (Ø) relative to existing conditions for habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, or non-fishing activities. This analysis includes information on the effects of all other EFH designation alternatives compared to the status quo.

Retaining the status quo EFH description and identification would continue the effects that those designations have had since 1999 (evaluated in the EA for FMP Amendments 55/55/8/5/5; NMFS 1999), which have been very similar to the anticipated effects of Alternatives 3, 4, and 5. In general, EFH designation can have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats. Such negative effects could be short-term for the fishing industry; longer-term effects are less certain, especially for sectors that may benefit from enhanced habitat productivity resulting from EFH description and identification. EFH description and identification can have positive effects for the habitats and species that may be protected by measures resulting indirectly from EFH description and identification. Such measures include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 2 to the other EFH description and identification alternatives is presented in Section 4.5.1 and Table 4.5-1.

4.1.4 Effects of Alternative 3 (Preliminary Preferred Alternative) (Revised General Distribution)

Under Alternative 3, EFH designations would be revised and, in some cases, the geographic extent of individual EFH designations would be narrower than the status quo Alternative 2. Alternative 3 uses the same basic methodology as Alternative 2, but applies the revised regulatory guidance from the EFH final rule (67 FR 2343; January 17, 2002) and incorporates recent and additional scientific information and improved mapping. Alternative 3 also provides EFH descriptions for a few species for which information was not readily available in 1998 when the existing designations were compiled. Under Alternative 3, EFH would be described and identified as all habitats within a general distribution for a life stage of a species, encompassing an area that contains about 95 percent of the population.

The effects of Alternative 3 are very similar to the effects of maintaining the status quo (Alternative 2). The only substantive difference between Alternatives 2 and 3 is that Alternative 3 applies more recent information, new analytical tools, and better mapping, which results in geographically smaller EFH description and identification for some life stages of some species. The smaller EFH designations for individual life stages of species mean that in any given location, fewer species might have EFH described and identified. However, the total aggregated area of EFH description and identification for all managed species is identical for Alternatives 2 and 3 because the limited available information results in some species having equally broad EFH designations under either alternative.

4.1.4.1 Effects on Habitat

4.1.4.1.1 Prey Species (E+)

Alternative 3 may have a positive effect on prey species. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect for species such as Pacific herring is unknown.

4.1.4.1.2 Benthic Biodiversity (E+)

Alternative 3 could have a positive effect on benthic biodiversity. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. The resulting analyses likely would cause the Council, NMFS, and other agencies to modify certain actions to protect sensitive benthic habitats. These actions that protect bottom habitats may facilitate habitat improvements over time as previously disturbed areas gradually develop more mature and productive communities of flora and fauna, and thus may result in localized increases in the number of species present in the affected areas.

4.1.4.1.3 Habitat Complexity (E+)

Alternative 3 may have a positive effect on habitat complexity. EFH description and identification would identify habitats that are necessary to managed species of fish for their basic life functions. The Council would be required to consider the effects of fishery management measures on those habitats and minimize adverse effects to the extent practicable. Federal agencies would consult with NMFS to evaluate the effects of non-fishing activities on EFH, and federal and state agencies would receive EFH conservation recommendations from NMFS for specific proposed actions. As a result, some actions probably would be modified to reduce impacts to living and non-living substrates, thereby improving habitat complexity for managed species of fish in comparison to conditions that might occur without the EFH designations.

4.1.4.2 Effects on Target Species

4.1.4.2.1 Fishing Mortality (Ø)

Alternative 3 would have a neutral effect on fishing mortality. EFH description and identification would trigger the requirement to minimize the effects of fishing on EFH, but resulting regulations would not necessarily include changes to total allowable catch levels.

4.1.4.2.2 Spatial/Temporal Concentration of Catch (E-)

Alternative 3 may have a negative effect on the spatial/temporal concentration of catch. If area closures designed to protect identified EFH areas are implemented, they could cause fishing to become concentrated in remaining open areas, resulting in intensive localized harvests. Fishery management measures likely would be designed to minimize such unintended consequences.

4.1.4.2.3 Productivity (E+)

Alternative 3 could have a positive effect on the reproductive success of managed fish stocks, although the magnitude of such an effect is unknown. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Any resulting decisions that protect EFH areas would sustain habitat conditions that are suitable for spawning and early life history requirements, such as hatching, larval development, and rearing.

4.1.4.2.4 Prey Availability (E+)

Alternative 3 may have a positive effect on prey availability. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH description and identification, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect is unknown.

4.1.4.2.5 Growth to Maturity (E+)

Alternative 3 could have a positive effect on growth to maturity for managed species of fish, although the magnitude of such an effect is unknown. EFH description and identification would trigger consideration of specific protections for habitats that are important to managed species for feeding or for shelter from predators. Protecting such habitat areas could decrease mortality at early life stages and result in a corresponding increase in the survival rate of fish to reach maturity.

4.1.4.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.1.4.3.1 Passive Use (E+)

Alternative 3 could have positive effects on passive use values. EFH description and identification may cause some people who do not participate in fisheries to value fisheries more if they perceive that habitats are protected adequately.

4.1.4.3.2 Gross Revenue (U)

Alternative 3 would have unknown net effects on revenues for the fishing industry. In the short term, certain sectors of the fishing industry could experience decreased revenues with EFH designations because of measures resulting from the Magnuson-Stevens Act requirement to reduce adverse effects of fishing on EFH (Section 4.3). In the longer term, if reducing the effects of fishing on sensitive habitats leads those habitats to produce greater numbers of fish, fishing industry revenues could increase.

4.1.4.3.3 Operating Costs (E-)

Alternative 3 could have a negative effect on operating costs for certain sectors of the fishing industry due to factors such as temporal displacement and spatial redistribution of fishing effort to avoid impacts to habitats identified as EFH or additional monitoring costs.

4.1.4.3.4 Costs to Consumers (U)

Alternative 3 would have no immediately discernable effect on costs to consumers for seafood. If, in the longer term, productivity is enhanced due to the designation of EFH and the adoption of associated measures to conserve important habitats, consumers may benefit from increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices. The extent of any such effects is unknown.

4.1.4.3.5 Safety (Ø)

Alternative 3 would have no discernable effect on safety for the fishing fleet, although temporal and spatial displacement of fishing effort could increase the distance between ports and open fishing grounds and/or the timing of openings, which could lead operators to risk fishing in more extreme weather and sea conditions.

4.1.4.3.6 Socioeconomic Effects on Fishing Communities (E-)

Alternative 3 may lead to negative socioeconomic effects for some fishing communities. Depending on the nature of any management measures adopted to minimize effects of fishing on EFH, there could be spatial and temporal dislocation of fishing effort to avoid impacts to habitat, 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 and efficient.

4.1.4.3.7 Regulatory and Enforcement Programs (E-)

Alternative 3 could have a negative effect on regulatory and enforcement programs. EFH description and identification would trigger the requirement to minimize adverse effects of fishing on EFH. Any resulting management measures could increase the complexity and cost of administering and enforcing fishery management.

4.1.4.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 3 could have a positive effect on fisheries for halibut and state-managed groundfish, crab, herring, salmon, and forage fish. EFH cannot be described and identified for these fisheries under the Magnuson-Stevens Act, but many of the species targeted by these fisheries use the same habitats as Magnuson-Stevens Act-managed species and, thus, could benefit from EFH protective measures. EFH designations might also affect these fisheries indirectly insofar as some vessels and people participate in Magnuson-Stevens Act fisheries as well as fisheries managed under other authorities, but any such effects would not result in substantial changes in catch for these fisheries.

4.1.4.5 Effects on Protected Species (E+)

Alternative 3 may have a positive effect on protected species of salmon, marine mammals, and seabirds. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many protected species use the same habitats as managed species and, thus, could benefit from EFH protective measures.

EFH designations, however, may not account for the specific habitat requirements of protected species, so the degree of positive effect for these species is unknown.

4.1.4.6 Effects on Ecosystems and Biodiversity

4.1.4.6.1 Predator-Prey Relationships (U)

Alternative 3 would have unknown effects on predator-prey relationships. EFH description and identification may indirectly benefit prey species, as discussed above, but it is unclear whether such effects would change trophic dynamics.

4.1.4.6.2 Energy Flow and Balance (Ø)

Alternative 3 would have no discernable effect on total catch or discards and, thus, no determinable effect on energy flow in the ecosystem.

4.1.4.6.3 Biodiversity (Ø)

Alternative 3 would have no discernable effect on extinction rates, trophic level changes, or selective fishing patterns that could affect biodiversity.

4.1.4.7 Effects on Non-fishing Activities

4.1.4.7.1 Costs to Federal and State Agencies (E-)

Alternative 3 could have a negative effect on costs to federal and state agencies. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats 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. However, to reduce duplication and promote efficiency, NMFS would combine most EFH consultations with environmental reviews required under other laws, as encouraged by the EFH regulations in 50 CFR 600.920.

4.1.4.7.2 Costs to Non-fishing Industries or Other Proponents of Affected Activities (E-)

Alternative 3 may have a negative effect on costs for the industries and other entities that sponsor non-fishing activities that have the potential to harm fish habitats. EFH description and identification 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. However, NMFS and other agencies can provide habitat recommendations under other authorities, and permitting or funding agencies can impose restrictions on development for environmental reasons other than EFH conservation, so the monetary costs specifically attributable to EFH can be difficult to discern.

4.1.4.8 Summary of the Effects of Alternative 3

Alternative 3 would result in relatively minor changes to the existing EFH description and identification (Alternative 2) to incorporate more recent information, improved mapping, and new EFH descriptions for a few species for which information was not readily available when the existing description and identification were compiled. Overall, Alternative 3 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats. Such negative effects could be short-term for the fishing industry; longer-term effects are less certain, especially for sectors that may benefit from enhanced habitat productivity resulting from EFH description and identification. Alternative 3 would likely have positive effects for the habitats and species that could be protected by measures resulting indirectly from EFH description and identification. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 3 to the other EFH designation alternatives is presented in Section 4.5.1 and Table 4.5-1.

4.1.5 Effects of Alternative 4 (Presumed Known Concentration)

Under Alternative 4, EFH designations would be revised and, in many cases, the geographic extent of individual EFH designations would be smaller than designations under Alternatives 2 and 3. Alternative 4 uses a narrower interpretation of the best available scientific information, resulting in somewhat narrower EFH designations for species and life stages for which sufficient information exists to identify possible areas of higher habitat function. For species and life stages with Level 1 information, EFH would be described and identified as all habitats within a general distribution for a life stage of a species, encompassing an area that contains about 95 percent of the population. For species and life stages with Level 2 or higher information, EFH would be described and identified as the areas of presumed concentration, representing about 75 percent of the population.

The effects of Alternative 4 are very similar to the effects of Alternatives 2 and 3, although the smaller EFH designations for individual life stages of species mean that in any given location, fewer species might have EFH designated. Measures to minimize the effects of fishing on EFH might therefore need to be responsive to habitat considerations for a smaller array of species than under Alternatives 2 or 3. Likewise, EFH consultations for non-fishing activities might need to address habitat requirements for fewer species than under Alternatives 2 or 3. The total aggregated area of EFH designations for all managed species, however, would be identical for Alternatives 2, 3, and 4 because the limited available information results in some species having equally broad EFH designations under any of these three alternatives.

4.1.5.1 Effects on Habitat

4.1.5.1.1 Prey Species (E+)

Alternative 4 may have a positive effect on prey species. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect for species such as Pacific herring is unknown.

4.1.5.1.2 Benthic Biodiversity (E+)

Alternative 4 could have a positive effect on benthic biodiversity. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. The resulting analyses likely would cause the Council, NMFS, and other agencies to modify certain actions to protect sensitive benthic habitats. These actions that protect bottom habitats may facilitate habitat improvements over time as previously disturbed areas gradually develop more mature and productive communities of flora and fauna, and thus may result in localized increases in the number of species present in the affected areas.

4.1.5.1.3 Habitat Complexity (E+)

Alternative 4 may have a positive effect on habitat complexity. EFH description and identification would identify habitats that are necessary to managed species of fish for their basic life functions. The Council would be required to consider the effects of fishery management measures on those habitats and minimize adverse effects to the extent practicable. Federal agencies would consult with NMFS to evaluate the effects of non-fishing activities on EFH, and federal and state agencies would receive EFH conservation recommendations from NMFS for specific proposed actions. As a result, some actions probably would be modified to reduce impacts to living and non-living substrates, thereby improving habitat complexity for managed species of fish in comparison to conditions that might occur without the EFH designations.

4.1.5.2 Effects on Target Species

4.1.5.2.1 Fishing Mortality (Ø)

Alternative 4 would have a neutral effect on fishing mortality. EFH description and identification would trigger the requirement to minimize the effects of fishing on EFH, but resulting regulations would not necessarily include changes to total allowable catch levels.

4.1.5.2.2 Spatial/Temporal Concentration of Catch (E-)

Alternative 4 may have a negative effect on the spatial/temporal concentration of catch. If area closures designed to protect identified EFH areas are implemented, they could cause fishing effort to become concentrated in remaining open areas, resulting in intensive localized harvests. Fishery management measures likely would be designed to minimize such unintended consequences.

4.1.5.2.3 Productivity (E+)

Alternative 4 could have a positive effect on the reproductive success of managed fish stocks, although the magnitude of such an effect is unknown. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Any resulting decisions that protect EFH areas would sustain habitat conditions that are suitable for spawning and early life history requirements such as hatching, larval development, and rearing.

4.1.5.2.4 Prey Availability (E+)

Alternative 4 may have a positive effect on prey availability. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect is unknown.

4.1.5.2.5 Growth to Maturity (E+)

Alternative 4 could have a positive effect on growth to maturity for managed species of fish, although the magnitude of such an effect is unknown. EFH description and identification would trigger consideration of specific protections for habitats that are important to managed species for feeding or for shelter from predators. Protecting such habitat areas could decrease mortality at early life stages and result in a corresponding increase in the survival rate of fish to reach maturity.

4.1.5.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.1.5.3.1 Passive Use (E+)

Alternative 4 could have positive effects on passive use values. EFH description and identification may cause some people who do not participate in fisheries to value fisheries more if they perceive that habitats are protected adequately.

4.1.5.3.2 Gross Revenue (U)

Alternative 4 would have unknown net effects on revenues for the fishing industry. In the short term, certain sectors of the fishing industry could experience decreased revenues with EFH designations, because of measures resulting from the Magnuson-Stevens Act requirement to reduce adverse effects of fishing on EFH (Section 4.3). In the longer term, if reducing the effects of fishing on sensitive habitats leads those habitats to produce greater numbers of fish, fishing industry revenues could increase.

4.1.5.3.3 Operating Costs (E-)

Alternative 4 could have a negative effect on operating costs for certain sectors of the fishing industry due to factors such as temporal displacement and spatial redistribution of fishing effort to avoid impacts to habitats identified as EFH or additional monitoring costs.

4.1.5.3.4 Costs to Consumers (U)

Alternative 4 would have no immediately discernable effect on costs to consumers for seafood. If, in the longer term, productivity is enhanced due to the description and identification of EFH and the adoption of associated measures to conserve important habitats, consumers may benefit from increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices. The extent of any such effects is unknown.

4.1.5.3.5 Safety (Ø)

Alternative 4 would have no discernable effect on safety for the fishing fleet, although temporal and spatial displacement of fishing effort could increase the distance between ports and open fishing grounds and/or the timing of openings, which could lead operators to risk fishing in more extreme weather and sea conditions.

4.1.5.3.6 Socioeconomic Effects on Fishing Communities (E-)

Alternative 4 may lead to negative socioeconomic effects for some fishing communities. Depending on the nature of any management measures adopted to minimize effects of fishing on EFH, there could be spatial and temporal dislocation of fishing effort to avoid impacts to habitat, 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 and efficient.

4.1.5.3.7 Regulatory and Enforcement Programs (E-)

Alternative 4 could have a negative effect on regulatory and enforcement programs. EFH description and identification would trigger the requirement to minimize adverse effects of fishing on EFH. Any resulting management measures could increase the complexity and cost of administering and enforcing fishery management.

4.1.5.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 4 could have a positive effect on fisheries for halibut and state-managed groundfish, crab, herring, salmon, and forage fish. EFH cannot be described and identified for these fisheries under the Magnuson-Stevens Act, but many of the species targeted by these fisheries use the same habitats as Magnuson-Stevens Act-managed species and, thus, could benefit from EFH protective measures. EFH description and identification might also affect these fisheries indirectly insofar as some vessels and people participate in Magnuson-Stevens Act fisheries as well as fisheries managed under other authorities, but any such effects would not result in substantial changes in catch for these fisheries.

4.1.5.5 Effects on Protected Species (E+)

Alternative 4 may have a positive effect on protected species of salmon, marine mammals, and seabirds. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many protected species use the same habitats as managed species and, thus, could benefit from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of protected species, so the degree of positive effect for these species is unknown.

4.1.5.6 Effects on Ecosystems and Biodiversity

4.1.5.6.1 Predator-Prey Relationships (U)

Alternative 4 would have unknown effects on predator-prey relationships. EFH description and identification may indirectly benefit prey species, as discussed above, but it is unclear whether such effects would change trophic dynamics.

4.1.5.6.2 Energy Flow and Balance (Ø)

Alternative 4 would have no discernable effect on total catch or discards and, thus, no determinable effect on energy flow in the ecosystem.

4.1.5.6.3 Biodiversity (Ø)

Alternative 4 would have no discernable effect on extinction rates, trophic level changes, or selective fishing patterns that could affect biodiversity.

4.1.5.7 Effects on Non-fishing Activities

4.1.5.7.1 Costs to Federal and State Agencies (E-)

Alternative 4 could have a negative effect on costs to federal and state agencies. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats 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. However, to reduce duplication and promote efficiency, NMFS would combine most EFH consultations with environmental reviews required under other laws, as encouraged by the EFH regulations in 50 CFR 600.920.

4.1.5.7.2 Costs to Non-fishing Industries or Other Proponents of Affected Activities (E-)

Alternative 4 may have a negative effect on costs for the industries and other entities that sponsor non-fishing activities that have the potential to harm fish habitats. EFH description and identification 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. However, NMFS and other agencies can provide habitat recommendations under other authorities, and permitting or funding agencies can impose restrictions on development for environmental reasons other than EFH conservation, so the monetary costs specifically attributable to EFH can be difficult to discern.

4.1.5.8 Summary of the Effects of Alternative 4

Alternative 4 would result in changes to the existing EFH designations (Alternative 2) to incorporate a narrower interpretation of the best available science, as well as more recent information, improved

mapping, and new EFH descriptions for a few species for which information was not readily available when the existing designations were compiled. Overall, Alternative 4 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats. Such negative effects could be short-term for the fishing industry; longer-term effects are less certain, especially for sectors that may benefit from enhanced habitat productivity resulting from EFH description and identification. Alternative 4 would likely have positive effects for the habitats and species that could be protected by measures resulting indirectly from EFH description and identification. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. For some life stages of some species, Alternative 4 would result in geographically smaller EFH description and identification than Alternatives 2 and 3. However, the total aggregated area of EFH designations for all managed species is identical for Alternatives 2, 3, and 4. A comparison of Alternative 4 to the other EFH description and identification alternatives is presented in Section 4.5.1 and Table 4.5-1.

4.1.6 Effects of Alternative 5 (Eco-region Strategy)

Alternative 5 represents a very different approach to EFH description and identification, as compared to Alternatives 2, 3, and 4. Under Alternative 5, EFH would be described in eight eco-regions (freshwater, nearshore and estuarine, inner and middle shelf, outer shelf, upper slope, middle slope, lower slope, and basin) by characterizing the species that use each eco-region and the habitat types present. The overall approach is to identify distinct ecological areas along with the species that rely upon those habitats.

The effects of Alternative 5 are very similar to the effects of Alternatives 2, 3, and 4. EFH description and identification under Alternative 5 would be broader for individual life stages and species, and the total aggregated area of EFH designations for all managed species would be broader because Alternative 5 includes basin habitats in deeper waters than those identified in Alternatives 2, 3, or 4.

4.1.6.1 Effects on Habitat

4.1.6.1.1 Prey Species (E+)

Alternative 5 may have a positive effect on prey species. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect for species such as Pacific herring is unknown.

4.1.6.1.2 Benthic Biodiversity (E+)

Alternative 5 could have a positive effect on benthic biodiversity. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. The resulting analyses likely would cause the Council, NMFS, and other agencies to modify certain actions to protect sensitive benthic habitats. These actions that protect bottom habitats may facilitate habitat improvements over time as previously disturbed areas gradually develop more mature and productive communities of flora and fauna, and thus may result in localized increases in the number of species present in the affected areas.

4.1.6.1.3 Habitat Complexity (E+)

Alternative 5 may have a positive effect on habitat complexity. EFH description and identification would identify habitats that are necessary to managed species of fish for their basic life functions. The Council would be required to consider the effects of fishery management measures on those habitats and minimize adverse effects to the extent practicable. Federal agencies would consult with NMFS to evaluate the effects of non-fishing activities on EFH, and federal and state agencies would receive EFH conservation recommendations from NMFS for specific proposed actions. As a result, some actions probably would be modified to reduce impacts to living and non-living substrates, thereby improving habitat complexity for managed species of fish in comparison to conditions that might occur without the EFH designations.

4.1.6.2 Effects on Target Species

4.1.6.2.1 Fishing Mortality (Ø)

Alternative 5 would have a neutral effect on fishing mortality. EFH description and identification would trigger the requirement to minimize the effects of fishing on EFH, but resulting regulations would not necessarily include changes to total allowable catch levels.

4.1.6.2.2 Spatial/Temporal Concentration of Catch (E-)

Alternative 5 may have a negative effect on the spatial/temporal concentration of catch. If area closures designed to protect identified EFH areas are implemented, they could cause fishing effort to become concentrated in remaining open areas, resulting in intensive localized harvests. Fishery management measures likely would be designed to minimize such unintended consequences.

4.1.6.2.3 Productivity (E+)

Alternative 5 could have a positive effect on the reproductive success of managed fish stocks, although the magnitude of such an effect is unknown. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Any resulting decisions that protect EFH areas would sustain habitat conditions that are suitable for spawning and early life history requirements such as hatching, larval development, and rearing.

4.1.6.2.4 Prey Availability (E+)

Alternative 5 may have a positive effect on prey availability. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of prey species, so the degree of positive effect is unknown.

4.1.6.2.5 Growth to Maturity (E+)

Alternative 5 could have a positive effect on growth to maturity for managed species of fish, although the magnitude of such an effect is unknown. EFH description and identification would trigger consideration of specific protections for habitats that are important to managed species for feeding or for shelter from

predators. Protecting such habitat areas could decrease mortality at early life stages and result in a corresponding increase in the survival rate of fish to reach maturity.

4.1.6.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.1.6.3.1 Passive Use (E+)

Alternative 5 could have positive effects on passive use values. EFH description and identification may cause some people who do not participate in fisheries to value fisheries more if they perceive that habitats are protected adequately.

4.1.6.3.2 Gross Revenue (U)

Alternative 5 would have unknown net effects on revenues for the fishing industry. In the short term, certain sectors of the fishing industry could experience decreased revenues with EFH designations because of measures resulting from the Magnuson-Stevens Act requirement to reduce adverse effects of fishing on EFH (Section 4.3). In the longer term, if reducing the effects of fishing on sensitive habitats leads those habitats to produce greater numbers of fish, fishing industry revenues could increase.

4.1.6.3.3 Operating Costs (E-)

Alternative 5 could have a negative effect on operating costs for certain sectors of the fishing industry due to factors such as temporal displacement and spatial redistribution of fishing effort to avoid impacts to habitats identified as EFH, or additional monitoring costs.

4.1.6.3.4 Costs to Consumers (U)

Alternative 5 would have no immediately discernable effect on costs to consumers for seafood. If, in the longer term, productivity is enhanced due to the designation of EFH and the adoption of associated measures to conserve important habitats, consumers may benefit from increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices. The extent of any such effects is unknown.

4.1.6.3.5 Safety (Ø)

Alternative 5 would have no discernable effect on safety for the fishing fleet, although temporal and spatial displacement of fishing effort could increase the distance between ports and open fishing grounds, and/or the timing of openings, which could lead operators to risk fishing in more extreme weather and sea conditions.

4.1.6.3.6 Socioeconomic Effects on Fishing Communities (E-)

Alternative 5 may lead to negative socioeconomic effects for some fishing communities. Depending on the nature of any management measures adopted to minimize effects of fishing on EFH, there could be spatial and temporal dislocation of fishing effort to avoid impacts to habitat, 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 and efficient.

4.1.6.3.7 Regulatory and Enforcement Programs (E-)

Alternative 5 could have a negative effect on regulatory and enforcement programs. EFH description and identification would trigger the requirement to minimize adverse effects of fishing on EFH. Any resulting management measures could increase the complexity and cost of administering and enforcing fishery management.

4.1.6.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 5 could have a positive effect on fisheries for halibut and state-managed groundfish, crab, herring, salmon, and forage fish. EFH cannot be described and identified for these fisheries under the Magnuson-Stevens Act, but many of the species targeted by these fisheries use the same habitats as Magnuson-Stevens Act-managed species and, thus, could benefit from EFH protective measures. EFH description and identification might also affect these fisheries indirectly insofar as some vessels and people participate in Magnuson-Stevens Act fisheries as well as fisheries managed under other authorities, but any such effects would not result in substantial changes in catch for these fisheries.

4.1.6.5 Effects on Protected Species (E+)

Alternative 5 may have a positive effect on protected species of salmon, marine mammals, and seabirds. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many protected species use the same habitats as managed species and, thus, could benefit from EFH protective measures. EFH designations, however, may not account for the specific habitat requirements of protected species, so the degree of positive effect for these species is unknown.

4.1.6.6 Effects on Ecosystems and Biodiversity

4.1.6.6.1 Predator-Prey Relationships (U)

Alternative 5 would have unknown effects on predator-prey relationships. EFH designations may indirectly benefit prey species, as discussed above, but it is unclear whether such effects would change trophic dynamics.

4.1.6.6.2 Energy Flow and Balance (Ø)

Alternative 5 would have no discernable effect on total catch or discards and, thus, no determinable effect on energy flow in the ecosystem.

4.1.6.6.3 Biodiversity (Ø)

Alternative 5 would have no discernable effect on extinction rates, trophic level changes, or selective fishing patterns that could affect biodiversity.

4.1.6.7 Effects on Non-fishing Activities

4.1.6.7.1 Costs to Federal and State Agencies (E-)

Alternative 5 could have a negative effect on costs to federal and state agencies. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats 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. However, to reduce duplication and promote efficiency, NMFS would combine most EFH consultations with environmental reviews required under other laws, as encouraged by the EFH regulations in 50 CFR 600.920.

4.1.6.7.2 Costs to Non-fishing Industries or Other Proponents of Affected Activities (E-)

Alternative 5 may have a negative effect on costs for the industries and other entities that sponsor non-fishing activities that have the potential to harm fish habitats. EFH description and identification 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. However, NMFS and other agencies can provide habitat recommendations under other authorities, and permitting or funding agencies can impose restrictions on development for environmental reasons other than EFH conservation, so the monetary costs specifically attributable to EFH can be difficult to discern.

4.1.6.8 Summary of the Effects of Alternative 5

Alternative 5 would result in substantial changes to the existing EFH designations (Alternative 2) to incorporate a habitat based approach. Overall, Alternative 5 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats. Such negative effects could be short-term for the fishing industry; longer-term effects are less certain, especially for sectors that may benefit from enhanced habitat productivity resulting from EFH designation. Alternative 5 would likely have positive effects for the habitats and species that could be protected by measures resulting indirectly from EFH designations. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. Alternative 5 would result in geographically broader EFH designations for many species as compared to other alternatives, and the total aggregated area of EFH designations for all managed species would be larger. A comparison of Alternative 5 to the other EFH description and identification alternatives is presented in Section 4.5.1 and Table 4.5-1.

4.1.7 Effects of Alternative 6 (EEZ Only)

Under Alternative 6, EFH designations would be revised using the updated general distribution information from Alternative 3, but EFH would be limited to waters and substrate within the EEZ. There would be no EFH designations in freshwater areas, estuaries, or nearshore marine waters under

jurisdiction of the State of Alaska. In other words, Alternative 6 is the same as the EEZ portion of Alternative 3.

The effects of Alternative 6 differ from the effects of the other alternatives insofar as there would be no EFH designations in state waters. Thus, the Magnuson-Stevens Act requirements to minimize effects of federally managed fishing activities on habitat and to consult regarding effects of non-fishing activities on habitat would not apply in state waters. Because the vast majority of non-fishing actions that could affect fish habitat happen in the coastal zone (wetland fill, dredging, pollutant discharges, coastal construction, etc.), Alternative 6 would lead to far fewer EFH consultations between NMFS and other agencies and fewer opportunities to ensure such actions minimize the loss or degradation of fish habitat. EFH designations in federal waters would be identical to those in Alternative 3, so the requirement to minimize adverse effects of fishing on EFH would continue to apply to most federally managed fishing activities.

4.1.7.1 Effects on Habitat

4.1.7.1.1 Prey Species (E+/E-)

Alternative 6 may have a positive effect on prey species in federal waters. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. Such benefits, however, would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. In state waters, prey species would lose the potential benefits that could have been derived from EFH protective measures. EFH designations may not account for the specific habitat requirements of prey species, so the degree of positive (in federal waters) or negative (in state waters) effect for species such as Pacific herring is unknown.

4.1.7.1.2 Benthic Biodiversity (E+/E-)

Alternative 6 could have a positive effect on benthic biodiversity in federal waters. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. The resulting analyses likely would cause the Council, NMFS, and other agencies to modify certain actions to protect sensitive offshore benthic habitats. These actions that protect bottom habitats may facilitate habitat improvements over time as previously disturbed areas gradually develop more mature and productive communities of flora and fauna, and thus may result in localized increases in the number of species present in the affected areas. However, such benefits would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. The same perturbations that would decrease habitat complexity (discussed above) would be expected to result in a decrease in the number of species present in those areas that are disturbed, because biodiversity tends to be proportional to habitat complexity.

4.1.7.1.3 Habitat Complexity (E+/E-)

Alternative 6 may have a positive effect on habitat complexity in federal waters. EFH description and identification would identify habitats in federal waters that are necessary to managed species of fish for their basic life functions. The Council would be required to consider the effects of fishery management

measures on those habitats and minimize adverse effects to the extent practicable. Federal agencies would consult with NMFS to evaluate the effects of non-fishing activities on EFH, and federal agencies would receive EFH conservation recommendations from NMFS for specific proposed actions occurring in federal waters (e.g., offshore mineral development). As a result, some actions probably would be modified to reduce impacts to living and non-living substrates, thereby improving habitat complexity for managed species of fish in comparison to conditions that might occur without the EFH designations. However, these benefits would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. Navigation dredging, coastal construction, and other activities would lead to a higher rate of removal or damage of living and non-living substrates than would occur if EFH were designated in state waters.

4.1.7.2 Effects on Target Species

4.1.7.2.1 Fishing Mortality (Ø)

Alternative 6 would have a neutral effect on fishing mortality. EFH description and identification would trigger the requirement to minimize the effects of fishing on EFH, but resulting regulations would not necessarily include changes to total allowable catch levels.

4.1.7.2.2 Spatial/Temporal Concentration of Catch (E-)

Alternative 6 may have a negative effect on the spatial/temporal concentration of catch. If area closures designed to protect identified EFH areas are implemented, they could cause fishing effort to become concentrated in remaining open areas, resulting in intensive localized harvests. Fishery management measures likely would be designed to minimize such unintended consequences.

4.1.7.2.3 Productivity (E+/E-)

Alternative 6 could have a positive effect on the reproductive success of managed fish stocks that reproduce in federal waters and a negative effect for those stocks that reproduce in state waters, although the magnitude of such effects is unknown. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Any resulting decisions that protect EFH areas would sustain habitat conditions that are suitable for spawning and early life history requirements such as hatching, larval development, and rearing. Without EFH designations in state waters, however, there would be no trigger for specific protections of such habitats, which could lead to reductions in stock productivity.

4.1.7.2.4 Prey Availability (E+/E-)

Alternative 6 may have a positive effect on prey availability in federal waters. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many prey species use the same habitats as managed species and, thus, may derive ancillary benefits from EFH protective measures. Such benefits, however, would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. In state waters, prey species would lose the potential benefits that could be derived from EFH protective measures. EFH designations may not account for the specific habitat requirements of prey species, so the degree of positive (in federal waters) or negative (in state waters) effect is unknown.

4.1.7.2.5 Growth to Maturity (E+/E-)

Alternative 6 could have a positive effect on growth to maturity for managed species of fish in federal waters, although the magnitude of such an effect is unknown. EFH description and identification would trigger consideration of specific protections for habitats that are important to managed species for feeding or for shelter from predators. Protecting such habitat areas could decrease mortality at early life stages and result in a corresponding increase in the survival rate of fish to reach maturity. However, such benefits would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. Navigation dredging, coastal construction, and other activities occurring without habitat conservation measures could lead to increased mortality at early life stages and a corresponding decrease in the survival rate of fish to reach maturity.

4.1.7.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

4.1.7.3.1 Passive Use (E+/E-)

Alternative 6 could have both positive and negative effects on passive use values. EFH designations in federal waters may cause some people who do not participate in fisheries to value fisheries more if they perceive that habitats are protected adequately. However, the lack of EFH designations in state waters may cause some people who do not participate in fisheries to value fisheries less if they perceive that nearshore and riverine habitats are not protected adequately.

4.1.7.3.2 Gross Revenue (U)

Alternative 6 would have unknown net effects on revenues for the fishing industry. In the short term, certain sectors of the fishing industry could experience decreased revenues with EFH designations because of measures resulting from the Magnuson-Stevens Act requirement to reduce adverse effects of fishing on EFH (Section 4.3). In the longer term, if reducing the effects of fishing on sensitive habitats leads those habitats to produce greater numbers of fish, fishing industry revenues could increase.

4.1.7.3.3 Operating Costs (E-)

Alternative 6 could have a negative effect on operating costs for certain sectors of the fishing industry due to factors such as temporal displacement and spatial redistribution of fishing effort to avoid impacts to habitats identified as EFH or additional monitoring costs.

4.1.7.3.4 Costs to Consumers (U)

Alternative 6 would have no immediately discernable effect on costs to consumers for seafood. If, in the longer term, productivity is enhanced due to the designation of EFH and the adoption of associated measures to conserve important habitats, consumers may benefit from increased supplies of seafood and other related products (e.g., fish oil or meal), increased quality, and reduced prices. The extent of any such effects is unknown.

4.1.7.3.5 Safety (Ø)

Alternative 6 would have no discernable effect on safety for the fishing fleet, although temporal and spatial displacement of fishing effort could increase the distance between ports and open fishing grounds,

and/or the timing of openings, which could lead operators to risk fishing in more extreme weather and sea conditions.

4.1.7.3.6 Socioeconomic Effects on Fishing Communities (E-)

Alternative 6 may lead to negative socioeconomic effects for some fishing communities. Depending on the nature of any management measures adopted to minimize effects of fishing on EFH, there could be spatial and temporal dislocation of fishing effort to avoid impacts to habitat, 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 and efficient.

4.1.7.3.7 Regulatory and Enforcement Programs (E-)

Alternative 6 could have a negative effect on regulatory and enforcement programs. EFH description and identification would trigger the requirement to minimize adverse effects of fishing on EFH. Any resulting management measures could increase the complexity and cost of administering and enforcing fishery management.

4.1.7.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 6 could have a positive effect on fisheries for halibut and state-managed groundfish, crab, herring, salmon, and forage fish. EFH cannot be described and identified for these fisheries under the Magnuson-Stevens Act, but to the extent that some of the species targeted by these fisheries use habitats in federal waters, they could benefit from EFH protective measures. EFH description and identification might also affect these fisheries indirectly insofar as some vessels and people participate in Magnuson-Stevens Act fisheries as well as fisheries managed under other authorities, but any such effects would not result in substantial changes in catch for these fisheries.

4.1.7.5 Effects on Protected Species (E+)

Alternative 6 may have a positive effect in federal waters for protected species of salmon, marine mammals, and seabirds. EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats for both fishing and non-fishing activities. Many protected species use the same habitats as managed species and, thus, could benefit from EFH protective measures offshore. However, such benefits would not apply in state waters, where a variety of human activities would proceed without explicit consideration of potential adverse effects on fish habitats under the Magnuson-Stevens Act. EFH designations may not account for the specific habitat requirements of protected species, so the degree of positive effect for these species is unknown.

4.1.7.6 Effects on Ecosystems and Biodiversity

4.1.7.6.1 Predator-Prey Relationships (U)

Alternative 6 would have unknown effects on predator-prey relationships. EFH description and identification in federal waters may indirectly benefit prey species, as discussed above, but it is unclear whether such effects would change trophic dynamics.

4.1.7.6.2 Energy Flow and Balance (Ø)

Alternative 6 would have no discernable effect on total catch or discards and, thus, no determinable effect on energy flow in the ecosystem.

4.1.7.6.3 Biodiversity (Ø)

Alternative 6 would have no discernable effect on extinction rates, trophic level changes, or selective fishing patterns that could affect biodiversity.

4.1.7.7 Effects on Non-fishing Activities

4.1.7.7.1 Costs to Federal and State Agencies (E+/E-)

Alternative 6 could have a positive effect on costs to most federal and state agencies. Without EFH description and identification in state waters, 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 description and identification as the impetus to provide conservation recommendations to federal or state agencies to protect fish habitats. 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 habitats. In federal waters, EFH description and identification would trigger Magnuson-Stevens Act requirements to consider potential adverse effects on fish habitats 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 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. To reduce duplication and promote efficiency, NMFS would combine most EFH consultations with environmental reviews required under other laws, as encouraged by the EFH regulations in 50 CFR 600.920.

4.1.7.7.2 Costs to Non-fishing Industries or Other Proponents of Affected Activities (E+/E-)

Alternative 6 may 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. The absence of EFH designations and associated consultations in state waters could result in a decrease in the cost of obtaining permits or funding from federal agencies. Without the requirement for NMFS to provide conservation recommendations for actions that would harm habitats for managed species in state waters, there could be a decrease in project costs that might otherwise be required by the permitting or funding agency to protect fish habitat. However, NMFS and other agencies could still provide habitat recommendations under other authorities, and the permitting or funding agencies could still impose restrictions on development to curtail losses of valuable habitats. In federal waters, EFH description and identification would trigger interagency consultations regarding the effects of proposed actions on EFH, which would have a negative effect on costs for the industries and other entities that sponsor certain non-fishing activities. 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 agencies deny or condition permits or funding to protect EFH, project costs for the proponents could increase. However, NMFS and other agencies can provide habitat recommendations under other authorities, and permitting or funding agencies can impose restrictions on development for environmental reasons other than EFH conservation, so the monetary costs specifically attributable to EFH can be difficult to discern.

4.1.7.8 Summary of the Effects of Alternative 6

Alternative 6 would result in the elimination of EFH description and identification in Alaska state waters and would result in relatively minor changes to the existing EFH description and identification in the EEZ to incorporate more recent information, improved mapping, and new EFH descriptions for a few species for which information was not readily available when the existing designations were compiled. Overall, Alternative 6 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect fish habitats in the EEZ. Such negative effects could be short term for the fishing industry; longer-term effects are less certain, especially for sectors that may benefit from enhanced habitat productivity resulting from EFH designation. Alternative 6 would likely have positive effects for the habitats and species in the EEZ that could be protected by measures resulting indirectly from EFH description and identification. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. Alternative 6 would result in geographically smaller EFH description and identification than Alternatives 2, 3, 4, or 5, because EFH would be limited to federal waters only. A comparison of Alternative 6 to the other EFH description and identification alternatives is presented in Section 4.5.1 and Table 4.5-1.

4.2 Effects of Establishing an Approach for Identifying Habitat Areas of Particular Concern

Identifying HAPCs, like describing and identifying EFH, does not have any direct environmental, economic, or socioeconomic impact, but may result in indirect impacts. The identification of HAPCs provides a means for NMFS and the Council to highlight priority areas within EFH for conservation and management. For example, HAPCs may be used to focus conservation and management efforts on particularly valuable and/or vulnerable subsets of EFH. Although HAPC identification does not convey any higher regulatory standards for minimizing adverse effects of fishing or conducting EFH consultations on non-fishing actions, NMFS and the Council may be more risk averse when developing management measures to minimize adverse effects of fishing on HAPCs and when recommending measures to federal and state agencies to minimize adverse effects of non-fishing activities on HAPCs. The potential environmental, economic, and socioeconomic impacts of designating HAPCs are comparable to those described in Section 4.1 for EFH, because any identified HAPCs would be a subset of areas identified as EFH. As with EFH, conservation of HAPCs is expected to support healthier fish stocks and more productive fisheries over the long term, which, in turn, will provide environmental, economic, and socioeconomic benefits.

4.2.1 Criteria for Evaluating the Effects of Establishing an Approach to Identify HAPCs

The alternatives for HAPC identification in this EIS are a range of different methodological approaches, rather than different specific types or areas of habitat. As discussed in Section 2.3.2, the Council decided to select an approach for identifying HAPCs first, and then to identify specific HAPCs. (Identification of HAPCs is not required under the Magnuson-Stevens Act or the EFH regulations.) Therefore, the likely environmental or socioeconomic impacts of HAPC identification cannot be evaluated with specificity in this EIS. Instead, the following sections provide a general qualitative analysis of how the different approaches, when applied to specific HAPC identifications, might affect the following topics: habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities. The criteria presented in Tables 4.1-1 through 4.1-7 for evaluating the effects of EFH description and identification apply to HAPC identification as well. Those tables present the criteria used in the following sections to determine whether the likely effects for each topic are negative (E-), neutral (Ø), positive (E+), or unknown (U). The following sections collapse all relevant issues for each topic into a single determination of effects, and thus use a simpler method of analysis than the method used in Section 4.1 to evaluate the effects of describing and identifying EFH. This broader analysis is warranted because the alternatives represent different approaches for identifying HAPCs, rather than specific different resulting HAPC designations. The analysis compares the effects of each alternative to status quo conditions (i.e., Alternative 2).

In general, if the analysis suggests either a potential effect or a known effect, the EIS assigns a rating of E+ or E-. The EIS assigns a rating of Ø if the analysis suggests no discernible effect, and a rating of U if there is no basis for inferring the effect. This rating method results in fewer Ø and U ratings than the more detailed analytical approach used in Section 4.3 for the alternatives to minimize the adverse effects of fishing on EFH, and is appropriate here because the analysis of the alternative approaches for identifying HAPCs is necessarily more qualitative. In short, the analysis assumes that facilitating the identification of HAPCs affords an opportunity to identify and minimize potential adverse effects, which in turn is likely to result in certain positive or negative effects for most of the factors evaluated. The accompanying Regulatory Impact Review and Initial Regulatory Flexibility Analysis (Appendix C) does not further evaluate the regulatory, economic, and socioeconomic effects of establishing an approach for identifying HAPCs, because such effects are indirect consequences that may result from separate future actions, and therefore cannot be evaluated more specifically in the present analysis.

Although the remainder of this section discusses the environmental consequences of the alternatives for establishing an approach to identify HAPCs, the results of the analysis are very similar for some of the alternatives, and it can be difficult to distinguish between them. Readers should refer to Section 4.5.2 for a comparison of the effects of the alternatives to highlight similarities and differences.

4.2.2 Effects of Alternative 1 (No HAPC Identification)

Under Alternative 1, there would be no HAPC identification for species managed by the North Pacific Council. The existing HAPC designations that were approved in 1999 would be rescinded.

4.2.2.1 Effects on Habitat (E-)

Alternative 1 could have a negative effect on habitat complexity, benthic biodiversity, and prey species. HAPC identification may confer incrementally more protection for identified habitats by distinguishing them from the whole of EFH and conveying that they are priority areas for conservation and management. Without HAPC identification, the opportunity to delineate specific subsets of EFH would not exist.

4.2.2.2 Effects on Target Species (E-)

Alternative 1 could have a negative effect on target species by precluding the opportunity to confer incrementally more habitat protection in specified areas that might benefit productivity, prey availability, and growth to maturity for managed species. The absence of HAPC identification would have no effect on fishing mortality and could be slightly beneficial for the spatial and temporal distribution of catch if it becomes less likely that there would be area closures for certain fisheries.

4.2.2.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries (E+/E-)

Alternative 1 could have a near-term positive effect on fishing industry operating costs, fishing communities, and regulatory and enforcement programs if the absence of HAPCs makes it less likely that there would be new restrictions on certain fisheries to protect habitats. The Magnuson-Stevens Act requirement to minimize adverse effects of fishing on habitat applies to all of EFH, not just HAPCs, so it would remain applicable under this alternative. However, with no HAPC identification, federally managed fisheries might have less predictability regarding areas of special concern, insofar as specific subsets of EFH would not be highlighted as HAPCs for priority conservation and management. In the long term, the protection of valuable habitats should be beneficial for fisheries because it will promote healthy fish stocks; therefore, near-term costs should yield longer-term benefits. 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, because some people who do not participate in fisheries may value fisheries less if they perceive that habitats are not protected adequately. Alternative 1 would have no short-term effect on industry revenue. Alternative 1 would have no effect on safety or consumer costs.

4.2.2.4 Effects on Other Fisheries and Fishery Resources (E-)

Alternative 1 could have a negative effect on other fisheries and fishery resources. Although HAPC identification pertains to habitats for federally managed species, other fisheries and fishery resources that are dependent on the same habitats may benefit indirectly from the protection of those areas. Without HAPC identification, those potential indirect benefits would be foregone.

4.2.2.5 Effects on Protected Species (E-)

Alternative 1 could have a negative effect on protected species of mammals, salmon, and seabirds. Although HAPC identification pertains to habitats for federally managed species, protected species of mammals, salmon, and seabirds that are dependent on the same habitats may benefit indirectly from the protection of those areas. Without HAPC identification, those potential indirect benefits would be foregone.

4.2.2.6 Effects on Ecosystems and Biodiversity (E-)

Alternative 1 could have a negative effect on ecosystems and biodiversity. Although HAPC identification pertains to habitats for federally managed species, overall ecosystem health and stability may benefit indirectly from the protection of those areas. Without HAPC identification, those potential indirect benefits would be foregone.

4.2.2.7 Effects on Non-fishing Activities (E+)

Alternative 1 could have a positive effect on costs for federal and state agencies that authorize, fund, or undertake actions affecting fish habitat and the industries that support such actions. Without HAPC identification, EFH consultations could not focus additional attention on especially valuable or vulnerable subsets of EFH.

4.2.2.8 Summary of the Effects of Alternative 1

Alternative 1 would result in the elimination of HAPC designations in Alaska. Overall, Alternative 1 could have positive effects for the industries and other entities that may currently face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect especially important subsets of EFH. Alternative 1 could have negative effects for the habitats and species that may be protected by measures resulting indirectly from HAPC identification. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 1 to the other alternatives for establishing an approach to identify HAPCs is presented in Section 4.5.2 and Table 4.5.-3.

4.2.3 Effects of Alternative 2 (Status Quo HAPCs)

Under Alternative 2, the existing HAPC designations would remain in effect with no changes. Those designations include living substrates in deep water, living substrates in shallow water, and freshwater areas used by anadromous salmon.

Alternative 2 represents a continuation of status quo conditions and, therefore, would have no effect (Ø) relative to existing conditions for habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, or non-fishing activities. This analysis includes information on the effects of all the other alternatives for establishing an approach to identify HAPCs as compared to the status quo.

Retaining the status quo HAPCs would continue the effects that those designations have had since 1999 (evaluated in the EA for FMP Amendments 55/55/8/5/5; NMFS 1999), which have been very similar to the anticipated effects of HAPCs that might be identified under Alternatives 3, 4, and 5. In general,

HAPC designation can have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect especially important subsets of EFH. Identification of HAPCs can have positive effects for the habitats and species that may be protected by measures resulting indirectly from HAPC identification. Such measures include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 2 to the other alternatives for establishing an approach to identify HAPCs is presented in Section 4.5.2 and Table 4.5-3.

4.2.4 Effects of Alternative 3 (Preliminary Preferred Alternative) (Site Based Concept)

Under Alternative 3, the existing HAPC designations would be rescinded and the Council would adopt an approach that allows specific sites within EFH, selected to address a particular problem, to be identified as HAPCs in the future.

4.2.4.1 Effects on Habitat (E+)

Alternative 3 could have a positive effect on habitat complexity, benthic biodiversity, and prey species. Site-based HAPCs may confer incrementally more protection for identified habitats by distinguishing them from the whole of EFH and from the broad types of habitat currently identified as HAPCs, thereby conveying that they are priority areas for conservation and management.

4.2.4.2 Effects on Target Species (E+)

Alternative 3 could have a positive effect on target species by conferring incrementally more habitat protection in specified areas that might benefit productivity, prey availability, and growth to maturity for managed species. Alternative 3 could have a beneficial effect on fishing mortality in the event that TAC reductions were enacted to protect HAPCs, and could be slightly negative for the spatial and temporal distribution of catch if the designations lead to HAPCs being closed to certain fisheries, thereby concentrating fishing effort in remaining open areas.

4.2.4.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries (E+/E-)

Alternative 3 could have a near-term negative effect on fishing industry operating costs, fishing communities, and regulatory and enforcement programs if the resulting HAPCs prompt new restrictions on certain fisheries to protect habitats. However, the Magnuson-Stevens Act requirement to minimize adverse effects of fishing on habitat applies to all of EFH, not just HAPCs. In the long term, the protection of valuable habitats should be beneficial for fisheries because it will promote healthy fish stocks. Alternative 3 could have a positive effect on passive use values because some people who do not participate in fisheries may value fisheries more if they perceive that habitats are protected adequately. Alternative 3 is not expected to affect fishing industry revenue in the short term, but fishing revenues could increase in the long term if identifying HAPCs leads these habitats to produce greater numbers of fish. The potential for this long-term effect is unclear. Alternative 3 would have no effect on safety or consumer costs.

4.2.4.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 3 may have a positive effect on other fisheries and fishery resources. Although HAPC identification pertains to habitats for federally managed species, other fisheries and fishery resources that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.4.5 Effects on Protected Species (E+)

Alternative 3 may have a positive effect on protected species of mammals, salmon, and seabirds. Although HAPC identification pertains to habitats for federally managed species, protected species of mammals, salmon, and seabirds that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.4.6 Effects on Ecosystems and Biodiversity (E+)

Alternative 3 could have a positive effect on ecosystems and biodiversity. Although HAPC identification pertains to habitats for federally managed species, overall ecosystem health and stability may benefit indirectly from the protection of those areas.

4.2.4.7 Effects on Non-fishing Activities (E-)

Alternative 3 could have a negative effect on federal and state agencies that authorize, fund, or undertake actions affecting fish habitat and the industries that support such actions. HAPCs may focus additional attention on especially valuable or vulnerable subsets of EFH, potentially leading the responsible agencies to restrict development that would affect such habitats.

4.2.4.8 Summary of the Effects of Alternative 3

Alternative 3 would rescind the existing HAPCs and allow specific sites within EFH, selected to address an identified problem, to be identified as HAPCs in the future. Overall, Alternative 3 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect especially important subsets of EFH. Alternative 3 could have positive effects for the habitats and species that may be protected by measures resulting indirectly from HAPC designations. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 3 to the other alternatives for establishing an approach to identify HAPCs is presented in Section 4.5.2 and Table 4.5-3.

4.2.5 Effects of Alternative 4 (Type/Site Based Concept)

Under Alternative 4, the existing HAPC designations would be rescinded and the Council would adopt an approach that allows specific sites selected within identified habitat types within EFH to be identified as HAPCs in the future.

4.2.5.1 Effects on Habitat (E+)

Alternative 4 could have a positive effect on habitat complexity, benthic biodiversity, and prey species. Site-based HAPCs may confer incrementally more protection for identified habitats by distinguishing

them from the whole of EFH and from the broad types of habitat currently identified as HAPCs, thereby conveying that they are priority areas for conservation and management.

4.2.5.2 Effects on Target Species (E+)

Alternative 4 could have a positive effect on target species by conferring incrementally more habitat protection in specified areas that might benefit productivity, prey availability, and growth to maturity for managed species. Alternative 3 could have a beneficial effect on fishing mortality in the event that TAC reductions were enacted to protect HAPCs, and could be slightly negative for the spatial and temporal distribution of catch if the designations lead to HAPCs being closed to certain fisheries, thereby concentrating fishing effort in remaining open areas.

4.2.5.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries (E+/E-)

Alternative 4 could have a near-term negative effect on fishing industry operating costs, fishing communities, and regulatory and enforcement programs if the resulting HAPCs prompt new restrictions on certain fisheries to protect habitats. However, the Magnuson-Stevens Act requirement to minimize adverse effects of fishing on habitat applies to all of EFH, not just HAPCs. In the long term, the protection of valuable habitats should be beneficial for fisheries because it will promote healthy fish stocks. Alternative 4 could have a positive effect on passive use values because some people who do not participate in fisheries may value fisheries more if they perceive that habitats are protected adequately. Alternative 4 is not expected to affect fishing industry revenue in the short term, but fishing revenues could increase in the long term if identifying HAPCs leads these habitats to produce greater numbers of fish. The potential for this long-term effect is unclear. Alternative 4 would have no effect on safety or consumer costs.

4.2.5.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 4 may have a positive effect on other fisheries and fishery resources. Although HAPC identification pertains to habitats for federally managed species, other fisheries and fishery resources that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.5.5 Effects on Protected Species (E+)

Alternative 4 may have a positive effect on protected species of mammals, salmon, and seabirds. Although HAPC identification pertains to habitats for federally managed species, protected species of mammals, salmon, and seabirds that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.5.6 Effects on Ecosystems and Biodiversity (E+)

Alternative 4 could have a positive effect on ecosystems and biodiversity. Although HAPC identification pertains to habitats for federally managed species, overall ecosystem health and stability may benefit indirectly from the protection of those areas.

4.2.5.7 Effects on Non-fishing Activities (E-)

Alternative 4 could have a negative effect on federal and state agencies that authorize, fund, or undertake actions affecting fish habitat and the industries that support such actions. HAPCs may focus additional

attention on especially valuable or vulnerable subsets of EFH, potentially leading the responsible agencies to restrict development that would affect such habitats.

4.2.5.8 Summary of the Effects of Alternative 4

Alternative 4 would rescind the existing HAPCs and allow specific sites within particular habitat types within EFH to be identified as HAPCs in the future. Overall, Alternative 4 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect especially important subsets of EFH. Alternative 4 could have positive effects for the habitats and species that may be protected by measures resulting indirectly from HAPC designations. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 4 to the other alternatives for establishing an approach to identify HAPCs is presented in Section 4.5.2 and Table 4.5-3.

4.2.6 Effects of Alternative 5 (Species Core Area)

Under Alternative 5, the existing HAPC designations would be rescinded and the Council would adopt an approach that allows areas within EFH to be identified as HAPCs in the future based on productivity of the habitat for individual species.

4.2.6.1 Effects on Habitat (E+)

Alternative 5 could have a positive effect on habitat complexity, benthic biodiversity, and prey species. HAPCs based on core areas may confer incrementally more protection for identified habitats by distinguishing them from the whole of EFH and from the broad types of habitat currently identified as HAPCs, thereby conveying that they are priority areas for conservation and management.

4.2.6.2 Effects on Target Species (E+)

Alternative 5 could have a positive effect on target species by conferring incrementally more habitat protection in specified areas that might benefit productivity, prey availability, and growth to maturity for managed species. Alternative 5 could have a beneficial effect on fishing mortality in the event that TAC reductions were enacted to protect HAPCs, and could be slightly negative for the spatial and temporal distribution of catch if the designations lead to HAPCs being closed to certain fisheries, thereby concentrating fishing effort in remaining open areas.

4.2.6.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries (E+/E-)

Alternative 5 could have a near-term negative effect on fishing industry operating costs, fishing communities, and regulatory and enforcement programs if the resulting HAPCs prompt new restrictions on certain fisheries to protect habitats. However, the Magnuson-Stevens Act requirement to minimize adverse effects of fishing on habitat applies to all of EFH, not just HAPCs. In the long term, the protection of valuable habitats should be beneficial for fisheries because it will promote healthy fish stocks. Alternative 5 could have a positive effect on passive use values because some people who do not participate in fisheries may value fisheries more if they perceive that habitats are protected adequately. Alternative 5 is not expected to affect fishing industry revenue in the short term, but fishing revenues could increase in the long term if identifying HAPCs leads these habitats to produce greater numbers of

fish. The potential for this long-term effect is unclear. Alternative 5 would have no effect on safety or consumer costs.

4.2.6.4 Effects on Other Fisheries and Fishery Resources (E+)

Alternative 5 may have a positive effect on other fisheries and fishery resources. Although HAPC identification pertains to habitats for federally managed species, other fisheries and fishery resources that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.6.5 Effects on Protected Species (E+)

Alternative 5 may have a positive effect on protected species of mammals, salmon, and seabirds. Although HAPC identification pertains to habitats for federally managed species, protected species of mammals, salmon, and seabirds that are dependent on the same habitats may benefit indirectly from the protection of those areas.

4.2.6.6 Effects on Ecosystems and Biodiversity (E+)

Alternative 5 could have a positive effect on ecosystems and biodiversity. Although HAPC identification pertains to habitats for federally managed species, overall ecosystem health and stability may benefit indirectly from the protection of those areas.

4.2.6.7 Effects on Non-fishing Activities (E-)

Alternative 5 could have a negative effect on federal and state agencies that authorize, fund, or undertake actions affecting fish habitat and the industries that support such actions. HAPCs may focus additional attention on especially valuable or vulnerable subsets of EFH, potentially leading the responsible agencies to restrict development that would affect such habitats.

4.2.6.8 Summary of the Effects of Alternative 5

Alternative 5 would rescind the existing HAPCs and allow areas within EFH to be identified as HAPCs in the future based on productivity of the habitat for individual species. Overall, Alternative 5 could have negative effects for the industries and other entities that may face requirements (for federally managed fishing activities) or recommendations (for non-fishing activities) that are designed to protect especially important subsets of EFH from harm. Alternative 5 would have positive effects for the habitats and species that could be protected by measures resulting indirectly from HAPC designations. Such measures would include either required measures to minimize adverse effects of fishing on EFH or recommended measures to minimize effects of non-fishing activities on EFH. A comparison of Alternative 5 to the other alternatives for establishing an approach to identify HAPCs is presented in Section 4.5.2 and Table 4.5-3.

4.3 Effects of Minimizing the Adverse Effects of Fishing on EFH

Under Section 303(a)(7) of the Magnuson-Stevens Act and 50 CFR 600.815(a)(2), every FMP must minimize to the extent practicable adverse effects of fishing on EFH. According to the EFH regulations, Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature. In determining whether it is practicable to minimize an adverse effect from fishing, Councils should consider the nature and extent of the adverse effect on EFH and the long- and short-term costs and benefits of potential management measures to EFH, associated fisheries, and the nation.

This section examines the environmental consequences of the alternatives to minimize the adverse effects of fishing on EFH. Environmental consequences are categorized into effects on fish habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, and ecosystems. Each alternative is examined separately. A comparison of the alternatives is provided in Section 4.5.

4.3.1 Criteria for Evaluating the Effects of Minimizing the Adverse Effects of Fishing on EFH

4.3.1.1 Habitat

EFH is defined in the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." In this context, the term "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Appendix B evaluates potentially adverse effects of fishing and provides much of the information required for the current comparison of alternative fishing impact minimization measures. This analysis evaluates the effects of the fishing impact minimization alternatives on EFH relative to existing conditions (status quo).

Benthic EFH is generally believed to be at greater risk to the impacts of fishing than pelagic habitat, although EFH does encompass nonbenthic habitat. No information was found indicating significant positive or negative effects of fishing on EFH features of pelagic waters; therefore the potential for such effects was considered minimal. The remainder of this evaluation focuses on benthic EFH.

Fishing activities affect several benthic features that may serve as EFH, including organisms of the infauna and epifauna that are fish prey and organisms and nonliving forms that provide three-dimensional structure to some epibenthic environments. Such structure may be used by fish species in spawning, breeding or as shelter in surviving to maturity. Fishing activities have variable effects on different organisms, which may cause changes in the composition of benthic communities. The literature describing these effects is reviewed in Section 3.4.3. Ecosystem effects of fishing, including effects on community composition, are described in Chapter 3 and evaluated for each alternative in this chapter.

Effects of fishing on habitat features are influenced by a complex combination of factors related to the ambient level of natural disturbance and include the following:

- Intensity of fishing effort
- Distribution of fishing effort relative to different types of habitat
- Sensitivity of habitat features to contact with fishing gear
- Recovery rates of habitat features

Appendix B contains an analysis that links information on these factors to estimated long-term effect indices (LEIs) for recent fishing patterns on benthic habitat features that provide potential prey and structure functions for the marine fish species of Alaska. While its primary use was the evaluation of whether those effects would affect habitat essential to the welfare of species enough to reduce fish stocks below a threshold needed to sustain fisheries, it is used here to assess the alternatives proposed for minimizing or preventing effects. Analyses of each alternative provided estimates of their long-term effects on organisms providing prey and structure functions and nonliving forms that provide structure function. Results of these analyses are presented in Table 4.3-1.

The analysis included all groundfish gears, including trawls, pots, and hook and line (e.g., longlines). Nearly all of the estimated effects were linked to trawl fishing. Knowledge was largely lacking on the amount of sea floor contacted by passive gears and the sensitivity of habitat features to such contact; however both would have to be very high to make their effects similar in magnitude to trawl effects. It is recognized that fixed gear (longlines, pots, and jigs) or pelagic trawl gear that comes in contact with the sea floor can disturb benthic EFH. In some types of habitats, fixed-gear may have an impact due to its ability to be more easily fished on rougher substrates (e.g., boulders with coral) than bottom-trawl gear and hence may be the principal effect in relatively vulnerable areas.

The analysis did not explicitly include the effects of crab, scallop, or salmon fisheries or groundfish fishing by vessels under 60 feet in length. A preliminary analysis (Witherell 2002) found that the non-groundfish fisheries were unlikely to have sufficient effects to notably change the results of the fishing effects analysis. Effects of groundfish fishing by vessels under 60 feet were also considered minimal since both fixed gear and trawl components produce less that 1 percent of the groundfish catch, indicating a commensurately small fraction of the effects.

The results of these analyses were presented to the same species authors who made the EFH evaluations for Appendix B. Their assessments of the relationship between the estimated effects on habitat features and the life history processes and welfare of each managed species are presented in Chapter 4.

Effects on Prey Species

Feeding is one of the key life history functions mentioned in the definition of EFH, and reductions in benthic prey species have been observed in fishing effects studies. Principal prey species for the managed fish species of Alaska are described in Section 3.2.1 and Appendix F. For the fishing effects analysis, benthic species were divided into two large classes, infauna (principally clams and marine worms) and epifauna (including several crustacean groups and brittle stars). These classes make up a significant part of the diet of most groundfish species. Potential reductions in these classes were evaluated by habitat type (Table 4.3-1). The effects on fish that serve as prey were not directly included in the fishing effects analysis, but the habitat and fishery effects on such species are evaluated in this chapter.

Effects on Habitat Complexity

Three-dimensional epibenthic structures can provide concealment for some fish (particularly during growth to maturity) and spawning substrates for others (i.e., 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 complex structures may be composed of nonliving materials (e.g., sand, rocks, shell) or living organisms. 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. Sediment structures, such as sand waves, may be reformed over time, while

disrupted piles of boulders will remain so. Recovery rates for structure-forming organisms are not well known and are very influential in estimating fishing effects.

Effects on Habitat Biodiversity

One type of functional diversity is that provided by structural habitat organisms such as living substrate biota. Members of this guild serve important functional roles, known only in a preliminary way, in providing fish and invertebrates with structural habitat and refuge from predation. The abundance of these structural species necessary to provide protection is not known, and it may be important to retain populations of these organisms that are well distributed spatially in order to fulfill their functional role. Some of these organisms have life-history traits that make them very sensitive to fishing removals. The long-lived nature of corals, in particular, makes them susceptible to eradication in fished areas. Therefore, it is important to evaluate the spatial distribution of areas closed to bottom fishing with respect to coral distribution to ensure a broad spatial distribution that would be necessary for them to fulfill their functional role.

The structure-providing organisms with ultra-slow recovery rates necessitate a different perspective for comparing alternatives. For the purposes of this evaluation, coral represents all structure with recovery times approaching a century or longer. Effects on hard corals (e.g., *Primnoa*) in areas that have been heavily fished may include the removal of 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. Because the fishing effects model assumes each unit of effort is randomly placed within each habitat type, accurate estimation of coral reductions is greatly limited by the potential for interactions between the small scale patchiness of the presence of these organisms with the patchiness of fishing effort. To the extent that effort tends to overlap previous tows, LEIs are overestimates of the actual effects because towing encounters less undamaged structure. Particularly in highly heterogeneous habitats that include trawl-damaging structures (such as the AI), trawling effort concentrates on tow sites known to produce fish with limited trawl damage. So long as the allowed catch can be taken at such sites, coral reductions in other parts of the same habitat type are limited. Closures of historically productive fishing grounds may have net negative effects if fishing effort is displaced to previously unfished or lightly fished areas.

A measure of the protection of coral is the proportion of habitat types known to contain significant amounts of such structure that are closed to future trawling. Table 4.3-2 provides trawl closure proportions for each of the alternatives. Consideration of the potential for displacement of effort due to closure of productive sites is also relevant.

Damage of such structure by longlines and pots is plausible and bycatch of such species indicates some effect of some of these fisheries. The key unknown in evaluating such effects is how much such gear moves across the seafloor during fishing and retrieval; however, the effects of fishing analysis indicates that this movement would need to be 10 to 100 times larger than estimated to approach the effects of trawling. Therefore, closures to longline and pot fisheries were not included in this analysis. Research is needed to determine actual contact coverage and effects of these fisheries.

Assessment of the Alternatives

For each alternative, the possible impacts on prey availability and benthic structure are addressed. Changes seen in the indicators for each alternative were determined to have positive effects, negative effects, no effect, or unknown effects on the environment. The effects of each alternative were compared to the status quo. Because total fishing effort has been relatively stable for the last 10 years and because it is in comparable units, the best proxy available for describing status quo was the set of LEIs based on recent (1998 through 2002) fishing patterns. This set was the basis for the evaluation of the effects of

fishing on EFH (Appendix B) and provides the LEI values for Alternative 1. The limitations of using this set of LEIs as a proxy mostly occur for longer-lived fish species and habitat features with long recovery times. These may not have fully responded to changes in fishing patterns and intensities extending back into the last several decades. The errors could appear either as incomplete recovery from heavier fishing in some areas in the past (proxy overestimates current levels) or as incomplete effects of low-intensity fishing on slow recovering features (proxy underestimates current levels). Table 4.3-3 lists the effects and describes the criteria used for evaluating the environmental impacts of minimizing the effects of fishing on EFH.

4.3.1.2 Target Species

4.3.1.2.1 Groundfish

The alternatives are analyzed with respect to potential impacts on groundfish target species managed under the FMPs. For each alternative, the possible impacts on stock biomass, spatial/temporal concentration of catch, spawning and breeding, feeding, and growth to maturity. As a means of evaluating the intensity of the effects on target species under the alternatives, the following analytical system was developed to evaluate the significance of the five selected effects. Additional details for each species or species complex are given in its specific section. The system consisted of four rankings: "effect negative (E-)," "no effect (Ø)," "effect positive (E+)," and "unknown (U)." Recognizing that such general terminology is inherently subjective, we applied criteria where possible to define the terms and rankings. The primary consideration for evaluating these five effects was the health/sustainability of the stock at the population level, which was measured by its ability to maintain itself at or above its minimum stock size threshold (MSST). In the National Standard Guidelines to the Magnuson-Stevens Act, sustainability is defined relative to the MSST. Stocks below the MSST are considered sufficiently small as to require an appropriate rate of rebuilding. This concept of sustainability was used here to maintain consistency with the National Standard Guidelines. Unless the evaluating scientists knew of ecosystem functions of the species that required a higher threshold level, they used the ability to stay at or above MSST as proxy for that criterion as well. The evaluating scientists were also given the latitude to consider sources of information other than MSST in arriving at their final evaluations.

For at least 30 years, fishing effort and presumably its habitat effects have been at similar or higher levels than current levels. The condition of fish populations is therefore one indicator of their response to all effects of fishing, including those on EFH. The EFH of species that maintained a favorable stock condition through this period, while supporting a fishery, was considered resistant to habitat effects caused by the fisheries.

For fish stocks where information was available to estimate recruitment, recruitments from the late 1970s to the present were used in assessing stock conditions relative to MSST. These estimated recruitments, as well as other stock characteristics, such as growth rates, represent a range of recent history when impacts to the stock from fishing practices would have been expected. As part of the revised draft programmatic groundfish SEIS (NMFS 2003a), 10-year projections were made to assess whether the stocks would be likely to fall below their MSST level under the status quo harvesting policy, as well as under a broad range of alternative policies. These projections combine the current stock status and historical distributions of population parameters, both of which reflect historic levels of fishing effects. As such, the SEIS analysis of stock status relative to MSST was used as an indicator of effects of recent fishing intensities on the species and their EFH on the population level. Evaluators were knowledgeable of any peculiarities in their species history that would make this indicator more or less relevant. For species where MSST could not be estimated with available data, assessing effects on EFH was more

uncertain and ratings of "unknown" were more likely. Given the current state of knowledge, uncertainties were expected and evaluators indicated where these might be important or raised concerns. Table 4.3-4 lists the effects and describes the criteria used for evaluating the environmental impacts to target groundfish species.

Stock Biomass – All target species are managed within the definitions of Amendments 56/56 of the EBS and GOA FMPs, which set the overfishing levels and the maximum permissible acceptable biological catch for six tier designations. Currently, no target groundfish species is overfished, subject to overfishing, or approaching an overfished condition. The effects on stock biomass is measured in terms of the changes in fishing mortality and the ability of the stock to reasonably sustain itself at or above its MSST.

Spatial/Temporal Concentration – Concentration of fishing effort in time and space could potentially alter the genetic diversity of a population through selective fishing (e.g., removal of certain spawning aggregations or members of the population with unique growth or maturation patterns). The effects on spatial/temporal concentration are measured in terms of changes in the distribution of the directed groundfish fishery.

Spawning/Breeding – Successful spawning and breeding is dependent upon the number of spawners, available habitat for spawning and nursery areas, and environmental conditions. Impacts on reproductive success may occur when these areas are disturbed or the spawning biomass is altered in an anomalous way.

Feeding – Refers to adult feeding only.

Growth to Maturity – Growth to maturity is measured in terms of survival to maturity (i.e., from eggs to adults, including feeding during this stage).

4.3.1.2.2 FMP Salmon, Crabs, and Scallops

The alternatives are also analyzed with respect to potential impacts on non-groundfish target species managed under the FMPs. For each alternative, the possible impacts are addressed regarding stock biomass, spatial/temporal concentration of catch, spawning and breeding, feeding, and growth to maturity. Changes seen in the indicators for each alternative were determined to have positive effects, negative effects, no effect, or unknown effects on FMP salmon, crabs, and scallops. In most cases, the predicted changes are estimated qualitatively based on professional judgement using the best available scientific information. Table 4.3-5 lists the effects and describes the criteria used for evaluating the environmental impacts to salmon, crab, and scallops as well as groundfish target species.

4.3.1.2.2.1 Salmon

Stock Biomass – All five species of salmon (chinook, chum, pink, coho, sockeye) in Alaska are currently considered to be at biomass levels above MSST. None are considered overfished, subject to overfishing, or approaching an overfished condition. The effects on stock biomass are measured in terms of the changes in fishing mortality and the ability of the stock to be sustained above the MSST.

Spatial/Temporal Concentration – Concentration of fishing effort in time and space could potentially alter the genetic diversity of a population through selective fishing (removal of certain spawning

aggregations or larger and faster growing animals, for example). The effects on spatial/temporal concentration are measured in terms of changes in the distribution of the directed salmon fishery.

Spawning/Breeding – Salmon spawn and deposit their eggs in gravel areas of freshwater rivers and streams. Successful spawning is dependent upon the numbers of spawners, available habitat for spawning and nursery areas, and environmental conditions. Impacts to spawning and breeding of salmon occur when these areas are disturbed, or the spawning biomass is reduced. The effects of the alternatives on the spawning and breeding of salmon are measured in terms of changes in activities affecting freshwater areas.

Feeding – Once salmon smolt and begin to enter the ocean, they feed on copepods, and as they get larger they add squid, herring, smelt, and other forage fish and invertebrate species to their diets. The effects of the alternatives on the feeding of salmon are thus measured in terms of the effects on prey availability, particularly squid, herring, and smelt.

Growth to Maturity – Salmon feed throughout the open ocean of the North Pacific for up to 6 years (depending upon species) before maturing and returning to their natal rivers to spawn. Mortality of juveniles depends on food availability, predation, bycatch in fisheries, and environmental conditions. The effects of the alternatives on the growth and survival of salmon are measured in terms of changes in prey availability and bycatch in the trawl fisheries.

4.3.1.2.2.2 Crabs

Stock Biomass – Several stocks of crabs (St. Matthew blue king crab, Pribilof Islands blue king crab, EBS Tanner crab) in the EBS are considered to be at biomass levels below MSST and are thus considered overfished. Rebuilding plans have been implemented for these stocks. The potential effects of the alternatives on stock biomass are measured in terms of changes in the catch of crabs in the directed fishery.

Spatial/Temporal Concentration – Concentration of fishing effort in time and space could potentially alter the genetic diversity of a population through selective fishing (removal of certain spawning aggregations or larger and faster growing animals, for example). The effects on spatial/temporal concentration are measured in terms of changes in the distribution of the directed crab fishery and, to a lesser extent, changes in the distribution of the trawl fishery (which takes some crabs as bycatch).

Spawning/Breeding – Spawning and breeding success of crab species depends upon high egg-fertilization rate, transport of pelagic larvae to nursery areas, and survival to the adult stage. Egg fertilization success depends upon the size and number of mature male crabs (and hence the amount of sperm) available. The eggs are attached to the undersides of females and carried for nearly a year prior to hatching. Transport of larvae depends upon environmental conditions, and survival depends upon the quantity and quality of nursery habitat and the presence of predators.

Settlement and nursery areas are important components of spawning success for crab species. For king crabs, selection of benthic habitat by glaucothoe appears to be an important mechanism leading to increased probability of larvae settling on an appropriate substrate. Such substrates appear to be largely rock or cobble bottoms, mussel beds, or other areas with a variety of epifauna (such as hydroids) or epiflora (such as kelp holdfasts). For Tanner and snow crabs, settlement occurs on mud habitats.

The effects of the alternatives on the spawning and breeding of crabs is thus measured in terms of the overlap and fishing intensity of trawl and dredge fishing effort in nursery areas and areas where mature females occur. Figures 4.3-1 through 4.3-4. show the recent distribution of females of blue king crab, red king crab, snow crab, and Tanner crab in the EBS area, together with the distribution of fishery catches (a proxy for fishing effort) for those species.

Feeding – From settling larvae to senescence, crabs dwell on the bottom and are dependent upon benthic feeding. The importance of habitat quality to crab diet intuitively seems obvious but is not quantified for benthic life stages. Changes in diet due to habitat disturbance may impact crab survival and production; however, the effects of these changes will be difficult to assess given the limited information on feeding requirements of crab species. Tanner and snow crabs feed on an extensive variety of benthic organisms including bivalves, brittle stars, crustaceans (including other snow crabs), polychaetes and other worms, gastropods, and fish. The effects of the alternatives on the feeding of crabs are measured in terms of the overlap and fishing intensity of trawl and dredge fishing effort in juvenile and adult areas.

Growth to Maturity – Early stage red king crabs seek out biological cover in which to hide. Survival at this stage depends upon availability of cover. After they reach a size exceeding 25 mm carapace length, red king crabs form pods, which consist of similar sized crabs of both sexes and may contain hundreds to thousands of crabs. Pods of juvenile crabs form during the daytime, but disperse at night for feeding. Unlike red king crabs, blue king crabs do not pod, but rely on cryptic coloration to avoid predators. Podding behavior has also been observed for adult Tanner crabs. Pods may be particularly vulnerable to incidental and unobserved mortality caused by fishing with trawl or dredge gear. Crabs are caught incidentally in groundfish and crab fisheries, and some of these crabs die after being discarded. Another source of mortality is unobserved interactions with trawl and dredge gear and crabs that do not come up to the surface with the catch. A review of crab bycatch mortality is provided in the annual EBS crab SAFE reports (e.g., Council 2002c). The effects of the alternatives on the growth of crabs to maturity are thus measured in terms of trawl fishing effort in the areas with juvenile crabs.

4.3.1.2.2.3 Scallops

Weathervane scallops are the only species caught in the commercial scallop fishery. Other species of scallops are small, found in near shore areas, and are not subject to directed fisheries or indirectly affected by other fisheries. Thus, the evaluation is based on the effects of the alternatives on weathervane scallops.

Stock Biomass – The weathervane scallop stock in Alaska is considered to be at biomass levels above MSST; the stock is not considered to be overfished, subject to overfishing, or approaching an overfished condition. The effects of the alternatives on stock biomass for weathervane scallops are measured in terms of changes in the catch of scallops.

Spatial/Temporal Concentration – Concentration of fishing effort in time and space could potentially alter the genetic diversity of a population through selective fishing (removal of certain spawning aggregations, for example). The effects on spatial/temporal concentration are measured in terms of changes in the distribution of the scallop fishery and its effects on fishing intensity on a given scallop bed. Figure 4.3-5 shows the recent distribution of scallop beds in Alaska.

Spawning/Breeding – Survey and fishery data have shown that scallops in localized areas increase and decrease in abundance with changes in year-class production. Thus, population abundance trends are dictated by recruitment, with interannual variability dependent upon environmental processes, which can

be affected by fishing. The effects of the alternatives on spawning and breeding for weathervane scallops are measured in terms of the effects on population biomass and on disturbance of settlement and nursery habitat caused by fishing.

Successful scallop recruitment depends upon high egg-fertilization rate, transport of spat to nursery areas, and survival to the adult stage. Scallop gametes are broadcast into the water and rely on currents to mix sperm and eggs. If males and females are not close together, the dilution of sperm can limit fertilization. Thus, spatial distribution is thought to be a critical component of spawning and breeding success of scallops (Stokesbury 2000, ADF&G 2000). Evaluation of the effects of alternatives thus considers the impacts on spatial distribution, which can be affected by total population size and catch removals. Indicators of potential effects on spatial distribution are changes in population biomass and fishing mortality.

Because scallops have limited mobility, scallop settlement generally occurs on substrates and in locations where adults are already found (Turk 2000). Thus the nursery areas are the same areas occupied by adults. These are also the areas where the directed scallop fisheries occur. The effects of the alternatives on nursery/settlement areas are evaluated based on total effort.

Feeding – Scallops are filter feeders. Successful feeding of scallops depends upon the concentration and quality of suspended food particles, particularly phytoplankton. Prey availability is dependent upon localized plankton blooms. Fishing activity can impact feeding of scallops through introduction of particles low in quality or organic content, thus diluting the naturally occurring nutritional particles (MacDonald 2000). More fishing activity by trawl or dredge gear could potentially introduce additional inorganic particulate matter that could negatively affect scallop feeding success or could introduce organic matter that can be beneficial. Therefore, the effects of the alternatives on feeding success of scallops are measured in terms of changes in trawl and dredge fishing effort.

Growth to Maturity – Growth to maturity is measured in terms of survival to maturity (which occurs at sizes smaller than legal size for commercial harvest). The consequences of fishing activities on scallop survival depend upon habitat alteration and gear-induced damage and mortality (Grant 2000). The effects of habitat alternation may be most dependent upon sediment resuspension and the potential for silting to increase mortality. Fisheries can cause shell damage to juvenile scallops and cause mortality even without capture by the dredge gear. Mortality of captured and subsequently discarded juvenile scallops is not thought to be common. The effects of the alternatives on the growth of scallops are thus measured in terms of scallop dredge fishing effort.

4.3.1.3 Economic and Socioeconomic Aspects of Federally Managed Fisheries

Appendix C, the Regulatory Impact Review/Initial Regulatory Flexibility Analysis (RIR/IRFA), provides a detailed analysis of the effects that proposed EFH fishing impact minimization alternatives may have on federally managed fisheries, including the fishing fleet, shoreside processors and support industries, communities, and regulatory and enforcement programs. The RIR contains an analysis of the potential benefits and costs attributable to, or deriving from, the alternatives. The IRFA builds on the RIR analysis, but takes a focused look at potential adverse impacts on several classes of "small entities" (as that term is defined by SBA guidelines) attributable to each of the proposed alternatives. The RIR, IRFA, and supporting text use the best available information and quantitative data, combined with accepted economic theory and practice, to provide the fullest possible assessment (both quantitative and qualitative) of the potential economic benefits and presumptive costs attributable to each alternative action. Based upon this analysis, conclusions are offered concerning the likely economic and

socioeconomic effects that may derive from each of the alternatives. This analytical approach is consistent with applicable policy and established practice for implementing Executive Order (EO) 12866.

These analyses are conducted from the point of view of all citizens of the United States (i.e., what is likely to be the net benefit to the nation?). The costs and benefits are not homogeneously distributed, and many of the costs are highly concentrated on particular fishing industry sectors, fishing communities, and sectors of the economy that support those portions of the industry. Therefore, the RIR/IRFA also reviews and evaluates, to the extent practicable, distributional issues and implications of the alternatives. Section C-3.9 of the RIR/IRFA summarizes all of these benefits, costs, and distributional impacts across all the alternatives.

The RIR/IRFA describes and analyzes a broad set of economic cost and benefit elements to illustrate the economic impacts of the alternatives. These elements include use and non-use benefits, gross revenue impacts, cost to the industry, and the distributional impacts of costs and benefits. The benefit elements considered in the RIR/IRFA include passive use (or non-use) benefits, use benefits (including non-consumptive use benefits, consumptive use benefits, as well as non-market benefits, and market benefits), and productivity benefits. The revenue impact elements considered in the RIR/IRFA include gross revenue at risk and revenue impacts related to changes in product quality. The industry cost elements considered in the RIR/IRFA include operating cost impacts, safety impacts, impacts to related fisheries, costs to consumers, and management and enforcement costs. The fleet distributional impact elements considered in the RIR/IRFA include gross revenue at risk effects by geographic area, fishery, and fleet component. See Appendix C for an explanation of each of these considerations, the criteria used to determine the effects of the alternatives, and the methodologies employed in the analysis. Table 4.3-6 lists the criteria used in this analysis to describe the effects of the alternatives on the economic and socioeconomic aspects of federally managed fisheries.

In some cases, this EIS characterizes potential economic and socioeconomic impacts with a somewhat higher degree of certainty than may be reflected in the analysis of biological, ecological, and environmental impacts. The reason for this difference is that substantial empirical experience and associated fishery economics data exist for a wide range of management measures affecting the EBS and GOA commercial fisheries, whereas knowledge is lacking and data gaps remain regarding a number of ecosystem variables and relationships. In all cases, the analyses are based upon the best available information.

Passive-use, Use, and Productivity Benefits

Attempts to minimize the adverse effects of fishing on EFH is predicated on the idea that such minimization provides ecosystem protection that translates into benefits to society (as a whole) and potentially to the fishing fleets. The RIR/IRFA (Appendix C) discusses three types of benefits: passive use benefits, use benefits, and productivity benefits.

The term "passive use value" implies that those who hold such values have no expectation of directly "using" this asset, in the normal sense of that term. However, whether referred to as passive-use, non-use, or existence value, the underlying premise is that individuals derive real benefit from the knowledge that relatively unique natural assets remain in a comparatively undisturbed state.

Use benefits are values associated with direct use of the resource. Among these use benefits are several additional categories: market and non-market, as well as consumptive and non-consumptive uses. Non-market/non-consumptive uses are, in general, associated with private recreation or leisure activities. The

typical example of such a use is bird watching; the user does not enter into a market transaction to acquire access of the resource (wild birds), nor does his or her use consume the resource. In the present context, it seems unlikely that non-market/non-consumptive values represent an important aspect of the aggregate benefit attributable to EFH off the coast of Alaska.

Non-market/consumptive uses may include, within the current context, authorized subsistence use of elements of EFH off the coast of Alaska. Some Alaska Native populations have retained the right to exploit the resources of EFH for customary and traditional subsistence activities. It is reported, for example, that subsistence users actively seek out and harvest black and red deep sea corals for use in the production of Native art. There may be other EFH resources from which subsistence users derive value through direct consumption. These extra-market consumptive uses represent a benefit that would be enhanced by EFH protective measures designed to minimize adverse impacts from commercial fishing gear. They are, therefore, appropriately listed among the gains society may expect from adoption of one or more of the alternatives to the status quo. It is not possible, given currently available information, to estimate the size or distribution of this category of benefits.

Market/non-consumptive uses comprise activities that involve a market transaction to acquire access to the resource, but do not involve consumption of the resource. Within the broader context of EFH located in other parts of the United States, an example of this use would be commercial dive services that take tourists out to scuba dive on coral reef formations. It is unlikely, given the geographic location and depth of most of the EFH identified with the subject action, that market/non-consumptive values represent a significant portion of the benefits deriving from this resource off the coast of Alaska.

Analogous market/consumptive uses (e.g., guided recreational spear fishing) are also unlikely to represent a significant element in the overall benefit accruing from protection and enhancement of EFH off Alaska, for many of the reasons just identified for market/non-consumptive uses. However, two associated classes of market/consumptive-use values may be identified in connection with measures to minimize the adverse effects of fishing on EFH off Alaska, including "opportunity reservation value" (future consumptive-use value)[1] and "production and yield of FMP and other species" (consumptive-use value).

Opportunity reservation value is a societal value distinct from traditional option value, the latter being an individually held form of future use value. In this instance, the value being defined may be regarded as a collective hedge against irreversible loss of some highly valuable good or service, flowing from EFH, that has not yet been recognized. That is, ecosystems such as those that comprise EFH are enormously complex and, as yet, not well understood. EFH may provide some future consumptive use benefit that is not currently used, or even identified. For example, minimization of the adverse impacts of fishing practices on EFH may preserve a species of plant or animal or an ecological process that, in the future, may prove to have irreplaceable, tangible value to the world's population. Such examples already exist. Specifically, marine sponges have yielded valuable medicinal compounds for use in anti-malaria and HIV infection suppression drugs (Bishop Museum 2000). At present, it is not known whether or how many of these potentially valuable species or functions exist and, therefore, it is not possible to place a monetary value on their future use. Retention of the option to exploit these public assets in the future clearly has some reservation value and argues for a precautionary management approach (i.e., erring on the side of preserving these assets).

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[1] See, also, the treatment of "Quasi option value" – the value of preserving a future option given an expectation of the growth of knowledge. In: Pearce, David W. and R. Kerry Turner, *Economics of Natural Resources and the Environment*, Johns Hopkins Press, 1990.

Production and yield of FMP and other species is another class of market/consumptive-use value considered here. The amended Magnuson-Stevens Act envisions that EFH conservation will lead to more robust fisheries, providing benefits to coastal communities and commercial and recreational fisheries alike. This assumes that minimizing damage to EFH from fishing practices will sustain or even increase the production and yield from FMP-managed species and other species important to the fishing industry in Alaska, as well as enhance the contribution of these species to a healthy ecosystem.

Current knowledge permits only a highly conditional evaluation of the effects of fishing on general classes of habitat features and allows only broad connections to be drawn between these features and the life history processes of some managed species. The level of effects on the stocks or potential yields of these species cannot be estimated with current knowledge. An expectation of substantial recoveries, directly attributable to implementation of measures to minimize the effects of fishing on EFH, would require the presence of a species with a clear habitat limitation and consequent poor stock condition. Alaska fisheries include no such clear cases. Therefore, no quantifiable or even qualitative measure of sustained or increased yield in production or biomass of FMP species is available for this analysis. That is, based upon currently available scientific data and understanding of these fishery and habitat resources, it is not possible to measure any economic benefits linked to the biological or ecological changes attributable to the proposed EFH action.

Gross Revenue Effects

Harvests, revenues, and costs associated with seafood and affiliated production may change for several reasons due to provisions of any of the proposed alternatives. These changes may include a price response from reduced fish supply caused by reduced harvest, harvest and revenue placed at risk due to closures, TAC reductions, and gear restrictions. The RIR/IRFA (Appendix C) examines each of these factors in detail and analyzes their potential to reduce revenues in affected fishing sectors.

Operating Cost Impacts

Any regulatory action that requires an operator to alter his or her fishing pattern is likely to impose additional operating costs. The fishing impact minimization alternatives would almost certainly affect the operating costs of the fishing fleets exploiting most of the marine resources of Alaska, compared to the status quo condition. The RIR/IRFA (Appendix C) address two classes of economic costs, fixed costs and variable costs. Fixed costs tend to arise from investment decisions and variable costs arise from short run production decisions. As the terms imply, fixed costs are those that do not change in the short run, no matter what the level of activity. Variable costs, on the other hand, are those costs that change directly with the level of activity, recognizing that variable inputs must be used if production exceeds zero. Fixed costs include such expenses as debt payments, the opportunity cost of the investment in the vessel (or plant), the cost of having the vessel or plant ready to participate in the fisheries, some insurance costs, property taxes, and depreciation. Following an action that negatively affects, for example, CPUE, TAC, or catch share, these fixed costs must be distributed across a smaller volume of product output, raising the average fixed cost per unit of production.

The reactions of fishing operations to EFH fishing impact minimization measures could include: 1) re-deploying fishing effort, using the same fishing gear and methods, to known adjacent fishing grounds that may be equally or only somewhat less productive (similar CPUE) than the fishing grounds lost to the EFH fishing impact minimization measure; 2) re-deploying fishing effort to an area of unknown production and operational potential, using the identical fishing gear, in an exploratory mode; 3) switching from a fishing gear that is prohibited to a fishing gear that is allowed within the EFH protection area; and 4) switching to a different target fishery in an area unaffected by EFH fishing impact minimization measures. Each of these strategies may have operational cost implications that affect the

variable cost structures of fishing operations. The RIR/IRFA (Appendix C) provides an analysis of these variable cost elements.

Costs to Consumers

Ultimately, fish are harvested, processed, and delivered to market because consumers place a value on the fish that is over and above what the consumers have to pay to buy them. A person who buys something would often have been willing to pay more than they actually did for the good. The difference between what they would have been willing to pay and what they had to pay is treated by economists as an approximation of the consumer's surplus value of the good and as one component of its social value. If the price of the good rises, the size of this benefit would be reduced, all else being equal. If the amount of the good available for consumption is reduced, the size of this benefit is also reduced. Provisions of the proposed EFH actions could reduce the value consumers receive from the fisheries for several reasons, including: 1) consumers may be supplied fewer fish products; 2) consumers may have to pay a higher price for the products they do consume; and 3) the quality of fish supplied by the fishing industry may be reduced and, thus, the value consumers place on (and receive from) them would decline. The RIR/IRFA (Appendix C) provides an analysis of the effects of EFH alternatives on costs to consumers.

Safety

There is the potential that the EFH fishing impact minimization measures may have effects on vessel safety in several ways. These include actions that may force the fleet to fish farther from shore, may reduce profitability for some fleet components, and could affect the operators' relative willingness to assume risk. Changes in fishery management regulations that result in vessels, particularly smaller vessels, operating farther offshore, could increase the risk of property loss, injury to crew members, and loss of life. EFH fishing impact minimization measures that close nearshore areas to fishing operations could compel vessel operators to choose between assuming these increased risks or exiting these fisheries entirely. Weather and ocean conditions, especially in the EBS, but also in the GOA, are among the most extreme in the world. The region is remote, sparsely populated, with relatively few developed ports, and the commercial fisheries are conducted over vast geographic areas. While many vessels in these fisheries are large and technologically sophisticated, many more are relatively small vessels with limited operational ranges. The RIR/IRFA (Appendix C) provides an analysis of several factors affecting safety and evaluates the effects of EFH alternatives on safety.

Impacts on Related Fisheries

Direct changes to a fishery, induced by fishing impact minimization measures, could have indirect and unanticipated impacts on other fisheries beyond the gear conflict issue addressed earlier. Some of these impacts could impose (perhaps substantial) costs on these other fisheries. The following costs have been considered in this RIR: displacing capacity and effort, compression/overlapping of fishing seasons, and increased costs of gearing up and standing down.

Costs to Consumers

Ultimately, fish are harvested, processed, and delivered to market because consumers place a value on the fish that is over and above what they actually have to pay to buy them. A person who buys something would often have been willing to pay more than they actually did for the goods. The difference between what they would have been willing to pay and what they had to pay is treated, by economists, as an approximation of the value of the goods or services to consumers (i.e., consumer's surplus) and as one component of its social value. If the price of the goods rises, the size of this benefit will be reduced, all else equal. If the amount of the goods available for consumption is reduced, the size of this benefit is also reduced. Provisions of the proposed EFH actions could reduce the value consumers of seafood (and associated fish products) receive from the fisheries for several reasons, including 1) consumers may be

supplied with fewer fish products; 2) consumers may have to pay a higher price for the products they do consume; and 3) the quality of fish supplied by the fishing industry may be reduced, and, thus, the value consumers place on (and receive from) them will decline. The RIR/IRFA (Appendix C) analyzes the EFH fishing impact minimization alternatives for potential impacts on costs to consumers.

Management and Enforcement Costs

In terms of both management and enforcement costs, NMFS anticipates that all of the EFH protection measure alternatives (with the exception of Alternative 1, Status Quo) would 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.

United States Coast Guard (Coast Guard) input to the EFH RIR (Appendix C) seeks to clarify the expected enforcement costs (i.e., tradeoffs) of the various fishery impact minimization alternatives, found within the proposed EFH action, relative to each other. On the basis of the proposed alternatives, as specified in the EFH fishing impact minimization action, the Coast Guard has provided an enforcement resource intensity ranking with regard to complexity and cost of enforcement. In addition to this information, the RIR (Appendix C) provides a discussion of potential changes in VMS and observer costs.

Socioeconomic Effects on Fishing Communities

Many of the coastal communities adjacent to the EBS 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 CDQ communities 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 EBS and/or GOA fisheries. In addition, Seattle, Washington, and the adjacent Puget Sound area have 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.

Communities engaged in and/or dependent upon Alaska fisheries span a large portion of coastal Alaska and the Pacific Northwest. These regions vary considerably in their socioeconomic structure and include communities of widely varying scales from small, relatively isolated Alaska Native villages to the greater Seattle metropolitan area. The specific geographic footprint of engagement with or dependence upon commercial fishing varies by the specific fishery involved. For example, many communities are engaged in the groundfish fisheries, while the scallop fishery involves few communities in a relatively small area. The RIR/IRFA (Appendix C) analyzes the EFH fishery impact minimization alternatives for potential adverse effects on the economy of coastal communities.

4.3.1.4 Other Fisheries and Fishery Resources

4.3.1.4.1 State-managed Groundfish Fisheries

"Whereas fisheries in the EEZ from 3 to 200 nm fall under federal authority by virtue of the MSFCMA, the State of Alaska has management authority for fishery resources within state territorial (0 to 3 nm) waters by virtue of the Submerged Lands Act (1953) and further recognized by the MSFCMA. For most groundfish fisheries, ADF&G issues emergency orders (EOs) for state waters that duplicate all NMFS groundfish fishery management actions. These EOs establish parallel fishing seasons such that vessels may fish for groundfish in either state or federal waters. In some other instances, the State of Alaska establishes separate catch quotas, termed GHLs in state management, and fishing seasons under state groundfish FMPs" (Kruse et al. 2000). The EFH fishing impact minimization alternatives 4, 5A, 5B, and 6, which include management of inside waters, also include an assumption that the State of Alaska would adopt similar mitigation measures for parallel fisheries which occur concurrently in state and federal waters.

As was discussed in Chapter 3, ADF&G manages GHL fisheries for walleye pollock, Pacific cod, sablefish, lingcod, and rockfish species inside state waters, lingcod and black and blue rockfishes throughout the EEZ, and demersal shelf rockfishes in the eastern GOA. Harvests from these fisheries are presented in tables in Chapter 3.

Current habitat protection measures include the closure of most state waters to nonpelagic trawling in the GOA, as well as many smaller closures to commercial harvest to protect spawning areas and other important habitat on a species-specific basis. Please refer to "An Inventory of Marine Managed Areas in Alaska" for more information on specific state-managed fisheries restrictions.

The Prince William Sound pollock fishery is conducted inside state waters, which are mostly closed to bottom trawl and also have pelagic trawl restrictions. The state-managed Pacific cod fisheries and sablefish and rockfish fisheries in the GOA occur inside state waters. Black rockfish are nearshore pelagic rockfish and are harvested near Kodiak, Chignik, and on the south Alaska peninsula. Lingcod are generally found nearshore and harvested in the EGOA, Prince William Sound, Cook Inlet, and Kodiak areas. Demersal shelf rockfish in the EGOA are managed by ADF&G in waters that are currently closed to bottom trawling. Most of the alternatives would likely have no effect on these fisheries.

The EFH fishing impact minimization alternatives are evaluated in the following sections in terms of potential changes in catch and/or biomass of these state-managed groundfish species, as well as effects to the fleet. The criteria for evaluating the effects of alternatives on other fisheries and fishery resources are listed in Table 4.3-7.

4.3.1.4.2 State-managed Crab and Invertebrate Fisheries

As was discussed in Chapter 3, ADF&G manages king, snow, and Tanner crab fisheries under federal FMPs in the EBS and AI. Please refer to the section on effects of other target species for a discussion of the effects of mitigation alternatives on FMP crab species. ADF&G also manages a Korean hair crab fishery in the EBS and Dungeness crab fisheries and all other crab species in the GOA. Harvests from these fisheries are presented in Chapter 3. Korean hair crabs are harvested around the Pribilof Islands, and Dungeness crabs are harvested around Kodiak, in the EGOA, and intermittently in the AI. In recent years, most Tanner and king crab fisheries in the GOA have been closed because of low abundance trends. Other stocks such as grooved and triangle Tanner crab are small and do not typically attract

commercial interest (Kruse et al. 2000). ADF&G also manages dive fisheries for sea cucumbers near Kodiak and sea cucumbers, geoducks, and sea urchins in southeast Alaska.

Current habitat protection measures include the closure of most state waters to nonpelagic trawling in the GOA, as well as many smaller closures to commercial harvest to protect spawning areas and other important habitat on a species-specific basis. Please refer to "An Inventory of Marine Managed Areas in Alaska" for more information on specific fisheries restrictions. The EFH fishing impact minimization alternatives are evaluated in Section 4.3.2 in terms of potential changes in catch and/or biomass of these state-managed crab species, as well as effects to the fleet.

4.3.1.4.3 Herring Fisheries

As was discussed in Section 3.4.2.4, ADF&G manages 25 fisheries for herring, including roe, food and bait, and spawn on kelp. Harvests from these fisheries are presented in tables in Chapter 3.

Current habitat protection measures include small closures to commercial harvest of herring to protect spawning areas and other important habitat. Additionally, herring bycatch limitation zones were adopted as Amendment 16A on July 12, 1991, to constrain herring bycatch in the EBS groundfish fisheries. The bycatch areas are seasonal closures that mimic the herring migration route in the EBS (Funk 1991). These zones are triggered when a cap of 1 percent of herring spawning biomass between Port Moller and Norton Sound is attained in any groundfish fishery. Most herring bycatch occurs in the pollock pelagic trawl fishery (pers. com., Funk). The EFH fishing impact minimization alternatives are evaluated in the following sections in terms of potential changes in catch and/or biomass of herring, as well as effects to the fleet.

4.3.1.4.4 Halibut Fisheries

The Alaska halibut fisheries are discussed in Chapter 3. As all of the alternatives except Alternative 6 do not restrict hook and line gear, they are likely to have no effect on directed halibut fisheries. Bycatch of halibut can constrain groundfish fisheries in the EBS and GOA, and current mechanisms in place to control halibut bycatch are discussed in that section.

4.3.1.5 Protected Species

Marine mammals, seabirds, and ESA-listed species of Pacific salmon and steelhead are considered protected resources because either they are listed as endangered or threatened under the Endangered Species Act (ESA), they are marine mammals protected under the Marine Mammal Protection Act (MMPA), they are candidates or being considered as candidates for ESA listing, their populations are declining in a manner of concern to state or federal agencies, they have experienced large bycatch or other mortality related to fishing activities, or they are believed to be particularly vulnerable to direct or indirect adverse effects from some fishing activities. These species have various levels of protection under the Council's FMPs and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts.

The proposed alternatives for minimizing the effects of fishing on EFH may affect protected species in various ways. Wilson (2003) discusses how groundfish fisheries may interact with marine mammals, seabirds, and listed salmon or steelhead, and provides the basis for criteria used to assess the impacts of the various EFH alternatives. The criteria for determining effects were developed based on known interactions of protected species with commercial fisheries in the North Pacific. Wilson (2003) divides

the protected species into five major groups: ESA-listed marine mammals (Steller sea lions and ESA-listed whales), other marine mammals (other cetaceans, northern fur seals, harbor seals, other pinnipeds, and sea otters), ESA-listed Pacific salmon and steelhead, ESA-listed seabirds (short-tailed albatross and other ESA-listed seabirds), and other seabirds (fulmars, other albatrosses and shearwaters, red-legged kittiwakes and Kittlitz's murrelets, and other piscivorous and non-piscivorous seabirds).

Table 4.3-8 outlines the criteria used for describing the effects of the fishing impact minimization alternatives on the five major categories of protected species listed above. In general, the analysis focuses on the degree of fishery overlap with a protected species population and the potential intensity of fishing activities in protected species habitat, particularly when a species may be concentrated in a geographic area.

4.3.1.6 Ecosystems

The alternatives are analyzed with respect to various ecosystem-level measures that might indicate the impacts of the alternatives from a broader ecological viewpoint. A review of ecosystem-based fishery management measures implemented for Alaska groundfish fisheries can be found in Witherell et al. (2000). An evaluation of how well the status quo management regime achieves ecosystem-based management objectives is contained in the draft programmatic groundfish SEIS (NMFS 2001a).

For each alternative, the possible impacts are addressed regarding the following: 1) predator-prey relationships, including introduction of nonnative species; 2) energy flow and redirection (through fishing removals and return of discards to the sea); and 3) biodiversity. Changes seen in the indicators for each alternative were determined to have positive effects, negative effects, no effect, or unknown effects on the ecosystem. In most cases, the predicted changes are estimated qualitatively. Table 4.3-9 lists the effects and criteria used for evaluating the environmental impacts to the ecosystem.

<u>Effects on Predator-Prey Relationships</u>
Fisheries can remove predators, prey, or competitors and thus alter predator-prey relationships relative to an unfished system. Studies from other ecosystems have been conducted to determine whether predators were controlling prey populations and whether fishing down predators produced a corresponding increase in prey. Similarly, the examination of fishing effects on prey populations has been conducted to evaluate impacts on predators. Finally, fishing down of competitors has the potential to produce species replacements in trophic guilds (see reviews of all these effects in Hall [1999]). Evidence from other ecosystems presents mixed results about the possible importance of fishing in causing population changes of the fished species' prey, predators, or competitors. Some studies showed a relationship, while others showed that the changes were more likely due to direct environmental influences on the prey, predator, or competitor species rather than a food web effect. Fishing has the potential to impact food webs, but each ecosystem must be examined to determine how important it is for that ecosystem. A review of fishing impacts to marine ecosystems and food webs of the North Pacific under the status quo and other alternative management regimes was provided in the draft programmatic groundfish SEIS (NMFS 2001a).

Fishing can selectively remove fish-eating predators then move down the food web and begin removing the next trophic level down, such as plankton-feeding fish. This process is known as fishing down the food web (Pauly et al. 1998). Trophic level of the fish and invertebrate catch from the EBS, and GOA was estimated from the 1960s to the present (Queirolo et al. 1995, Livingston et al. 1999) to determine whether such effects were occurring. Trophic level of the catch in all three areas has been relatively high and stable over the last 30 or more years.

Fishing vessels and vessels supporting fishing operations have the potential to disrupt predator-prey relationships through the introduction of nonindigenous species. These introductions occur when ship ballast water containing live organisms is obtained outside a region and is released into fishery management areas. Vessels also have organisms fouling their hulls that can be transported between regions. These organisms have the potential to cause large alterations in species composition and dominance in ecosystems (Carlton 1996).

Effects on Energy Flow and Balance

Fishing may alter the amount and flow of energy in an ecosystem by removing energy and altering energetic pathways through the return of discards and fish processing offal back into the sea. The recipients, locations, and forms of this returned biomass may differ from those in an unfished system. A mass-balance model of the EBS (Trites et al. 1999) provides some information on fishing removals relative to total system production and the distribution of biomass and energy flow throughout the system in recent times. The trophic pyramids (distribution of biomass at various trophic levels) indicate that biomass and energy flow are distributed fairly well throughout the system (Trites et al. 1999, p. 28 of 100). These show that the EBS is a more mature system compared to other shelf systems. A more mature system is one that is less disturbed (Odum 1985). Total catch biomass (including non-groundfish removals) as a percentage of total system biomass (excluding dead organic material, known as detritus) was estimated to be 1 percent, a small proportion of total system biomass. Fishery removal rates are based in the most basic sense on the amount of surplus production (the excess of reproduction and growth over natural mortality) (Hilborn and Walters 1992) for fish stocks. Because there is great variability among stocks with regard to the amount of this excess production, it is likely more important that removals stay within the bounds of each individual stock's excess production (a topic that is considered in the individual stock impacts sections). From an ecosystem point of view, total fishing removals are a small proportion of the total system energy budget and are small relative to internal sources of interannual variability in production.

Fisheries can redirect energy in the system by discarding and returning fish processing wastes to the system. These practices take energy and potentially provide them to different parts of the ecosystem relative to the natural state. For example, discards of dead flatfish or small benthic invertebrates might be consumed at the surface by scavenging birds, which would normally not have access to those energy sources. An analysis of the importance of these fisheries practices on the EBS and GOA ecosystems was conducted by Queirolo et al. (1995), before the improved retention requirements for pollock and cod were mandated. Total offal and discard production at that time was estimated at only 1 percent of the unused detritus already going to the bottom. No scavenger population increases were noted that related to changes in discard or offal production amounts. The annual consumptive capacity of scavenging birds, groundfish, and crab in the EBS was determined to be over ten times larger than the total amount of offal and discards in the EBS and GOA.

Effects on Biological Diversity

Fishing can alter different measures of diversity. Species level diversity, or the number of species, can be altered if fishing removes a species from the system. Fishing can alter functional or trophic diversity if it selectively removes a trophic guild member and changes the way biomass is distributed within a trophic guild. Fishing can alter genetic level diversity by selectively removing faster growing fish or removing spawning aggregations that might have different genetic characteristics than other spawning aggregations. Large, old fishes may be more heterozygous (i.e., have more genetic differences or diversity) and some stock structures may have a genetic component (see review in Jennings and Kaiser [1998]), thus one would expect a decline in genetic diversity due to heavy exploitation.

The scientific literature on diversity is somewhat mixed about what changes might be expected due to a stressor. Odum (1985) asserts that species diversity (number of species) would decrease and dominance (the degree to which a particular species dominated in terms of numbers or biomass in the system) would increase if original diversity was high, while the reverse might occur if original diversity was low. Genetic diversity can also be altered by humans through selective fishing (removal of faster growing individuals or certain spawning aggregations). Accidental releases of cultured fish and ocean ranching tends to reduce genetic diversity (Boehlert 1996). More recently, there is growing agreement that functional (trophic) diversity might be the key attribute that lends ecosystem stability (see review by Hanski [1997]). This type of diversity ensures there are sufficient number of species that perform the same function, so that if one species declines for any reason (human or climate-induced), then other species can maintain that particular ecosystem function, and less variability would occur in ecosystem processes. However, measures of diversity are subject to bias and how much change in diversity is acceptable is not really known (Murawski 2000).

Localized extinctions due to fishing are rare but some evidence exists that this may have occurred to some skate species in areas of the North Atlantic (see review in Greenstreet and Rogers [2000]). These extinctions could be thought of as a decrease in species level diversity or the actual number of species in an area. Elasmobranchs such as shark, skate, and ray species may be vulnerable to fishing removals and direct impacts. No fishing induced extinctions have been documented for any fish species in Alaska during the last 30 years or so. Taxonomic work on some fish species (e.g., skates) is ongoing, and minimal survey and systematic work is being done on other ecosystem components, such as benthic invertebrates, which could be impacted by fishing activities.

Diversity may not be a sensitive indicator of fishing effects (Livingston et al. 1999, Jennings and Reynolds 2000). Studies of other more heavily fished systems, such as the North Sea, Georges Bank, or Gulf of Thailand have shown declines in diversity (Hall 1999, Jennings and Reynolds 2000) related to fishing, and the diversity declines were due to direct mortality of target species. Genetic assessment of pollock populations and subpopulations in the North Pacific shows some genetic differences among stocks but has not demonstrated any genetic variability across time within stocks that might indicate fishing influences (Bailey et al. 1999).

4.3.2 Effects of Alternative 1

4.3.2.1 Effects of Alternative 1 on Habitat

Effects on Prey Species (Ø) – The long-term effect indices (LEI) for Alternative 1 were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make them relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in the center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Benthic Biodiversity (Ø) – Hard corals had the highest LEI values. Because of the very slow recovery rate of these organisms, the LEI values directly reflect the proportion of each habitat type subject to more than the most minimal amount of trawl fishing (annual trawl effort less than one tenth the area in the block). The values range from 6 to 20 percent with the highest values in the shallow AI and the GOA slope. High and low estimates were not as variable as for the other biological substrate organisms, ranging from plus 40 percent to minus 33 percent of the central value. While the general class of biological structure can be assumed to occur in all blocks studied, hard corals have a much more

limited distribution. Many of the blocks where the analysis indicates the potential for coral reduction may never have contained coral. Also, as described in Section 4.3.1.1, small-scale (within blocks) patchiness of coral presence and fishing are likely to affect the accuracy of these results. Therefore, the raw LEIs should not be taken at face value, particularly in habitat areas where coral is not common. Hard corals are most abundant in the Aleutian deep habitat type, with some also found in shallower areas of the AI and in the GOA.

Effects on Habitat Complexity (Ø) – Long-term reductions in structure-forming habitat features were not different from status quo for any of the habitat types or features examined in the fishing effects analysis, and hence this issue receives a no effect rating for Alternative 1. LEI values for non-living structure were all less than 5 percent, as were the biological structure values for most soft bottom habitat types. Higher LEI values were indicated for biological structure in the hard bottom areas of the two deeper Gulf and the shallow Aleutian habitats and the highest (11 percent) effects were in the sand/mud and slope habitats of the EBS. Because some of the input parameters, particularly the recovery rate of these organisms, are not well established, the analysis was run with sets of more conservative and more optimistic values. These runs indicated that LEI values could plausibly be one quarter to two and a half times the central estimates. Effects, primarily determined by the fishing distribution, were not evenly distributed across any of the habitat types. All habitat types included substantial unfished and lightly fished areas and some areas of high (more than 50 percent or even more than 75 percent) LEIs. In the AI and GOA, and on the EBS slope, effects were primarily concentrated into many small, discrete pockets. On the EBS shelf, there were two larger areas where high-effect values were concentrated: 1) an area of sand/mud habitat between Bristol Bay and the Pribilof Islands and 2) an area of sand habitat north of Unimak Island and Unimak Pass mostly inside of the 100-m contour. These areas have been fished long enough that the current state of habitat features likely reflects reductions similar to those expected at equilibrium.

Future protection of hard corals is related to the area fully closed to bottom trawl fishing, which is both potential coral habitat and has not been subject to moderate or heavy trawling. Current regulations close 0 percent of the deep Aleutian habitat type, 4 percent of the shallow AI, and 19 percent of the GOA slope to all bottom trawling. These closures are unchanged under Alterative 1 leading to a no effect rating for this aspect of EFH.

4.3.2.2 Effects of Alternative 1 on Target Species

4.3.2.2.1 Effects on Groundfish

4.3.2.2.1.1 Walleye Pollock (EBS and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the EBS, distinct stocks are recognized for the AI, the EBS, and the central Bering Sea. In the western central GOA, the acceptable biological catch (ABC) is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, western-central Gulf of Alaska (WCGOA) and southeast Gulf of Alaska (SeGOA) pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – Biomass of walleye pollock in the EBS and WCGOA is determined from bottom trawl and acoustic mid-water surveys of the GOA. The 2003 exploitable biomass for the four stocks are: SeGOA 28,709t, WCGOA 699,120t, EBS 11,100,000 t, and AI 175,000 t. Age-structured population models exist for the EBS and WCGOA stocks, and a preliminary model has been developed for the AI population. Estimates of stock status are possible for the EBS and WCGOA stocks. These estimates show the EBS and WCGOA stocks are not overfished and are not approaching an overfished condition. Directed fishing is not allowed on the AI pollock population. Directed fishing for pollock does not occur in southeast Alaska because bottom trawling is prohibited. ABCs and OFLs are estimated for the EBS, WCGOA, and SeGOA stocks following Amendment 56. The EBS population is managed in tier 1, the WCGOA population is managed in tier 3, and the SeGOA population is managed in tier 5.

As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and WCGOA pollock stocks are projected to remain above their respective MSSTs under the current fishery management regime. By definition, no substantial changes in walleye pollock fishing mortality would be expected as a result of adopting Alternative 1. Because status determinations show the EBS and WCGOA stocks are not overfished or approaching an overfished condition, the effect of Alternative 1 on these stocks is considered insignificant. Because the status of the AI and southeast GOA pollock stocks is unknown, the effect of Alternative 1 on stock biomass is unknown. However, given that Alternative 1 sets a bycatch-only restriction on pollock in the AI and directed fisheries for pollock do not occur in southeast Alaska, it is likely that the impact of Alternative 1 on pollock biomass is insignificant.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – The present management regime for partitioning the catch of walleye pollock in Alaskan waters disperses catch in time and space. The spatial temporal impacts of Alternative 1 on EFH do not appear to be impacting the productivity of walleye pollock in the GOA or EBS. Genetic studies reveal a considerable mixing across large geographic regions. Based on these findings, the impact of Alternative 1 is considered insignificant.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – Because of their abundance and potential impact on the ecosystem, a number of programs have focused research on the reproductive biology of walleye pollock. These programs revealed that pollock eggs are released at depth and migrate upwards in the water column through development. Larvae are pelagic and subject to considerable drift. At age 1, pollock are found in both the pelagic zone and on the bottom. Juveniles (ages 2 to 3) form mid-water layers. The commercial fleet uses mesh that allows for escapement of juvenile fish. Mid-water trawls could injure juvenile pollock moving through the net. However, the magnitude of this mortality is not sufficient to reduce the stocks capacity to avoid an overfished condition. The impact of Alternative 1 on the habitat required for reproduction of walleye pollock is insignificant.

Feeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – The major prey of adult walleye pollock are euphausiids and forage fish (Yang 1993). As euphausiids and forage fish are pelagic rather than benthic in their distribution and are too small to be retained by fishing gear, the status quo Alternative 1 is unlikely to have a significant effect on the availability of prey to walleye pollock.

Growth to Maturity (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was previously discussed, walleye pollock are pelagic during their early life history. Pollock are capable of rapid expansion into new niches. This type of life history makes this species particularly adept at expanding into niches resulting from disturbance. Factors that reduce the incidence of disturbance may reduce the expansion of pollock

stocks. The importance of disturbance relative to the ability of the stock to maintain itself above minimum stock size thresholds is uncertain. In the case of EBS and GOA pollock, the stocks are not overfished or approaching an overfished condition, therefore, the impact of the alternative on these stocks is considered insignificant. The impact of Alternative 1 on AI and SeGOA pollock is unknown.

4.3.2.2.1.2 Pacific Cod (EBS and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. By definition, no substantial changes in Pacific cod fishing mortality would be expected as a result of adopting Alternative 1.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or GOA Pacific cod populations that materially impact either stock's ability to maintain itself at or above its respective MSST. By definition, no substantial changes in spatial-temporal concentration of the Pacific cod catch would be expected as a result of adopting Alternative 1.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. By definition, no substantial changes in the process of spawning and breeding would be expected as a result of adopting Alternative 1.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. By definition, no substantial changes in the process of feeding would be expected as a result of adopting Alternative 1.

Growth to Maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. By definition, no substantial changes in the process of growth to maturity would be expected as a result of adopting Alternative 1.

4.3.2.2.1.3 Sablefish (EBS and GOA)

Stock Biomass (Ø) – Sablefish biomass is estimated using an age-structured model from abundance indices and age and length data from longline surveys and the longline fishery, catch data from the longline and trawl fisheries, and independent estimates of growth, maturity, and sex ratio (Sigler 1999). The current exploitable biomass estimate (2002) is 210,000 mt. The EBS/GOA sablefish stock is not overfished. This stock is near target biomass. Management takes into account all catch and bycatch when setting annual harvest levels. Alaska sablefish abundance now appears moderate and increased from recent lows. Projected 2003 spawning biomass is 39 percent of unfished spawning biomass, having been as low as 35 percent during 1998 to 2000. The increase confirms the projection from last year's assessment that abundance would increase due to the above average 1997 year class. The 1997 year class is an important part of the total biomass and is projected to account for 24 percent of 2003

spawning biomass. The 1998 year class is also likely to be above average. Whether sablefish abundance falls after the 2003 peak depends on the actual strength of the 1998 year class.

Spatial/Temporal Concentration of the Catch (Ø) – Sablefish fishing occurs along the upper continental slope and deepwater gullies. The Alaska-wide quota is apportioned into six areas (EBS, AI, western GOA, central GOA, West Yakutat, East Yakutat/Southeast). The apportionment is based on the biomass in each area so that the exploitation rates among areas are similar. The fishery is managed as an IFQ fishery, which allows fishermen to catch their quota anytime during the 8-1/2 month season. Catches are spread out throughout the season, although proportionately more of the fish typically are caught during spring.

Spawning/Breeding (Ø) – Sablefish currently are sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 1 on sablefish spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat. Although sablefish do not appear substantially dependent on physical structure, all structure (biological, nonliving, coral) on the GOA slope is substantially reduced for Alternative 1 (5 to 20 percent). In areas where sablefish are concentrated, biological structure is reduced up to 66 percent (EBS sand/mud), nonliving structure up to 17 percent (AI shallow), and coral up to 56 percent (AI shallow). Coral is the habitat most consistently affected, with substantial decreases in all habitats where sablefish are concentrated in the GOA and AI (29 to 56 percent).

Feeding (Ø) – Sablefish currently are sustaining themselves above MSST. Based on this criteria, fishing effects of Alternative 1 on sablefish feeding are insignificant. Long-term effects on benthic prey are estimated to be small for Alternative 1. However caution is warranted. Trawling can physically impact the bottom and sablefish are substantially dependent on benthic prey, so that sablefish feeding may be adversely impacted by essential prey availability, especially for sand/mud habitat in the EBS. Although sablefish do not appear substantially dependent on physical structure, all structure (biological, nonliving, coral) is substantially reduced for Alternative 1 (see spawning and breeding section).

Growth to Maturity (Ø) – Sablefish currently are sustaining themselves above MSST. Based on this criterion, fishing effects of Alternative 1 on sablefish growth to maturity are insignificant. However caution is warranted. Our understanding of the habitat requirements for growth to maturity and possible fishing effects on that habitat is incomplete. Although sablefish do not appear substantially dependent on physical structure, all structure (biological, nonliving, coral) is substantially reduced for Alternative 1 (see spawning and breeding section). Other anthropogenic effects besides fishing, such as coastal development, may impact juvenile sablefish habitat. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may reduce juvenile survivorship and are a particular concern in areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity is high.

The fishing effects of Alternative 1 on the habitat of sablefish are insignificant, based on the criteria that sablefish currently are above MSST. However caution is warranted. Sablefish are substantially dependent on benthic prey, which may be adversely affected by fishing. Little is known about sablefish spawning habitat and effects of fishing on that habitat. Habitat requirements for growth to maturity are better known, but this knowledge is incomplete. Although sablefish do not appear substantially dependent on physical structure, all structure (biological, nonliving, coral) on the GOA slope is substantially reduced for Alternative 1 (5 to 20 percent). In areas where sablefish are concentrated, biological structure is reduced up to 66 percent (EBS sand/mud), nonliving structure up to 17 percent (AI shallow), and coral up to 56 percent (AI shallow). Coral is the habitat most consistently affected,

with substantial decreases in all habitats where sablefish are concentrated in the GOA and AI (29 to 56 percent). Other anthropogenic effects besides fishing, such as coastal development, may impact juvenile sablefish habitat. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may reduce juvenile survivorship and are a particular concern in areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity is high.

4.3.2.2.1.4 Atka Mackerel (EBS and GOA)

Stock Biomass (Ø) – AI Atka mackerel biomass is derived from bottom trawl surveys and an age-structured model. The current stock assessment determined that the EBS Atka mackerel stock is above its MSST (Lowe et al. 2002). Also, the PSEIS (NMFS 2001a) showed that the effects of fishing under the current fishery regime on the Atka mackerel stock did not jeopardize the ability of the stock to maintain itself at or above its MSST in the short term. Although the biomass and MSST for GOA Atka mackerel is unknown, there is no directed fishery for Atka mackerel in the GOA. Therefore, it can be reasonably assumed that the impacts of Alternative 1 are negligible given the same criteria, and the rating for stock biomass for Atka mackerel is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – The directed fishery for Atka mackerel is prosecuted by catcher-processor bottom trawlers. The patterns of the fishery generally reflect the behavior of the species in that the fishery is highly localized, occurring in the same few locations each year, at depths that typically range between 100 and 200 m. The localized pattern of fishing for Atka mackerel apparently does not affect fishing success from 1 year to the next since local populations in the AI appear to be replenished by immigration and recruitment. In addition, management measures are in place that have the effect of spreading out the harvest in time and space. The overall EBS TAC is allocated to three management areas (western, central, and EBS/eastern AI). The regional TACs are further allocated to two seasons and there are limits to the amount of catch that can be taken inside of Steller sea lion critical habitat. Because Steller sea lion critical habitat overlaps significantly with Atka mackerel habitat, these measures provide protection to Atka mackerel by reducing the risk of localized depletion through effort limitations and reductions. There is no directed fishery for Atka mackerel in the GOA. The spatial/temporal concentration of the catch under Alternative 1 is not likely to affect the sustainability of the stock through changes in the genetic structure of the population, and the rating is no effect.

Spawning/Breeding (Ø) – Spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The directed fishery generally occurs at depths greater than 100 m in the AI, and there is assumed to be little or no overlap with Atka mackerel nesting grounds.

The current stock assessment determined that the EBS Atka mackerel stock is above it MSST (Lowe et al. 2002). Also, the PSEIS (NMFS 2001a) showed that the effects of fishing under the current fishery regime on the Atka mackerel stock did not jeopardize the ability of the stock to maintain itself at or above its MSST in the short term. There is no directed fishery for Atka mackerel in the GOA that would impact the spawning and breeding of Atka mackerel. Therefore, it can be reasonably assumed that the impacts of Alternative 1 relative to status quo are negligible given the same criteria, and the rating for spawning and breeding is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods, which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than

benthic in their distribution, and they are so small that they are not retained by any fishing gear, therefore, Alternative 1 probably has little or no impact on the availability of prey to adult Atka mackerel, and the rating for feeding is no effect.

Growth to Maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The fishery overlaps with late juvenile/mature adult habitat at depths of generally less than 200 m.

The current stock assessment determined that the EBS Atka mackerel stock is above its MSST (Lowe et al. 2002). Also, the PSEIS (2003) showed that the effects of fishing under the current fishery regime on the Atka mackerel stock did not jeopardize the ability of the stock to maintain itself at or above its MSST in the short term. Although the MSST for GOA Atka mackerel is unknown, there is no directed fishery for GOA Atka mackerel. Therefore, it can be reasonably assumed that the impacts of Alternative 1 are negligible given the same criteria, and the rating for growth to maturity is no effect.

4.3.2.2.1.5 Yellowfin Sole (EBS)

Stock Biomass (Ø) – The EBS yellowfin sole female spawning biomass was estimated to be well above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Nichol 2002).

Spatial/Temporal Concentration of the Catch (Ø) – EBS yellowfin sole are lightly exploited with the ABC annually set below the TAC. Targeting on yellowfin sole generally occurs throughout the year, primarily on the middle portion of the EBS shelf although some harvest has occurred on spawning concentrations in the vicinity of the Togiak area. Yellowfin sole are also retained in catches where they are caught in pursuit of other species, usually Pacific cod or other flatfish species. EBS yellowfin sole are managed as a single stock. Since the harvest is characterized as light exploitation spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are pelagic and spawning occurs in nearshore areas; it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact on EFH has had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs on benthic infauna during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, bivalves, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact on EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, yellowfin sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods,

other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.6 Greenland Turbot (EBS)

Stock Biomass (Ø) – The EBS Greenland turbot female spawning biomass was estimated above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Ianelli et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – EBS Greenland turbot are lightly exploited with the ABC annually set below the TAC due to concerns regarding perceived values of low recruitment. Greenland turbot harvest generally occurs throughout the year by both longline and trawl operations operating on the continental slope. Greenland turbot are commonly retained in catches where they are mostly caught in pursuit of sablefish. EBS Greenland turbot are managed as a single stock. Since the harvest is characterized as light exploitation spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are pelagic and spawning occurs at deeper areas of the continental shelf, it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact on EFH has had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding on pollock, squid, and deep water fish species primarily occurs during summer throughout the deep slope waters and to a lesser extent on the upper slope/shelf margins. Most of the Greenland turbot feeding behavior is observed to take place off bottom and is not related to the benthic food availability.

Growth to Maturity (Ø) – Within the first year of life, Greenland turbot metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing impact to EFH on survival and growth to maturity.

4.3.2.2.1.7 Arrowtooth Flounder (EBS and GOA)

Stock Biomass (Ø) – The GOA and EBS arrowtooth flounder female spawning biomass was estimated to be well above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Wilderbuer and Sample 1997).

Spatial/Temporal Concentration of the Catch (Ø) – GOA arrowtooth flounder are lightly exploited with the ABC annually set below the TAC. Arrowtooth flounder harvest generally occurs throughout the year and ranges from the mid-shelf area to the upper slope. Although a small fishery does target this species, Arrowtooth flounder are usually retained in catches where they are caught in pursuit of other species, usually Pacific cod or other flatfish species. GOA arrowtooth flounder are managed as a single stock. EBS arrowtooth flounder are also managed as a single stock. Since the harvest is characterized

as lightly exploited and spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are semi-demersal and spawning occurs at deeper areas of the continental shelf; it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs during summer throughout the outer continental shelf and upper slope areas on fish, squid, pandalid and cragonid shrimp, and euphausiids. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing impact to EFH on survival and growth to maturity.

4.3.2.2.1.8 Rock Sole (EBS)

Stock Biomass (Ø) – The EBS rock sole female spawning biomass was estimated to be well above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – EBS rock sole are lightly exploited with the ABC annually set below the TAC. Targeting on rock sole generally occurs from February through March north of Unimak Island, when rock sole are in spawning condition, to supply a limited roe market in Japan. After March, the harvest is spread throughout the EBS shelf over the rest of the year as they are usually retained in catches where they are caught in pursuit of other species, usually yellowfin sole. EBS rock sole are managed as a single stock. Since the harvest is characterized by light exploitation spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Although eggs are demersal and adhesive (specific gravity of 1.047 [Hart 1973]), it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, fishing impact to EFH is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.9 Flathead Sole (EBS and GOA)

Stock Biomass (Ø) – The GOA and EBS flathead sole female spawning biomass was estimated to be well above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – GOA and EBS flathead sole are lightly exploited with the ABC annually set below the TAC. Over the past 20 years the catch has not reached the ABC in the GOA. Flathead sole are generally captured throughout the year, primarily on the middle and outer portions of the GOA and EBS shelf. GOA and EBS flathead sole are managed as separate stocks. Since the harvest is characterized by light exploitation spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are pelagic, and spawning occurs over a broad area of the middle and outer shelf; it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – The GOA rex sole biomass was estimated at 71,300 t in the 2001 survey and has been at a stable level since the first survey in 1984. However, rex sole are not currently assessed with an age-structured population model, and the MSST for this species has not been determined (Turnock et al. 2002). The effect of fishing on the stock's ability to maintain itself at or above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Rex sole are lightly exploited, the ABC is annually set below the TAC, and the catch is usually less than the TAC. Targeting on rex sole generally occurs throughout the year with most of the catch from the central GOA mid to outer shelf and slope area.

Spawning/Breeding (Ø) – Eggs are pelagic, and it is not known what role the habitat has in spawning success. However, given the present condition of the resource resulting from current management practices, fishing is not suspected to have a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to habitat has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.11 Alaska Plaice (EBS)

Stock Biomass (Ø) – The EBS Alaska plaice female spawning biomass was estimated to be well above the MSST level for the 2003 fishing season. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – EBS Alaska plaice are lightly exploited with the ABC annually set below the TAC. Alaska plaice harvest generally occurs throughout the year, primarily on the middle portion of the EBS shelf. Alaska plaice are usually retained in catches where they are caught in pursuit of other species, typically yellowfin sole or other flatfish. EBS Alaska plaice are managed as a single stock. Since the harvest is characterized as light exploitation spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are pelagic, and spawning occurs in nearshore areas; it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs during summer throughout the continental shelf on benthic infauna and is, therefore, dependent on the infaunal supply of polychaete worms, marine worms and, to a lesser extent, bivalves. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact to EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, Alaska plaice metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle

in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize this group of species, which have similar life histories and habitat usage.

Stock Biomass (U) – The GOA southern rock sole biomass was estimated at 126,100 t in the 2001 survey and has been at a stable level since the first survey in 1984. Since the species in this management category are in tiers 4 through 6, it is unknown what the MSST level is for this management category (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – GOA shallow water flatfish are lightly exploited since the ABC annually is set below the TAC and the catch is usually less than the TAC. Targeting on rock sole generally occurs throughout the year with most of the catch from the central GOA shelf area. Since the harvest is characterized as lightly exploited and spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Although eggs are demersal and adhesive (specific gravity of 1.047, Hart 1973), it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, fishing impact on EFH is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact on EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species, which have similar life histories and habitat usage.

Stock Biomass (U) – The GOA Dover sole biomass was estimated at 68,211 t in the 2001 survey and has been at a stable level since the first survey in 1984. Since the species in this management category are in tiers 4 through 6, it is unknown what the MSST level is for this management category (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – GOA deep water flatfish are lightly exploited as the ABC annually is set below the TAC and the catch is usually less than the TAC. Targeting on Dover sole generally occurs throughout the year with most of the catch from the central GOA slope area. Since the harvest is characterized as lightly exploited and spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Eggs are pelagic it is not known what role the habitat has in spawning success. Given the present condition of the resource resulting from current management practices, fishing impact on EFH is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing impact on EFH has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Within the first 2 years of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.2.2.1.14 Pacific Ocean Perch (EBS)

Stock Biomass (Ø) – Total biomass (ages 3 through 21+) of EBS Pacific ocean perch at the start of 2003 is estimated to be 374,000 mt, which is above the MSST (Spencer and Ianelli 2002). Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. Thus, it can reasonably be inferred that there is no effect of fishing on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – In recent years, the Pacific ocean perch directed fishery in the AI typically occurs in the month of July. Harvest data from 2000 through 2002 indicates that approximately 80 percent of the Pacific ocean perch in the EBS are harvested during this month; there is no directed fishing for Pacific ocean perch in the EBS management area. The harvest of Pacific ocean perch is distributed across the AI subareas in proportion to relative biomass. From 2000 to 2002, approximately 44 percent of the harvest occurred in area 543, with 23 and 26 percent in the eastern and central AI, respectively. Pacific ocean perch are patchily distributed, and are harvested in relatively few areas within the broad management subareas of the AI. Recent genetic work on Pacific ocean perch off British Columbia suggests that stock structure of Pacific ocean perch may occur on relatively small spatial scales (Withler et al. 2001). It is currently believed that recent harvest policies lead to no substantial effects on genetic diversity, although this interpretation may change with more genetic information.

Spawning/Breeding (Ø) – Adult Pacific ocean perch have been found in pebble substrates with little relief (Kreiger 1993). Pacific ocean perch are viviparous, with parturition occurring in the late winter early spring. Pacific ocean perch off Queen Charlotte Island, British Columbia, were found in shallower depths in the summer than during other times of year (Gunderson 1971). A strong association between habitat characteristics and the insemination/parturition processes has not been shown for Pacific ocean perch. Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. Thus, it can reasonably be inferred that there is no effect of fishing on essential spawning habitat.

Feeding (Ø) – Pacific ocean perch are plankton feeders, with juvenile Pacific ocean perch eating calanoid copepods and adults eating largely euphausiids (Yang 1993, 1996). Fishing activity would be expected to have no effect on these pelagic prey items.

Growth to Maturity (Ø) – Information on the habitat of juvenile Pacific ocean perch is available from a limited number of submersible studies. Straty (1987) found that juvenile Pacific ocean perch occupied rocky coastal areas off southeast Alaska at depths of 134-171 m; the ranges in age and size of these juvenile were 1 to 3 years and 78 to 164 mm, respectively. These juvenile Pacific ocean perch and other juvenile rockfish took refuge in rocky areas when alarmed by the movement of the submersible. Carlson and Straty (1981) also noted the use of coastal rocky habitats by juvenile rockfish, and Kreiger (1993) noted the use of rugged habitat (cobble with boulders) by small (less than 25 cm) Pacific ocean perch. Fishing activity in these areas may affect growth to maturity if there is a substantial reduction of juvenile refuge habitat. However, model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. Thus, it can reasonably be inferred that there is no substantial effect of fishing on survival to maturity.

4.3.2.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. In the GOA, a foreign Pacific ocean perch fishery began in the early 1960s. This fishery developed rapidly, with massive efforts by the Soviet and Japanese fleets. Catches peaked in 1965 with landings of 350,000 mt. This apparent overfishing resulted in a precipitous decline in catches in the late 1960s. Catches continued to decline in the 1970s and early 1980s and by 1985 were only 1,100 mt. Landings rose as the fishery became increasingly domestic after 1985, declined again in the early 1990s, and then increased to nearly 12,000 mt in 2002. Due to concern that the stocks of Pacific ocean perch were not sufficiently recovering from their relatively low condition, a rebuilding plan was implemented in 1995. Soon thereafter, strong year-classes contributed to increased abundance, and the stock was considered rebuilt in 1997. Pacific ocean perch is now believed to be relatively abundant compared to its low level in the 1980s and early 1990s, and abundance appears to be increasing.

The 2003 estimated total biomass in the GOA is 298,820 mt. In 2002, GOA Pacific ocean perch had an estimated $F_{35\%}$ (a proxy for the F_{OFL} overfishing limit) of 0.060 and an estimated $B_{35\%}$ (a proxy for the B_{MSY} maximum sustained yield limit) of 91,710 mt (Heifetz et al. 2002). In 2002, the projected female spawning biomass for 2003 (B_{2003}) of 112,269 mt was greater than $B_{35\%}$ and consequently by definition the stock is currently above its MSST and is not currently in an overfished condition (Heifetz et al. 2002). In 2002, the projected female spawning biomass for 2005 (B_{2005}) of 108,588 mt was greater than $B_{35\%}$ and consequently by definition the stock is also not currently approaching an overfished condition (Heifetz et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST under Alternative 1. The ABC for Pacific ocean perch is determined for the entire GOA and then geographically apportioned among management areas. This apportionment spreads fishery effort over the GOA in an effort to reduce the risk of localized depletion. Model runs from the revised draft programmatic groundfish SEIS (NMFS 2003a) for status quo, same as Alternative 1, indicated that GOA Pacific ocean perch are taken in the central (80 percent of GOA Pacific ocean perch captured), western (13 percent), and eastern (7 percent) GOA, primarily in directed Pacific ocean perch bottom trawl fisheries (74 percent of GOA Pacific ocean perch captured), directed Pacific ocean perch pelagic trawl fisheries (11 percent), and as bycatch in directed bottom trawl fisheries for other rockfish species (11 percent).

Under Alternative 1, The Pacific ocean perch trawl fishery is managed under an open season that occurs in July and generally lasts a few weeks. The race for fish and overcapacity compresses the fishery effort into a short time period and increases the risk of overfishing. Pacific ocean perch caught in the commercial fishery are most prevalent on the shelf break, slope, and inside major gullies and trenches running perpendicular to the shelf break (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Within this range, research surveys suggest that Pacific ocean perch distribution also has both fine-scale and habitat-scale patterns, is highly restricted to specific depths, and may vary with time of day (Hanselman et al. 2001). Examination of Pacific ocean perch general distribution maps overlaid in relation to bottom trawl intensity show the highest concentration of bottom trawl intensity inshore of the Pacific ocean perch general distribution. The remaining bottom trawl intensity appears to be associated with the general distribution of Pacific ocean perch catch in deep shelf gullies (200 to 300 m) and the upper continental slope (more than 200 m) and is likely from directed rockfish bottom trawl fisheries in those areas.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 1 on Pacific ocean perch spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Under Alternative 1, trawl fishing is not permitted in the southeast/east Yakutat area and the ABC (approximately 12 percent of the total GOA ABC) normally allocated to that area is not likely to be caught. This creates a *de facto* no-take zone or refugium for Pacific ocean perch in this area, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited fish populations (Yoklavich 1988). In particular, the closed areas may allow increased survival of larger and older fish that produce significantly more offspring. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit Pacific ocean perch.

Feeding (Ø) – The major prey of Pacific ocean perch is euphausiids, and Pacific ocean perch may in turn be preyed upon by large piscivorous fish. There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 1.

Growth to Maturity (Ø) – Under Alternative 1, bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. If so, damage to this epifauna by bottom trawls could reduce survival of juvenile fish.

4.3.2.2.1.16 Shortraker and Rougheye Rockfish (EBS)

Stock Biomass (U) – Total biomass of EBS rougheye rockfish, based on a recent average of NMFS trawl surveys, is 11,480 t for the AI and 1,721 t for the EBS. Total biomass of EBS shortraker rockfish, based on the same recent NMFS trawl surveys, is 27,317 t for the AI and 4,640 t for the EBS. EBS shortraker and rougheye rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – A directed fishery does not exist for shortraker rockfish or rougheye rockfish in the EBS area. Harvest data from 2000 to 2002 indicates that over 90 percent of the harvest of shortraker and rougheye rockfish is taken in the AI, with the proportion among the three subareas ranging from 26 to 34 percent. Rougheye and shortraker rockfish are most commonly caught in July, with 58 percent of the harvest occurring in that month in 2000 to 2002, and the bulk of this harvest is obtained as bycatch in the Pacific ocean perch trawl fishery. Although a directed fishery does not exist, rougheye and shortraker rockfish are valuable species and vessels in the Pacific ocean perch fishery may intentionally seek rougheye/shortraker catches while still meeting the definitions of a Pacific ocean perch target fishery (Soh 1998). Rougheye and shortraker are also caught in the sablefish longline fishery, particularly in the eastern and central AI, and in the Pacific cod longline fishery, particularly in the central and western AI. Genetic studies with shortraker rockfish reveal that stock structure exists across relatively broad spatial scales, and genetic studies for rougheye rockfish indicate that there exist two species of rougheye rockfish with overlapping distributions (Dr. Tony Gharrett, University of Alaska, pers. comm.) Given that shortraker/rougheye rockfish are caught throughout the AI region, it is currently believed that recent harvest policies lead to no substantial effects on genetic diversity, although this interpretation may change with more genetic information.

Spawning/Breeding (U) – Adult rougheye/shortraker rockfish have been found at depths of 300 to 500 m in AI trawl surveys. In a submersible study off southeast Alaska, Kreiger and Ito (1999) found that rougheye/shortraker rockfish were associated with habitats containing frequent boulders, steep slopes (more than 20°), and sand-mud substrates. Rougheye/shortraker rockfish are viviparous, with parturition occurring in the spring. Much of the data on rougheye/shortraker rockfish is collected during surveys and fisheries in the summer months when rougheye and shortraker rockfish are not expected to be either breeding or spawning. Because the MSSTs for shortraker and rougheye rockfish are unknown, the effect of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Pandalid and hippolytid shrimp are the largest components of the rougheye rockfish diet (Yang 1993, 1996). The diet of shortraker rockfish is largely unknown, but a limited number of samples suggest that squid is a major component. Kreiger and Ito (1999) hypothesized that shortraker/rougheye rockfish may use boulders to avoid currents and/or capture prey. The reduction of epifaunal prey could affect the diet of rougheye rockfish, but the projected percent reductions in these prey are so small (0 to 3 percent) that fishing is anticipated to have no effect on the diet of shortraker/rougheye rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile rougheye/shortraker rockfish. Studies using submersibles have indicated that several species of rockfish appear to use rocky, shallower habitats during their juvenile stage (Carlson and Straty 1981, Straty 1987, Kreiger 1993). Although these studies did not specifically observe rougheye/shortraker rockfish, it is reasonable to suspect that juvenile rougheye and shortraker rockfish also use these shallower habitats as refuge areas. NMFS trawl surveys suggest that smaller rougheye (less than 35 cm) occur in shallower areas than the

larger adults. Because the MSSTs for rougheye and shortraker rockfish are unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.2.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (U) – Biomass of shortraker and rougheye rockfish is determined from bottom trawl surveys of the GOA. The current exploitable biomass for shortraker rockfish is 25,470 t, and that for rougheye rockfish is 41,360 t; both estimates of biomass are based on the average of the last three trawl surveys. A population model has not been developed for either species (exploratory modeling is in progress for rougheye rockfish), so determination of MSST is not possible at present. Because the value of MSST is unknown, and also because of the general uncertainty of the biomass estimates for the two species, the effect of Alternative 1 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Fishery data indicate catches of shortraker and rougheye rockfish are rather evenly spread along the continental slope of the GOA, especially in the central GOA and west Yakutat areas, where most of the catch is taken. This lack of geographic catch concentration may be due to Council regulations that only allow these species to be taken as bycatch in other fisheries. About 40 percent of the shortraker/rougheye catch in recent years has come from longline fisheries that target on sablefish and halibut (Heifetz et al. 2002). These fisheries are open continuously between March and November, which causes the catch to be spread out over this period. The remainder of the shortraker/rougheye catch comes as bycatch in trawl fisheries, which typically are open for only a few weeks per year in the summer. However, it is unlikely this temporal concentration has much impact on stock structure of these fish; for example, there is no evidence that mating aggregations are caught.

Genetic studies of shortraker and rougheye rockfish indicate that there is some population structure in the GOA related to geographic location for each species, but additional research is needed to better define this structure (Gharrett 2003). Although the genetic studies are not yet definitive, catches of shortraker and rougheye rockfish are generally not concentrated in geography and time. Consequently, Alternative 1 has "no effect" on spatial/temporal concentration of catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur in February through August for shortraker rockfish and in December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish is unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small in size, they are generally not taken in bottom-tending fishing gear. Consequently, the status quo Alternative 1 probably has little or no direct effect on prey availability to adult shortraker and rougheye rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Juvenile shortraker rockfish have almost never been caught on any fishing gear, so it is likely that fishing does not occur (and thus has no direct effect) on whatever habitat they do occupy. Juvenile rougheye rockfish are frequently taken in bottom trawls, but their preferred

habitat and whether they associate with any habitat features is uncertain. In contrast, adults of both species are known to inhabit particularly steep, rocky areas of the continental slope, and they have been observed in association with boulders and corals (Krieger and Ito 1999, Krieger and Wing 2002). Bottom trawling is known to displace boulders and damage corals, and it could have a negative impact on growth and survival of these fish. However, to really evaluate this possible problem, additional research is needed to determine how essential are these associations to the health of the stocks and how much damage is actually being done by fishing gear.

An amendment to the GOA Groundfish FMP has prohibited bottom trawling in the eastern GOA east of long. 140° W since 1998. Although fishing with longline gear is still allowed in these closure areas, longlines are thought to do relatively little damage to the benthic habitat when compared with trawls. The eastern GOA trawl closure prevents damage to the bottom in this area, and it may have a positive future effect on stock condition if living substrates are an important habitat for shortraker and rougheye rockfish.

Taking into consideration all of these factors, a rating of "unknown" is given to the "growth to maturity" issue. This rating is a trade-off among the various factors discussed in the previous two paragraphs. Status quo fishing appears to have no effect on the habitat of juvenile shortraker rockfish, whereas the eastern GOA trawl closure may have a positive impact. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to firmly conclude that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals.

4.3.2.2.1.18 Northern Rockfish (EBS)

Stock Biomass (U) – Total biomass of EBS northern rockfish, based on a recent average of NMFS trawl surveys, is 155,108 t for the AI and 409 t for the EBS. EBS northern rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stock's ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Northern rockfish is harvested as bycatch in the EBS area, as a directed fishery does not exist. Harvest data from 2000-2002 indicate that approximately 90 percent of the EBS northern rockfish are harvested in the Atka mackerel fishery, with a large amount of the catch occurring in September in the western AI (area 543). The distribution of northern rockfish harvest by AI subarea reflects both the spatial regulation of the Atka mackerel fishery and the increased biomass of northern rockfish in the western AI. The average proportion of northern rockfish biomass occurring in the western, central, and eastern AI, based on trawl surveys from 1991-2002, were 72 percent, 22 percent and 5 percent, respectively. Northern rockfish are patchily distributed and are harvested in relatively few areas within the broad management subareas of the AI, with important fishing grounds being Petral Bank, Sturdevant Rock, south of Amchitka Island, and Seguam Pass (Dave Clausen, NMFS-AFSC, personal communication). Preliminary genetic work with small sample sizes indicate that northern rockfish do not show genetic differentiation over large spatial scales, although a more comprehensive study should be conducted (Dr. Anthony Gharrett, University of Alaska, personal communication). It is currently believed that recent harvest policies lead to no substantial effects on genetic diversity, although this interpretation may change with more genetic information.

Spawning/Breeding (U) – Little is known of the spawning and breeding habitat of northern rockfish. In the AI, observations from NMFS trawl surveys indicate that adults are generally found at depths from

100 to 150 m over generally hard substrates. Northern rockfish are viviparous, and observations on trawl surveys in the GOA indicate that parturition occurs in the spring. Much of the data on northern rockfish is collected during surveys and fisheries in the summer months, when northern rockfish are not expected to be either breeding or spawning. Because the MSST for northern rockfish is unknown, the effects of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Northern rockfish are largely plankton feeders, eating mainly euphausiids but also copepods, hermit crabs, and shrimp (Yang 1993). Fishing activity under Alternative 1 would be expected to have no effect on the largely pelagic diet of northern rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile northern rockfish. Studies using submersibles have indicated that several species of rockfish appear to use rocky, shallower habitats during their juvenile stage (Carlson and Straty 1981, Straty 1987, Kreiger 1993). Although these studies did not specifically identify northern rockfish, it is reasonable to suspect that juvenile northern rockfish also use these shallower habitats as refuge areas. NMFS trawl surveys suggest that older juveniles occur in shallower areas than adults. Because the MSST for northern rockfish is unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.2.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The 2003 estimated total biomass in the GOA is 108,830 mt. In 2002, GOA northern rockfish had an estimated $F_{35\%}$ (a proxy for the F_{OFL} overfishing limit) of 0.066 and an estimated $B_{35\%}$ (a proxy for the B_{MSY} maximum sustained yield limit) of 22,109 mt (Heifetz et al. 2002). In 2002, the projected female spawning biomass for 2003 (B_{2003}) of 42,743 mt was greater than $B_{35\%}$ and consequently by definition the stock is currently above its MSST and is not currently in an overfished condition (Heifetz et al. 2002). In 2002, the projected female spawning biomass for 2005 (B_{2005}) of 37,177 mt was greater than $B_{35\%}$ and consequently by definition the stock is also not currently approaching an overfished condition (Heifetz et al. 2002). However, the uncertainty of the survey biomass estimates together with the declining stock trend indicated by a lack of recent strong year classes suggest that precaution is warranted for management of the GOA northern rockfish stock (Heifetz et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST under Alternative 1. The ABC for northern rockfish is determined for the entire GOA and then geographically apportioned among management areas. This apportionment spreads fishery effort over the GOA in an effort to reduce the risk of localized depletion. Model runs from the revised draft programmatic groundfish SEIS (NMFS 2003a) for status quo, same as Alternative 1, indicated that GOA northern rockfish are taken in the central (89 percent of GOA northern rockfish captured) and the western (11 percent) GOA, primarily in directed rockfish bottom trawl fisheries (60 percent of GOA northern rockfish captured) and as bycatch in Pacific ocean perch bottom trawl fisheries (22 percent).

The majority of EBS and GOA northern rockfish commercial catches have historically come from the same localized geographic regions year after year. The largest GOA commercial catches occurred in one area known as the "Snakehead," which accounted for 45.8 percent of all GOA northern rockfish catches from 1990 to 1998 (Clausen and Heifetz 2003). Similarly, the largest EBS commercial catches occurred in one area known as the Zhemchug Canyon, which accounted for 57.05 percent of all EBS

northern rockfish catches from 1990 to 1998 (Clausen and Heifetz 2003). AI northern rockfish commercial catches were also concentrated in several geographic regions, but there was no one localized aggregation that dominated the catch year after year. Based upon these highly localized catches, northern rockfish are not believed to be highly mobile or migratory as adults. Examination of GOA northern rockfish general distribution overlaid in relation to bottom trawl intensity found the highest concentration of bottom trawl intensity inshore of northern rockfish general distribution. The remaining trawl intensity associated with the general distribution of northern rockfish is likely from directed bottom trawl rockfish fisheries.

The GOA rockfish trawl fishery is managed under an open season that occurs in July and generally lasts a few weeks. The open fishery system compresses the fishery effort into a short time period and increases the risk of overfishing.

Northern rockfish are not common in the eastern GOA. However, under Alternative 1, trawl fishing is not permitted in the southeast/east Yakutat area, and the ABC (approximately 0.1 percent of the total GOA ABC) normally allocated to that area is not likely to be caught.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 1 on northern rockfish spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Northern rockfish are not common in the eastern GOA. However, under Alternative 1, trawl fishing is not permitted in the southeast/east Yakutat area and the ABC (approximately 0.1 percent of the total GOA ABC) normally allocated to that area is not likely to be caught. This creates a *de facto* no-take zone or refugium for northern rockfish in this area, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited fish populations (Yoklavich 1988). In particular, the closed areas may allow increased survival of larger and older fish that produce significantly more offspring. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit northern rockfish.

Feeding (Ø) – The major prey of northern rockfish is euphausiids, and northern rockfish may in turn be preyed upon by large piscivorous fish. There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 1.

Growth to Maturity (Ø) – Under Alternative 1, bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile northern rockfish. Like juvenile Pacific ocean perch, juvenile northern rockfish are believed to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. If so, damage to this epifauna by bottom trawls could reduce survival of juvenile fish.

4.3.2.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA is comprised of three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of

the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on the EFH for this species.

Stock Biomass (U) – Biomass of light dusky rockfish is determined from bottom trawl surveys of the GOA. The current exploitable biomass for this species, 55,338 t, is based on the average of the last three trawl surveys. A population model has not been finalized for this species (although a preliminary model has been developed), so determination of MSST is not possible at present. Because the value of MSST is unknown and also because of the statistical uncertainty of the biomass estimates, the effect of Alternative 1 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – The present management regime for pelagic shelf rockfish results in a concentration of the catch of light dusky rockfish into relatively small localities and over a relatively short duration. Although ABC for the GOA is apportioned into three areas (eastern, central, and western), about 80 percent of the usable ABC is assigned to the central area. Fishermen are free to take light dusky rockfish anywhere in this area. Because the fish are found in greatest abundance in relatively small bank and gully areas of the outer continental shelf, such as Portlock and Albatross Banks near Kodiak Island, the fishery is concentrated at these locations (Reuter 1999). Adult light dusky rockfish have been observed in association with epifauna such as sponges, and a reasonable conjecture is that the fishing grounds may contain, or may have once contained, such living structure on the bottom. If so, the concentrated fishery may be harming this structure or preventing its re-growth.

The season for rockfish trawling in the GOA has opened on approximately July 1 for a number of years. Due to the relatively large fishing power of the trawl fleet, the rockfish season typically remains open for only a few weeks, and catches of light dusky rockfish are concentrated into this short time period.

There have been no studies on the genetic stock structure of light dusky rockfish, therefore, it is unknown if the spatial concentration of fishing is having a negative effect on the stocks.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring, based on observations of ripe females sampled on a research cruise in April in the central GOA. Because of this lack of knowledge, the effects of Alternative 1 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution and they are so small they are not retained by any fishing gear, the status quo Alternative 1 probably has little or no direct effect on the availability of prey to adult light dusky rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of light dusky rockfish are mostly unknown. Younger juveniles (less than 25 cm fork length) are almost never caught on any fishing gear, so it is likely that fishing does not occur (and thus has no direct effect) on whatever habitat they do occupy. However, older juveniles and adults have been observed in association with corals and sponges (Krieger and Wing 2002), and both life stages may prefer the rocky substrate inhabited by such epifauna. Although the importance of these associations is uncertain, bottom trawling is known to damage such living substrates and could have a negative impact on stocks of this species.

An amendment to the GOA Groundfish FMP has prohibited bottom trawling in the eastern GOA east of long. 140° W since 1998. Although abundance of light dusky rockfish is relatively low in this area, the closure prevents damage to the bottom, and it may have a positive future effect on stock condition if living substrates are an important habitat for the species.

Taking into consideration all these factors, a rating of "unknown" is given to the "growth to maturity" issue for Alternative 1, with the caveat that if more information were available, the rating might change to an "effect negative." This caveat is necessary because additional research may show that fishing activities are negatively impacting epifauna such as corals or sponges that may be important to growth and survival of light dusky rockfish.

4.3.2.2.1.21 Other Rockfish Species (EBS)

The other rockfish management group in the /EBS comprises those rockfish other than Pacific ocean perch, northern rockfish, shortraker rockfish and rougheye rockfish and consists largely of shortspine thornyhead (*Sebastolobus alascanus*) and light dusky rockfish (*Sebastes ciliatus*). In the AI fisheries, light dusky rockfish are the species in the other rockfish category taken in greatest abundance, whereas in the EBS, shortspine thornyheads are taken in greatest abundance in the fishery. It should be noted though that a large portion of the other rockfish biomass estimate is from shortspine thornyheads. This section focuses exclusively on light dusky rockfish, which represent the vast majority of the Sebastes biomass in the other rockfish species complex, and more information on the life history and habitat is known about this species. Shortspine thornyheads are described in greater detail in the following the section.

Stock Biomass (U) – The most current biomass estimate (543 mt) for light dusky rockfish in the EBS is from the 2002 AI survey. The abundance of light dusky rockfish decreases westward along the Aleutian chain and northward into the EBS (Reuter and Spencer 2002). Consequently, biomass of light dusky rockfish in the EBS is not very well understood. Determination of MSST is not possible at present due to lack of good biomass estimates. Because the value of MSST is unknown, and also because of the statistical uncertainty of the biomass estimates, the effect of Alternative 1 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – There have been no studies on the genetic stock structure of light dusky rockfish in the EBS. It is known though that light dusky rockfish in the GOA occur in localized concentrations (Reuter 1999). Furthermore, preliminary analysis of light dusky rockfish distribution in the AI shows similar patterns, which are not fully understood (Reuter and Spencer 2002). Therefore, it is unknown if the spatial concentration of fishing is having a negative effect on the stocks.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish. Because of this lack of knowledge, the effects of Alternative 1 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (U) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). Any direct or indirect effects of fishing on euphausiid abundance is not presently known.

Growth to Maturity (U) – Habitat requirements for the various life stages of light dusky rockfish are mostly unknown. Younger juveniles (less than 25 cm fork length) are almost never caught on any fishing gear, so it is likely that fishing does not occur (and thus has no direct effect) on whatever habitat

they do occupy. However, older juveniles and adults have been observed in association with corals and sponges (Krieger and Wing 2002), and both life stages may prefer the rocky substrate inhabited by such epifauna. Nevertheless, the importance of these associations is uncertain.

Taking into consideration all these factors, a rating of "unknown" is given to the "growth to maturity" issue for Alternative 1, with the caveat that if more information were available, the rating might change to an "effect negative." This caveat is necessary because additional research may provide for a better understanding of the importance of structural habitats to growth and survival of light dusky rockfish.

4.3.2.2.1.22 Shortspine Thornyheads (EBS)

Stock Biomass (U) – The most current biomass estimates (15,255 mt and 16,988 mt) for shortspine thornyheads in the AI is from the 2002 AI survey and the 2002 EBS slope survey respectively. The biomass estimate from the EBS slope survey was not used in the calculation of the exploitable biomass for the 2003 other rockfish stock assessment because this was the first year of this survey (Reuter and Spencer 2002). Consequently, biomass of shortspine thornyheads in the EBS is uncertain. Determination of MSST is not possible at present due to lack of appropriate information. Because the status of the stock relative to MSST is unknown, the effect of Alternative 1 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – There have been no studies on the genetic stock structure of shortspine thornyheads. The general distribution patterns of shortspine thornyhead is along the slope from 200 to 500 m in the EBS (Reuter and Spencer 2002). Therefore, it is unknown if the spatial concentration of fishing is affecting the stocks.

Spawning/Breeding (U) – There is little information on reproductive behavior for shortspine thornyheads in Alaskan waters. Off the west coast of the U.S., spawning occurs in the spring when gelatinous bi-lobed egg masses are released and float to the surface (Pearcy 1962). Larval and pelagic phases of this species are thought to be up to 15 months, and juveniles may settle on the shelf at about 100 m (Wakefield 1990, Moser 1974). Because of this lack of knowledge, the effects of Alternative 1 on the habitat required for reproduction of shortspine thornyheads are unknown.

Feeding (U) – The major prey of adult shortspine thornyheads appears to be pandalid shrimp (based on the limited food information available for this species) (Yang 1993). Since pandalid shrimp are epibenthic, there is the possibility that they may be retained by bottom-trawl gear, but in relatively small amounts due to the large mesh size of this gear type. It is not well understood, though, how fishing impacts pandalid shrimp life history.

Growth to Maturity (U) – Ontogenetic movements of shortspine thornyheads are poorly understood, especially in Alaskan waters. A few studies conducted off of the west coast have shown that shortspine thornyhead mean length increases with depth (Jacobson and Vetter 1996). The peak spawning biomass in these areas was between 800 and 1,000 m, suggesting these depths are most vulnerable to fishing pressure. Although bathymetry plays an important role in shortspine thornyhead growth, the effect of habitat disturbance, other than direct fishing mortality and reproductive success, is uncertain.

4.3.2.2.1.23 Forage Species (EBS and GOA)

Stock Biomass (Ø) – Due to the lack of data, stock assessments are not currently being performed for forage species. A model is currently being developed for capelin but is not yet complete. Determining

MSST is not possible at the present time. Without a value for MSST or a reliable biomass estimate for most species, effects of Alternative 1 on stock biomass truly are unknown; however, catch of most forage species is so small that it is doubtful that fishing mortality under Alternative 1 would affect the stocks ability to remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – Directed fishing for forage species is currently prohibited, therefore all catch of forage species comes as incidental catch from other fisheries. Forage species are not caught in large amounts in the EBS or GOA. Due to certain life history traits (depth, size), many forage species are very rarely encountered by the fishery. Although there has been no work done on the genetic stock structure of any forage species, it is believed that Alternative 1 does not lead to a substantial change in the genetic diversity of the stocks.

Spawning/Breeding (Ø) – Species in the forage species category have diverse spawning and breeding behaviors. Some species are broadcast spawners (myctophids, bathylagids, gonostomatids, and euphausiids) and some lay eggs on the substrate (osmerids, sand lance, sandfish, pholids and stichaeids). Broadcast spawning is not thought to be affected by fishing. The forage species that lay demersal eggs do so in such a way that it is thought not to be greatly affected by federally mandated fishing. Alternative 1 has minimal impact on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – With the exception of Pacific sandfish, forage species feed at low trophic levels. For most species in the category, the diet is primarily composed of euphausiids and copepods. Due to their small size, euphausiids and copepods are not affected by fishing. Pholids and Stichaeids consume epibenthic and infaunal prey, which can be disturbed by fishing. However, pholids and stichaeids live in shallow waters that do not receive much fishing pressure. Alternative 1 is anticipated to have no substantial effect on essential prey availability.

Growth to maturity (Ø) – All forage species have pelagic larval stages. Fishing is not thought to have a substantial effect on small pelagic organisms. The juvenile stages of forage species are diverse and some families could potentially be affected more than others. Species with pelagic juvenile life stages are not thought to be greatly affected by fishing. There is a potential for fishing to affect species with demersal juvenile life stages, but these species are usually found inshore in shallow water that does not receive much fishing pressure. Therefore, it is thought that Alternative 1 has no substantial effect on the survival of fish to maturity.

4.3.2.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.2.2.2.1 Salmon

Stock Biomass (Ø) – No changes in the catch of salmon would be expected under Alternative 1, so no effects would be anticipated.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of fishing effort is expected under Alternative 1. The fishery is managed such that catch limits are established for separate river drainages or regions to avoid potential concentration of the fisheries.

Spawning/Breeding (Ø) – No fisheries in Alaska are thought to adversely affect salmon habitat because there is almost no fishing effort (except some very small recreational and subsistence fisheries) in freshwater spawning and rearing areas. For the salmon fisheries, the preliminary evaluation of the

fishery impacts on habitat analysis (Witherell 2002) found that the effects of this gear on EFH are almost non-existent because the gear generally never touches bottom. Only the drift gillnet fishery was found to have an overall footprint of more than 0.1 percent of available EFH, but because the gear never touched the bottom, this fishery did not affect EFH. Thus, the effects of the Alaska salmon fisheries are considered minimal and temporary in nature. No effects on spawning and breeding of salmon would be expected under Alternative 1.

Feeding (Ø) – Fisheries are considered not to have any impact on freshwater or pelagic habitats used by juvenile salmon. However, fisheries do catch some species eaten by piscivorous species of salmon in the ocean, including squid, capelin, and juvenile herring. Currently, the catch of these prey species is very small, so Alternative 1 is considered to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alterative 1. As previously stated, fisheries are considered to have very minimal effects on salmon EFH. Additionally, survival of juvenile salmon is affected by the incidental catch of salmon at sea. Bycatch in groundfish fisheries is almost non-existent for pink salmon, coho salmon, and sockeye salmon, but does occur in measurable numbers for chum salmon and chinook salmon taken in trawl fisheries, particularly the pollock trawl fisheries (Witherell et al. 2002). The bycatch amounts are considered to be a small proportion of the stocks and not a substantial impact on salmon populations (Witherell et al. 2002). Thus, Alternative 1 is considered to have no effect on the growth to maturity of salmon.

4.3.2.2.2.2 Crabs

Stock Biomass (Ø) – The catch of crabs is not expected to change much in the near future under Alternative 1, so no effects on stock biomass would be anticipated.

Spatial/Temporal Concentration (Ø) – The distribution and intensity of fishing effort in the crab fisheries is expected to remain the same under Alternative 1. Because the pots fished in crab fisheries require spacing between them, the fisheries tend to be widely dispersed in the areas where legal male crabs are found, and this limits the potential concentration of the fisheries. No effects would be anticipated under Alternative 1.

Spawning/Breeding (Ø) – No effects on spawning and breeding of crabs would be expected under Alternative 1. The overlap of groundfish trawl effort with mature female crabs is very limited. For red and blue king crabs, the existing trawl closure areas encompass nearly the entire stock. For golden king crab, trawl fishing intensity does overlap to some extent with crab distribution on the EBS slope, but not in the AI slope area. Scarlet king crab likely occur in waters deeper than trawl fisheries occur. For opilio, trawl effort intensity is low in the habitat types and areas used by this stock, particularly in those areas where juveniles and females are abundant. For Tanner crabs, the overlap of trawl fisheries with mature females and the habitat areas used by this stock is also relatively low.

Feeding (Ø) – Fisheries are considered not to have any substantial effects on the prey of crab species. Alternative 1 is considered to have no effects on feeding of crab species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alternative 1. In the preliminary evaluation of the fishery impacts on habitat (Witherell 2002), the spreadsheet analysis found that the crab fisheries have an extremely small overall footprint, totaling less than 1 sq. nm per year, equating to less than 0.0007 percent of the total available benthic EFH area.

Thus, the effects of the crab fisheries are concentrated in an extremely small proportion of available EFH and these effects are considered minimal and temporary in nature.

4.3.2.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 1 is anticipated to have no substantial effects on scallop stock biomass. The weathervane scallop resource is considered to be at sustainable biomass levels and has maintained relatively high recruitment in most areas over the past 10 years (Jeff Barnhart, ADF&G, personal communication). Since 1992, the scallop dredge fishery is constrained by conservative catch limits, bycatch limits, and other regulations designed to minimize the environmental effects of harvesting (Kruse et al. 2000). Catches over the past few years have been maintained at constant levels, and no increases in fishing effort or in the distribution of effort would be anticipated under Alternative 1 (Jeff Barnhart, ADF&G, personal communication).

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of fishing effort is expected under Alternative 1. The fishery is managed such that catch limits are established for separate beds to avoid potential concentration of the fishery.

Spawning/Breeding (Ø) – Alternative 1 is anticipated to have no substantial effects on spawning and breeding of weathervane scallops. In the preliminary evaluation of the scallop fishery impacts on habitat (Witherell 2002), the spreadsheet analysis found that although the effects of scallop dredge gear on the bottom are higher than other gear types, the fishery occurs in areas and habitat types that have relatively quick recovery rates. Additionally, the overall footprint (area affected annually) of the scallop fishery was small (149 sq. nm), equating to about 0.1 percent of the total available benthic EFH area. Thus, the effects of the fishery are concentrated in a relatively small proportion of EFH and these effects are considered minimal and temporary in nature.

Feeding (U) – Sediment resuspension by dredges can have positive or negative effects on scallop feeding. The current fishing effort intensity of the Alaska scallop fishery does not appear to affect scallop growth, so one may surmise that feeding is not disturbed. However, there is not enough information to evaluate this issue.

Growth to Maturity (Ø) – No additional dredge effort is expected under Alternative 1. Fishing effort (number of vessels) is limited under a licence limitation system, and the number of dredge hauls would be expected to remain relatively constant in the near future.

4.3.2.3 Effects of Alternative 1 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 1 on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.2 of the RIR/IRFA (Appendix C).

4.3.2.3.1 Effects on Passive Use Values (Ø)

Under Alternative 1, the status quo, no additional measures would be taken at this time to minimize the effects of fishing on EFH. Fishing activities would continue to affect EFH at current levels.

Alternative 1 would not provide any additional measures to minimize the effects of fishing on EFH beyond those currently in place or planned as part of other fishery management actions. Current

scientific knowledge does not permit either a quantitative or qualitative assessment of the use benefits derived from minimizing the effects of fishing on EFH. However, the assumption implicit in the Magnuson-Stevens Act requirement to minimize effects of fishing on EFH is that doing so would result in sustained or enhanced production from FMP species and would contribute to a healthy ecosystem. As such, the action alternatives would contribute additional minimization measures that would reduce the impacts of fishing on EFH. Whether these measures would provide increased future productivity benefits over Alternative 1 is unknown at this time.

4.3.2.3.2 Effects on the Fishing Fleet

Gross Revenue, Operating Costs, Cost to Consumers, Safety, Related Fisheries, Management and Enforcement (Ø)
There would be no direct industry revenue at risk under Alternative 1 because no additional fishery management measures would be put in place. Similarly, Alternative 1 would not create impacts on product quality and revenue, operating cost, safety, related fisheries, costs to consumers, or management and enforcement costs. Further, since no revenue is placed at risk under Alternative 1, there would not be any distributional impacts associated with this alternative.

4.3.2.3.3 Effects on Communities and Shoreside Industries (Ø)

No significant impacts on dependent communities or shoreside support industries are foreseen under the status quo alternative. Communities and shoreside support industries currently dependent on the relevant fisheries would continue to engage in support and related activities in the same manner as is occurring under existing conditions.

4.3.2.3.4 Effects on Regulatory and Enforcement Programs (Ø)

Under Alternative 1, no new management measures would be taken at this time to mitigate the effects of fishing on EFH. Therefore, there would be no effects on federal regulatory and enforcement programs.

4.3.2.4 Effects of Alternative 1 on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – Alternative 1 would have no effect on state-managed groundfish fisheries as current management measures would remain in place.

State-managed Crab and Invertebrate Fisheries (Ø) – Alternative 1 would have no effect on state-managed crab and invertebrate fisheries. All current management measures would remain in effect.

Herring Fisheries (Ø) – Alternative 1 would have no effect on state-managed herring fisheries. All current management measures would remain in effect.

Halibut Fisheries (Ø) – Alternative 1 would have no effect on halibut fisheries. All current management measures would remain in effect.

4.3.2.5 Effects of Alternative 1 on Protected Species

A detailed review of impacts of EFH alternatives on protected species is presented in Wilson (2003). The following is a summary of the potential effects of Alternative 1 on protected species.

ESA-listed Marine Mammals (Ø) – Under Alternative 1, the no action option, the current very low levels of mortality or potential injury to ESA-listed marine mammals would be expected to continue. Alternative 1 would not result in increased levels of take or injury to these species, nor would it result in increased removals of prey items used by these marine mammals. Thus Alternative 1 would have no further or additional adverse effect on ESA-listed marine mammals.

Other Marine Mammals (Ø) – The current levels of mortality or potential injury to other non-ESA-listed marine mammals are very low, and for some species no mortalities have been observed. There also is very little overlap between groundfish fisheries and the prey taken by these species. And for many of these marine mammals, their preferred habitat is more to the north, particularly for the ice seals, and thus the opportunities for fishery interactions with these species is minimal. Thus Alternative 1 would have no further or additional adverse effect on other (non-ESA-listed) marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – The current patterns of incidental take of ESA-listed salmon and steelhead in the groundfish fisheries of the GOA and EBS would likely continue under Alternative 1. While any take of an endangered or threatened species could have a serious adverse effect on the population, it is likely that very few endangered or threatened salmon or steelhead are taken as bycatch in the trawl fisheries in the GOA and EBS. The 12 evolutionarily significant units (ESUs) of salmon and steelhead that are known to occur in marine waters off Alaska co-mingle with non-listed salmonid stocks and are thus "diluted" by the particularly large numbers of salmon originating in Alaskan fresh waters. Fishing under Alternative 1 would continue as it is at present and no additional effort that might increase salmon bycatch would occur under this alternative. PSC limits in the EBS and designation of salmon as a PSC in the GOA provide further incentives for fishing activities to avoid areas where salmon, including those from ESA-listed salmonid ESUs, are concentrated.

ESA-listed Seabirds (Ø) – Under Alternative 1, incidental take of short-tailed albatross would likely be zero or near zero. There have been no reported mortalities of short-tailed albatross in the GOA or EBS trawl fisheries and none reported in the observed longline fisheries since 1998. The average annual estimated mortality of short-tailed albatross in the EBS longline fishery is one bird, based on 1993 to 2001 observer data (Council 2002, seabird section of Ecosystems Considerations chapter). With the current and proposed new seabird bycatch avoidance measures in place, both for longline fisheries and trawl (especially those using third-wire gear) fisheries, mortalities to this seabird may decline. Areas of the EEZ exploited by Steller's and spectacled eiders overlap very little with the groundfish fisheries off of Alaska. There have been no reported fishery-related mortalities to these marine duck species, and this would likely continue to be the case under Alternative 1.

Other Seabirds (Ø) – Under Alternative 1, fishing regimes in the GOA and EBS would continue to experience seabird bycatch, but at a fairly low level, although for some species, such as northern fulmars, there would be concern if this mortality were largely from one colony. Incidental mortality from longline and trawl fishing operations would continue to take fulmars, albatrosses, gulls, and shearwaters because of these seabirds' feeding behavior. Some of these concerns would be alleviated with implementation of new seabird bycatch reduction programs in the longline fisheries. Bird strikes with trawl third wires would continue to occur under Alternative 1. Although there are few concerns

over fishery-related depletion of seabird prey, some concerns would continue over the occasional intense fishing activity near seabird colonies that might interrupt or displace seabird foraging. Seabirds would continue to strike vessels and suffer mortality, particularly such species as storm-petrels, fulmars, some albatrosses, and crested auklets. Kittlitz's murrelets and red-legged kittiwakes are species of concern because of their declining population sizes, but do not appear to be impacted by groundfish fisheries at present. Overall, the effects of Alternative 1 on seabirds would be minimal.

4.3.2.6 Effects of Alternative 1 on the Ecosystem

Predator-Prey Relationships (Ø) – Most of the work on predator-prey relationships in the EBS and GOA regions has been done in the EBS. Evidence from modeling studies and examination of trophic guild changes (NMFS 2001a) suggest that there is no clear evidence of fishing as the cause of species fluctuations through food web effects. Multispecies models have shown that although cannibalism can explain a large part of the density-dependent part of the stock recruitment relationship for pollock (that is, the decline in recruitment observed at high spawner biomasses), most of the overall variability in stock and recruitment is not explained by predation (Livingston and Methot 1998). Pollock is a key prey species of many target and nontarget species in the EBS and GOA (Livingston 1989, 1994) and has a central position in the food webs of those ecosystems. Modeling of predation on pollock in the EBS and GOA (Livingston and Methot 1998, Livingston and Jurado-Molina 1999, and Hollowed et al. 2000) shows that different predators may be the most important source of predation mortality during different time periods. For example, Steller sea lion predation on pollock in the GOA was more important in earlier years, but the most important current source of predation mortality on pollock is now from arrowtooth flounder. Population levels of some of these predators such as arrowtooth flounder appear unrelated to fishing removals but are more linked to environmental forces that favor the production of these species (Hollowed et al. 1998). Thus Alternative 1 has had insignificant impacts to the ecosystem with respect to removal of top predators, although impacts to some top predator species such as sharks remain unknown. Similarly, the fluctuations observed in species composition of trophic guilds (Livingston et al. 1999) do not appear to be related to fishing removals of competitors or prey when analyzed at the aggregated level for the whole EBS.

Regarding the potential for ecosystem change through introductions of nonindigenous species, recent work done primarily in Port Valdez and Prince William Sound shows that biological introductions of nonindigenous species have occurred, although these introductions cannot be ascribed to a particular vessel type, such as oil tankers or fishing vessels (Hines and Ruiz 2000). There have been 24 nonindigenous species of plants and animals documented, primarily in shallow water marine and estuarine ecosystems of Alaska, with 15 species recorded in Prince William Sound. One example of a likely introduction is the predatory seastar Asterias amurensis, which is found in other areas of Alaska but has not previously been found in Cook Inlet. These predators have the potential to have a major impact on benthic communities. The extent of impacts remain unknown and unquantified. Because no substantial changes in the number of fishing vessels would occur under this alternative, additional risks of introduction of nonindigenous species by fishing vessels are not expected.

Energy Flow and Balance (Ø) – A mass-balance model of the EBS (Trites et al. 1999) showed that under Alternative 1, total catch biomass (including non-groundfish removals) as a percentage of total system biomass (excluding dead organic material, known as detritus) was estimated to be 1 percent, a small proportion of total EBS system biomass. From an ecosystem point of view, total fishing removals are a small proportion of the total system energy budget and are small relative to internal sources of interannual variability in production.

Total offal and discard production prior to 1994 was estimated at only 1 percent of the unused detritus already going to the bottom (Queirolo et al. 1995). The annual consumptive capacity of scavenging birds, groundfish, and crab in the EBS was determined to be over ten times larger than the total amount of offal and discards in the EBS and GOA, and the main scavengers of fish processing offal, which primarily consisted of pollock, were also natural pollock predators. Combined evidence regarding the level of discards relative to natural sources of detritus and no evidence of changes in scavenger populations that are related to discard trends suggest that Alternative 1 would have no ecosystem impacts through energy removal and redirection. No changes in energy flow or balance would be expected for Alternative 1.

Diversity (Ø) – No fishing induced extinctions of groundfish or other marine species have been documented in the last 30 years or so. However, because of the sensitive nature of some species in Alaska waters (i.e., long-lived or low-reproductive potential species, such as skates, sharks, corals and grenadiers) and the evidence of extinction of related species in the Atlantic, species diversity could potentially be adversely impacted by fishing. No fishing-induced changes in functional (trophic) diversity under the current management regime have been detected (NMFS 2001a).

Biomass diversity and evenness for trophic guilds was investigated by Livingston et al. (1999) in the EBS in the current regime (NMFS 2001a). There appeared to be no evidence that groundfish fisheries caused declines in trophic guild diversity for the groups. Other groups, such as the benthic infauna consumer guild and the crab and fish consumer guild, had higher species biomass diversity than the pelagic fish consumer guild. Guild diversity changes were again seen when a dominant member changed in abundance. The abundance changes of those species were mostly related to recruitment changes and not to fishing. There appeared to be no fishing-induced changes in functional (trophic) diversity in the past under similar fishing practices (Livingston et al. 1999), so Alternative 1 was considered to have no effect on the status quo environment. Present-day Steller sea lion trawl closures are spread throughout the Aleutian chain, but these closures may be more inshore than most of the coral. For this reason, the areas closed to trawling in this alternative may not be sufficient to provide additional protection beyond the baseline for these sensitive organisms. Therefore, Alternative 1 is judged to have no effect on the status quo environment with respect to structural habitat diversity.

4.3.3 Effects of Alternative 2

4.3.3.1 Effects of Alternative 2 on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type differed from status quo for this alternative. LEIs for both status quo and Alternative 2 were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make them relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Habitat Complexity (Ø) – Alternative 2 institutes closures to rockfish trawling in 11 areas of the GOA. All of these areas mostly enclose slope habitat. Only small changes in LEI values resulted and all were for the GOA slope (proportional reductions – soft bottom biostructure -4 percent; hard bottom bio- and nonliving structure -5 percent). These changes were not considered substantial, resulting in a no effect rating.

Effects on Habitat Biodiversity (Ø) – The alternative does not change the amount of the slope area closed to all bottom trawling, since fishing for species besides rockfish would be allowed. Although some reduction in fishing at these sites may occur, this is not considered a substantial improvement in coral protection.

4.3.3.2 Effects of Alternative 2 on Target Species

4.3.3.2.1 Effects on Groundfish

4.3.3.2.1.1 Walleye Pollock (EBS and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the EBS, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis will focus on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the draft programmatic groundfish SEIS (NMFS 2003a), the EBS and WCGOA walleye pollock stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are nearly entirely outside of walleye pollock habitat and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on walleye pollock.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – Because the fishing closures are not in areas typically occupied by walleye pollock, the impact of Alternative 2 on walleye pollock is insignificant.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – The impact of Alternative 2 on the breeding and spawning success of walleye pollock is insignificant.

Feeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – The major prey of adult walleye pollock appears to be euphausiids and forage fish (Yang 1993). As euphausiids and forage fish are pelagic rather than benthic in their distribution and are too small to be retained by fishing gear, Alternative 2 probably has little or no direct effect on the availability of prey to adult walleye pollock. The impact of Alternative 2 on the feeding success of walleye pollock is insignificant.

Growth to maturity (EBS Ø, WCGOA Ø, SeGOA U, AI U) – Alternative 2 would have little or no effect on growth to maturity of walleye pollock. Closing certain areas to bottom trawling along the shelf break would have an insignificant impact on walleye pollock.

4.3.3.2.1.2 Pacific Cod (EBS and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in Pacific cod fishing mortality would be expected as a result of adopting Alternative 2.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in spatial-temporal concentration of the Pacific cod catch would be expected as a result of adopting Alternative 2.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of spawning and breeding would be expected as a result of adopting Alternative 2.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of feeding would be expected as a result of adopting Alternative 2.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 2 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish.

Because the additional areas closed under Alternative 2 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 2 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of growth to maturity would be expected as a result of adopting Alternative 2.

4.3.3.2.1.3 Sablefish (EBS and GOA)

Stock Biomass (Ø) – Alternative 2 closes 11 areas of the GOA to slope rockfish bottom trawling. Some sablefish are caught as bycatch in the slope rockfish bottom trawl fishery. However the slope rockfish fishery likely would move to adjacent open areas of the slope, keeping total sablefish catch the same. Thus Alternative 2 likely would have an insignificant impact on sablefish biomass compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 2 would increase the spatial/temporal concentration of trawl fishing mortality compared to the status quo. The closed areas are relatively small in the central GOA, so that the increase in concentration would be small. The closed areas are relatively larger in West Yakutat and especially the western GOA, so the increase in concentration would be higher, up to 1/3 higher in the western GOA. However the trawl fishery is small (10 to 12 percent of total catch) relative to the longline fishery, which remains open in all areas. Thus Alternative 2 would not significantly change the spatial-temporal concentration of total fishing mortality (trawl and longline combined) compared to the status quo.

Spawning/Breeding (Ø) – Changes to the slope rockfish trawl fishery have no direct effect on sablefish spawning compared to the status quo because sablefish spawning occurs during winter whereas the slope rockfish trawl fishery is open during summer. Changes in sablefish spawning due to effects of fishing on physical structure are projected to decrease slightly compared to the status quo.

Feeding (Ø) – Benthic prey (epifauna and infauna) are substantial prey items for sablefish. The slope rockfish trawl fishery closure areas for Alternative 2 probably would have little effect on availability of benthic prey to sablefish. Total trawl effort would not change for Alternative 2 as slope rockfish fishing would shift to open areas. Trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing (e.g., effects of fishing that impact sablefish habitat with a subsequent effect on some aspect of sablefish life history) would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Overall, habitat-mediated effects on feeding due to physical structure are projected to decrease slightly compared to the status quo.

Growth to maturity (Ø) – The slope rockfish closure areas for Alternative 2 probably would have little effect on growth to maturity of sablefish. Total trawl effort would not change for Alternative 2 as slope rockfish fishing would shift to open areas. Trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Overall, habitat-mediated effects on growth to maturity due to physical structure are projected to decrease slightly compared to the status quo.

The slope rockfish closure areas for Alternative 2 probably would have only a slight overall effect on sablefish compared to the status quo. Total trawl effort would not change for Alternative 2 as slope rockfish fishing would shift to open areas and biomass would stay about the same. Concentration of fishing also would remain about the same because only the smaller trawl fishery is affected by the

closures. Trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Overall, habitat-mediated effects due to physical structure are projected to decrease slightly compared to the status quo.

4.3.3.2.1.4 Atka Mackerel (EBS and GOA)

Stock Biomass (Ø) – This alternative is not expected to impact the stock biomass of Atka mackerel relative to the status quo. Alternative 2 closes areas in the GOA to rockfish bottom trawling. There is no directed fishery for Atka mackerel in the GOA, and the rating for stock biomass is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – Because the fishing closures are in the GOA where there is no directed fishery for Atka mackerel, this alternative would not have an effect on the spatial/temporal concentration of catch and the rating is no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Because the fishing closures are in the GOA where there is no directed fishery for Atka mackerel, this alternative is not likely have an effect on the spawning and breeding and the rating is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. In addition, the closed area in Alternative 2 is mostly directed at the GOA Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so that in theory, any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for Atka mackerel. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative were implemented, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to status quo. Therefore the rating for feeding is no effect.

Growth to maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The directed fishery in the AI overlaps with late juvenile/mature adult habitat at depths of generally less than 200 m.

Alternative 2 closes areas in the GOA to rockfish bottom trawling. There is no directed fishery for Atka mackerel in the GOA, and the rating for growth to maturity is no effect.

4.3.3.2.1.5 Yellowfin Sole (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS yellowfin sole would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.6 Greenland Turbot (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS Greenland turbot would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.7 Arrowtooth Flounder (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA arrowtooth flounder biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Relative to the status quo, Alternative 2 would have no effect on EBS arrowtooth flounder biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Sample 1997).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA arrowtooth flounder since there would be no changes in the spatial/temporal concentration of the catch. Since GOA arrowtooth flounder are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Relative to the status quo, Alternative 2 would have no effect on EBS arrowtooth flounder since there would be no changes in the spatial/temporal concentration of the catch. Since EBS arrowtooth flounder are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA arrowtooth flounder since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish.

When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.8 Rock Sole (EBS)

Stock Biomass (Ø) – Relative to the status quo, Alternative 2 would have no effect on EBS rock sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on EBS rock sole, since there would be no changes in the spatial/temporal concentration of the catch. Since EBS rock sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on EBS rock sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.9 Flathead Sole (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA and EBS flathead sole, since there would be no change in the spatial/temporal concentration of the catch.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA flathead sole, since there would be no changes in the current management practices. Fishing effects on EFH are not expected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna, epifauna and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that Alternative 2 will change fishing effects on EFH such that they would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 2 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA rex sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA rex sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA rex sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.11 Alaska Plaice (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS Alaska plaice would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA shallow water flatfish management complex, the effect of Alternative 2 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA rock sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA rock sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA rock sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that Alternative 2 would alter fishing effects on EFH such that it would have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the deep water flatfish complex, the effect of Alternative 2 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA Dover sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA Dover sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 2 would have no effect on GOA Dover sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 is not expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that Alternative 2 would alter fishing effects on EFH such that it would have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 2 would have no effect on the growth to maturity for Dover sole. Within the first 2 years of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.3.2.1.14 Pacific Ocean Perch (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS Pacific ocean perch would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. Alternative 2 would likely have little impact on the stock biomass of Pacific ocean perch compared to the status quo. The 11 areas in the GOA that the alternative would close to rockfish bottom trawling cover a relatively small portion of the slope, geographically, and do not appear to coincide with many areas of high Pacific ocean perch concentrations.

Spatial/Temporal Concentration of the Catch (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. Because the fishing closures are geographically small and generally not in areas with high Pacific ocean perch concentrations, Alternative 2 would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. Because the fishing closures are geographically small and generally not in areas with high Pacific ocean perch concentrations, Alternative 2 would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 2 on Pacific ocean perch spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 2.

Growth to Maturity (Ø) – Alternative 2 would likely have little impact on the growth to maturity of Pacific ocean perch compared to the status quo. The fishing closures are geographically small and generally not in areas with high Pacific ocean perch concentrations.

Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. If the bottom trawl closures coincide with juvenile habitat then damage to this epifauna by bottom trawls would be reduced in closed areas.

Areas of the slope closed only to bottom trawling would not likely serve as refugia for Pacific ocean perch because trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002).

4.3.3.2.1.16 Shortraker and Rougheye Rockfish (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects on EBS rougheye and shortraker rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – Alternative 2 would likely have little impact on the stock biomass of shortraker and rougheye rockfish compared to the status quo. The 11 areas in the GOA that the alternative would close to rockfish bottom trawling cover a relatively small portion of the slope. Fishery data indicate catches of shortraker and rougheye rockfish are rather evenly spread along the continental slope of the GOA, especially in the central GOA and west Yakutat areas, where most of the catch is taken. This lack of geographic catch concentration may be due to Council regulations that allow these species to only be taken as bycatch in other fisheries. About 40 percent of the shortraker/rougheye catch in recent years has come from longline fisheries that target on sablefish and halibut (Heifetz et al. 2002). These fisheries are open continuously between March and November, which causes the catch to be spread out over this period. Since shortraker and rougheye are only taken as bycatch and because distribution is evenly spread over a wide geographical area it is unlikely that the closure of the 11 proposed areas under Alternative 2 would have an effect on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – Because the fishing closures proposed under Alternative 2 are widely distributed small geographical areas, this alternative would have a negligible effect on the spatial/temporal concentration of catch. Fishery data indicates shortraker and rougheye rockfish catches are evenly spread along the continental slope of the GOA and occurs as bycatch to other target fisheries which does not indicate any specific concentration of effort or removals. Any population structure that may exist appears to be on a larger scale than the proposed closure areas (Gharrett 2003).

Spawning/Breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur in February through August for shortraker rockfish, and in December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish is unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp, and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small in size, they are generally not taken in bottom-tending fishing gear. The closure areas proposed under Alternative 2 are small in total geographic area and are closed only to directed slope rockfish fishing which generally is only a few weeks in duration. Therefore, it is unlikely the effects of Alternative 2 would lead to a change in food availability to shortraker or rougheye rockfish.

Growth to maturity (Ø) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Status quo fishing appears to have no effect on the habitat of juvenile shortraker rockfish, whereas the eastern GOA trawl closure may have a positive impact. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to firmly conclude that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals. Since the closure areas proposed under Alternative 2 are small in total geographic area and may still be trawled in by fisheries other than the directed slope rockfish fishery, it is unlikely that the effects of Alternative 2 would lead to any major benefit to shortraker and rougheye rockfish.

4.3.3.2.1.18 Northern Rockfish (EBS)

Alternative 2 prohibits the use of bottom trawls for rockfish in 11 areas of the GOA slope (200 to 1,000 m), and has the objective of allowing benthic habitat in these areas to recover or remain relatively undisturbed. Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS northern rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. Alternative 2 would likely have little impact on the stock biomass of northern rockfish compared to the status quo. The 11 areas in the GOA that the alternative would close to rockfish bottom trawling cover a relatively small portion of the slope, geographically, and do not appear to coincide with many areas of high northern rockfish concentrations. Trawl surveys and commercial fishing data indicate that the

preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). The closed areas are all from 200 to 1,000 m.

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. Because the fishing closures are geographically small and generally not in areas with high northern rockfish concentrations, Alternative 2 would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. Because the fishing closures are geographically small and generally not in areas with high northern rockfish concentrations, Alternative 2 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 2 on northern rockfish spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 2.

Growth to Maturity (Ø) – Alternative 2 would likely have little impact on the growth to maturity of GOA northern rockfish compared to the status quo. The fishing closures are geographically small and generally not in areas with high northern rockfish concentrations.

4.3.3.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA is comprised of three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*) and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on this species as a proxy for the pelagic shelf rockfish management group.

Stock Biomass (Ø) – Alternative 2 would likely have little impact on the stock biomass of light dusky rockfish compared to the status quo. The 11 areas in the GOA that the alternative would close to rockfish bottom trawling cover a relatively small portion of the slope, and all are in depths more than 200 m. In contrast, the fishing grounds that account for most of the catch of light dusky rockfish are all on the outer shelf in depths less than 200 m.

Spatial/Temporal Concentration of the Catch (Ø) – Because the fishing closures are not in areas where most light dusky rockfish are caught, Alternative 2 would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring, based on observations of ripe females sampled on a research cruise in April in the central GOA. Because of this lack of knowledge, the effects of Alternative 2 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution and they are so small they are not retained by any fishing gear, Alternative 2 probably has little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closure areas apparently are directed mostly at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so in theory, any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for light dusky rockfish. However, the small total area of the closures would probably not lead to much of a reduction in the catch of Pacific ocean perch, and food availability to light dusky rockfish would be mostly unchanged.

Growth to maturity (Ø) – Alternative 2 would have little or no effect on growth to maturity of light dusky rockfish. Closing certain areas to bottom trawling could potentially have a benefit to light dusky rockfish because evidence suggests the fish may be associated with epifauna and rocky substrates. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the closure areas in this alternative are too small and are located in areas inhabited by few light dusky rockfish, so they provide very little benefit to these fish.

4.3.3.2.1.21 Other Rockfish Species (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS other rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.22 Shortspine Thornyheads (EBS)

Alternative 2 does not affect harvest policies in the EBS, and thus the effects of Alternative 2 on EBS shortspine thornyheads would be expected to remain identical to those discussed under Alternative 1.

4.3.3.2.1.23 Forage Species (EBS and GOA)

Stock Biomass (Ø) – The impact of Alternative 2 on forage species is likely to be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 2 would lead to a change in the stock biomass from the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 2 are not in areas of significant forage species bycatch. Alternative 2 is thought to have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 2 are not thought to be important to the spawning and breeding of forage species. Alternative 2 would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 2 are not thought to be important to the feeding ecology of forage species. Alternative 2 would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 2 are not thought to be important to the feeding ecology of forage species. Alternative 2 would have minimal effect on the growth to maturity of forage species.

4.3.3.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.3.2.2.1 Salmon

Stock Biomass (Ø) – No changes in the catch of salmon would be expected under Alternative 2, so no effects would be anticipated.

Spatial/Temporal Concentration (Ø) – None of the alternatives considered would affect the salmon fisheries. Thus, no changes in the distribution and intensity of fishing effort for salmon is expected under Alternative 2.

Spawning/Breeding (Ø) – No fisheries in Alaska are thought to adversely affect salmon habitat since there is almost no fishing effort (except some very small recreational and subsistence fisheries) in freshwater spawning and rearing areas. Alternative 2 does not modify any activities in these areas, thus no effects on spawning and breeding of salmon would be expected under Alternative 2.

Feeding (Ø) – No changes would be expected in the catch of prey for salmon under Alternative 2, so Alternative 2 would be expected to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in the habitat used by juvenile salmon or the survival of juvenile salmon would be expected under Alternative 2. The bycatch amounts of juvenile salmon in the GOA rockfish fisheries is in the order of only a few fish per year (NMFS data). Thus, the closures to rockfish fisheries under Alternative 2 would be expected to have no effect on the growth to maturity of salmon.

4.3.3.2.2.2 Crabs

Stock Biomass (Ø) – The catch of EBS crabs would not be affected by GOA trawl closures under Alternative 2, so no effects on stock biomass would be anticipated.

Spatial/Temporal Concentration (Ø) – The distribution and intensity of fishing effort in the EBS crab fisheries would not be affected by GOA trawl closures under Alternative 2, so no effects on spatial/temporal concentration of catch would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of EBS crabs would be expected under Alternative 2.

Feeding (Ø) – GOA trawl closures would have no effect on EBS crab feeding, and thus Alternative 2 is considered to have no effect on feeding of crab species.

Growth to Maturity (Ø) – GOA trawl closures of Alternative 2 would have no effect on EBS crab habitat or juvenile survival.

4.3.3.2.2.3 Scallops

Stock Biomass (Ø) – None of the trawl closure areas proposed for Alternative 2 overlap with scallop distribution. Therefore, Alternative 2 would be expected to have no effect on scallop stock biomass.

Spatial/Temporal Concentration (Ø) – No substantial changes in the distribution and intensity of fishing effort would be expected under Alternative 2.

Spawning/Breeding (Ø) – Alternative 2 closures, which do not overlap with scallop distribution at all, would have no effect on spawning and breeding of weathervane scallops.

Feeding (Ø) – No redistribution of fishing effort by dredge or trawl gear to areas with scallops would be expected and thus there would be no effects on the feeding of scallops under Alternative 2.

Growth to Maturity (Ø) – No additional dredge effort is expected under Alternative 2, and thus no changes in survival or growth to maturity would be expected.

4.3.3.3 Effects of Alternative 2 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 2 on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.3 of the RIR/IRFA (Appendix C).

4.3.3.3.1 Effects on Passive Use Values (E+)

Under Alternative 2, non-pelagic trawl (NPT) fishing activities targeting slope rockfish in 11 designated areas of the GOA would be eliminated. While it is not possible at this time to provide an empirical estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 2 would yield some incremental increase in the passive-use benefit of EFH over the status quo Alternative 1. Alternative 2 would reduce the impact of NPT fishing for slope rockfish over 10,228 square kilometers (sq. km) of GOA shelf and slope edge habitat, or 3.7 percent of the existing fishable area of 279,874 sq. km in the GOA.

Alternative 2 was designed to reduce the effects of NPT fishing for slope rockfish on EFH in the GOA beyond those measures currently in place or planned as part of other fishery management actions. Current scientific knowledge does not permit either a quantitative or qualitative assessment of the use or productivity benefits derived from minimizing the effects of fishing on EFH. However, the assumption implicit in the Magnuson-Stevens Act requirement to minimize effects of fishing on EFH is that doing so would result in sustained or enhanced production from FMP species and would contribute to a healthy ecosystem. As such, Alternative 2 would contribute additional measures that would further reduce the impacts of fishing on EFH.

4.3.3.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (Ø)
Alternative 2, had it been in place in 2001, would have placed a total of approximately $900,000 of gross revenue at risk in the GOA NPT slope rockfish target fisheries (including the value of retained bycatch). The revenue at risk would have been equal to 9.6 percent of the total status quo revenue of

$9.36 million (Table 3.3-1). Alternative 2 imposes no EFH fishing impact minimization measures in the EBS and AI.

Within the GOA, the largest amount of revenue at risk would have been in the central GOA (CG) with $640,000 at risk, or 8.1 percent of the $7.95 million status quo revenue in the CG. The revenue at risk in the western GOA (WG) totals $230,000, or 28.9 percent of the total status quo revenue of $790,000, reported in 2001. There would have been less revenue at risk in the eastern GOA (EG), equaling $22,711 or 3.6 percent of the $620,000 status quo revenue, reported in 2001, in the EG.

The only fishery that would have been directly affected by the EFH fishing impact minimization measures under Alternative 2 is the NPT slope rockfish fishery in the GOA. The total revenue at risk in this fishery would have been $900,000, or 9.6 percent of the status quo revenue of $9.36 million. The catcher-processor fleet would have had the greatest amount of revenue at risk at $870,000, or 12.3 percent of the status quo total revenue. The catcher-vessel fleet would have $28,570 of ex-vessel revenue at risk, or 1.2 percent of the 2001 total status quo ex-vessel revenue of $2.33 million. The catcher-vessel fleet would have had revenue at risk only in the CG, whereas the catcher-processor fleet would have had revenue at risk in both the CG and WG. Catcher-processor fleet revenue at risk in the CG would have equaled $620,000, or 10.9 percent of 2001 status quo. The catcher-vessel fleet would also have had $230,000 revenue at risk in the WG or 28.9 percent of the $790,000 status quo 2001 gross revenue in the WG, and nearly all of the $22,711 in revenue at risk in the EG as well.

The revenue at risk in the catcher-vessel fleet would have been very small compared with the status quo revenue. Therefore, some or all of the revenue at risk could possibly have been mitigated by redeploying NPT fishing effort into adjacent areas not affected by the EFH fishing impact minimization measures under Alternative 2. Although the revenue at risk in the catcher-processor fleet under Alternative 2 would have been larger than that in the catcher-vessel fleet and represented more than 12 percent of the total status quo revenue in the catcher-processor fleet component of this fishery, catcher-processor revenue at risk might also have been be mitigated by redeploying NPT fishing effort for slope rockfish to fishing areas adjacent to the EFH affected areas.

It is not possible to estimate the amount of the revenue at risk under Alternative 2 that could have been recovered by redeployment of fishing effort to adjacent areas or to alternative fishing gears without a thorough understanding of the fishing strategies that would actually have been employed by fishermen in response to the impacts of the EFH fishing impact minimization measures imposed by Alternative 2.

Revenue impacts from changes in product quality could have been minimal under Alternative 2 for both catcher-vessel and catcher-processor fleet components. The small catch and revenue at risk in the catcher-vessel fleet component of the NPT slope rockfish fishery could possibly have been recovered by redeploying fishing effort to areas adjacent to the EFH fishing impact minimization measure areas with minimal additional time required to attain the necessary catch and deliver it to a shore-based plant for processing. Product quality would not likely have been affected in the catcher-processor fleet component since these vessels process the catch onboard the vessel.

Operating Costs (E-)

Operating cost impacts under Alternative 2 could have been minimal for the catcher-vessel fleet given the very small amount of revenue at risk for this fleet component. Operational costs for the catcher-processor fleet component might have increased due to the redeployment of fishing effort necessary to mitigate the 12.3 percent of the status quo revenue at risk for this fleet component. Fishing effort redeployed into areas adjacent to the EFH fishing impact minimization measure areas might have had

lower CPUE of slope rockfish, requiring additional fishing effort to mitigate the catch and revenue at risk. There may have been crowding externalities, as well, as effort became concentrated in remaining open areas (Table 3.3-1).

Costs to U.S. Consumers (E-)
Had it been in place in 2001, Alternative 2 would likely have had some impact on the cost to consumers because, although some or all of the revenue at risk may have been recovered by redeployment of fishing effort, there would likely have been some operational cost increases for the fleet components. These operational cost increases due to Alternative 2 EFH fishing impact minimization measures may have resulted in changes in the product mix, quality, and availability and, therefore, could, under these rules, have resulted in a measurable increase in the cost to consumers of species caught in fisheries directly or indirectly affected by redeployment of the fishing effort. It is not possible, with data and market models currently available, to confirm the existence or size of these potential impacts.

Safety (E-)
Alternative 2 likely would not have affected safety in the catcher-vessel fleet component, given the unlikelihood of any significant changes in the operational aspects of this fleet. There could have been an increase in the safety impacts of Alternative 2 on the catcher-processor fleet component if additional fishing effort and time had been required to mitigate the revenue at risk for this fleet component.

Impacts to Related Fisheries (Ø)
Alternative 2 would have been unlikely to have significant impacts on related fisheries because NPT fishing effort for slope rockfish would likely have been redeployed into adjacent areas not affected by the fishing impact minimization measures. NPT fishing for slope rockfish currently occurs in those adjacent areas.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs may increase under Alternative 2, although it is not possible to estimate by what amount (Table 3.3-1). Under these regulations, additional on-water enforcement could have been needed, and a vessel monitoring system (VMS) system or 100 percent observer coverage could have been needed on all vessels targeting slope rockfish with NPT gear to assure compliance with the EFH fishing impact minimization measures applied to the 11 designated areas in the GOA.

4.3.3.3.3 Effects on Communities and Shoreside Industries (Ø)

Overview
Impacts on dependent communities and shoreside industries would have been insignificant if Alternative 2 had been in effect in 2001, although at least a few individual operations may have experienced adverse impacts, as detailed below. The only fisheries directly affected by this alternative would have been the rockfish fisheries in the GOA, and the only gear group directly affected (for both catcher vessels and catcher-processors) would have been non-pelagic trawl. Using 2001 fleet data, 23 vessels (both catcher vessels and catcher-processors) would have been affected by this alternative: 3 in Alaska, 4 from Oregon, 15 from Washington, and 1 from another state. Using 2001 processor data, ten shoreside processors in Alaska would potentially have been affected by this alternative.

Catcher Vessels
For catcher vessels, revenue at risk would have been exclusively concentrated in the CG and would represent 1.23 percent of the 2001 status quo value (about $29,000 out of $2.33 million) for rockfish fishery harvest of the affected vessels in this area. As noted elsewhere, figures given for catcher vessels

represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities if examined alone. Values for first wholesale revenues at risk by shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. As discussed earlier, given the location and size of the closure areas and the small proportion of catch at risk, it is assumed that vessels could have recovered any potential losses in catch through minimal additional effort. In 2001, the ownership of catcher vessels involved in the at-risk harvest was concentrated in Washington and Oregon communities (with five and four vessels, respectively). Within Alaska, only Kodiak and Anchorage had any vessel ownership, with just one vessel each. No significant impacts would have been likely for these communities as a result of changes that would have been associated with catcher vessels under this alternative, due to the low revenues at risk and the small numbers of vessels involved.

Catcher-Processors

For catcher-processors, revenue at risk would have been concentrated in the CG, but not exclusively so, and would have represented 12.24 percent of the 2001 status quo value (about $860,000 out of $7.04 million) for rockfish fishery harvest of affected vessels in the entire GOA. It is possible that catcher-processors could have made up foregone harvests from closed areas by fishing in adjacent open areas, but the costs associated with this increased effort are unknown at this time. The catcher-processors that would have been involved in the at-risk harvest in 2001 generally head, eviscerate, and freeze their catch (and are known as "head and gut" vessels). Ownership of these vessels was concentrated in Washington with ten vessels (Kodiak is the only Alaska community with ownership, and then only for one vessel; one catcher-processor was owned in an another state). No significant impacts would have been likely for the community of Kodiak as a result of changes that would have been associated with catcher-processors under this alternative, due primarily to having only a single vessel involved. Community-level impacts would not have been likely in Washington, even though most vessels with at-risk revenues were concentrated there, due to the large size and diversity of its economy. Individual entities may have experienced increased costs and/or reductions in harvest in 2001 were this alternative in place.

Shoreside Processors

A summary of the 2001 first wholesale market level impacts of Alternative 2 for shoreside processors (by FMP region of harvest) is presented below. These shoreside processor first wholesale impact estimates are strictly non-additive with the catcher vessel ex-vessel impact estimates associated with this alternative presented above. Indeed, were the data available to permit a quantitative net impact assessment, the ex-vessel revenues accruing to the catcher vessel operators delivering inshore would appropriately be accounted for as just one of many input costs to the plant's production process (e.g., electricity, water, packaging, labor, etc.). These input costs (e.g., ex-vessel payments to catcher vessels for delivery of raw fish) would be deducted from (rather than summed with) the plant's gross earnings, to arrive at net revenue, at this level of the market.

Being unable, due to data limitations, to carry out this final analytical step, the quantitative impact estimates are limited to gross effects. Both market-level impacts (i.e., ex-vessel and first wholesale) are presented in order to accommodate the specific information needs of each potentially affected sector (e.g., catcher vessels, catcher-processors/motherships, shoreside processors), but their interpretation and application (as noted above) should not be confused. The first wholesale information for shoreside processors may be taken as a proxy for some types of community impacts, but there are four main caveats for the use of this information for these purposes. First, a number of locally important sources of revenue such as fish taxes, which are the cornerstone of municipal revenues in some communities, are more closely tied to ex-vessel value of landings than to processor first wholesale values. Second, depending on the structure of the individual processors, the individual communities, and the

relationships between the two, more or less of the difference between the ex-vessel and first wholesale values may be realized as inputs to the local economy of any particular place. This is due, in part, to the degree to which the individual processing entities are effectively operating as industrial enclaves, the relationship of the workforce to the overall resident labor force (and general population) of the community, the degree of development of local support service industries, local public revenue and service provision structures, and the structure of ownership of the processing entity, among many other factors. Third, the information on first wholesale value for processors is available only on an FMP regional basis and cannot be directly attributed to individual communities, although inferences on general patterns of distribution of impacts may be drawn from the information presented below. Fourth, and perhaps most important, overall harvest levels would have been unlikely to change substantially as a direct result of this alternative (and a number of other alternatives). While individual entities may have been relatively advantaged or disadvantaged, it is likely that these gains and losses will be more or less neutral at the community level, although some cost increases may have occurred.

For shoreside processors in Alaska, no substantial impacts are likely to have been realized under this alternative because catcher vessel harvest levels probably would have remained constant, and no substantial change in the fishery that would alter delivery patterns would have occurred (although there may have been some relatively minor redistribution of catch among individual vessels). In 2001, processors involved in the at-risk harvest were concentrated in Kodiak, with eight entities involved. Unalaska/Dutch Harbor and Homer each had one processor that would have processed at least some volume landed by vessels that would have had some revenue at risk under this alternative. The total first wholesale value at-risk of catch delivered inshore for processing represents approximately 1 percent of the total 2001 status quo value (about $149,000 out of $10.78 million) of the relevant fisheries of the CG area, but no breakdown by port of landing is available. Given the very minor potential changes, however, no significant impacts would have been likely for Kodiak or for any other dependent community as a result of changes that would have been associated with processors under this alternative.

Multi-Sector Impacts

Multiple sector impacts are unlikely to have been significant at the community level under Alternative 2. Among Alaska communities, only Kodiak participated in more that one sector that would have had at-risk revenues, and then with only a single locally owned catcher vessel, a single locally owned catcher-processor, and multiple locally operating shoreside processors. As noted, impacts to shoreside processors would likely have been insignificant, due to the low volumes that would have been at risk and the assumption that overall delivery patterns would have been unlikely to change under this alternative. Some additional Alaska resident crew positions on vessels owned elsewhere may have had some compensation at risk, but overall potential for employment and wage or crew share compensation loss would have been small. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which in this case would have been concentrated in Kodiak. Given the assumption of general landing patterns remaining consistent, however, any vessel expenditure associated impacts would likely have been minor.

4.3.3.3.4 Effects on Regulatory and Enforcement Programs

Alternative 2, which would prohibit the use of bottom-trawl gear to target GOA slope rockfish species in designated areas of the slope, would increase the complexity of management of the fisheries for rockfish in the GOA. It would require changes in industry and observer reporting requirements and enforcement activity.

Catch accounting from inside and outside the restricted area is one basis for determining compliance with the bottom gear prohibition. The restrictions would, in effect, create new reporting areas. The status of the fishery for rockfish for vessels using bottom-trawl gear would change from open to closed, once the vessel crossed the boundary into the restricted area.

Catch is accounted for in two ways, by reports from the industry and from observers. The industry currently reports catch by federal reporting areas or State of Alaska statistical areas. Catcher vessels report on the basis of State of Alaska statistical areas, the boundaries of which do not coincide with the proposed closed areas. If a vessel reported catch from a statistical area straddling the boundary of the restricted area, the agency would not know whether the catch was from inside or outside the habitat protection area. For catcher-processors, which report on the basis of federal reporting areas, these difficulties would not occur.

However, a more encompassing problem is that vessels' reports of their catch location are not a reliable way of determining any fishing vessel's activity. Without some changes in reporting requirements, managers would not be able to strictly verify whether or not catch came from inside the restricted areas established by Alternative 2. Although observers provide location-specific fishery information from a portion of the fleet, current regulations do not require complete observer coverage on all vessels using trawl gear.

For vessels that do carry observers, although the catch is taken along a path, the location of the catch is defined by where it is hauled up. Under current data collection practice, these haul retrieval locations are copied by the observer from the vessel logbook. Under these procedures, vessels that started fishing inside an Alternative 2 protected area and finished outside, would report the entire haul from the external location, and the regulatory conditions for outside the restricted area would then apply. Managers could require that vessels include the initial location where the trawl was deployed in their report, but given that catch could be taken anywhere along the vessel's path, this still would not ensure an accurate picture of how much catch was taken inside or outside a protected area. To enforce compliance with the restricted areas, it might be necessary for management to impose conservative accounting rules, which would require that regulatory conditions in the restricted area apply to the catch if a vessel fished inside the restricted area at any time during a period over which catch was aggregated and reported. These conditions could have the effect of a de facto expansion of the closed area.

This is exactly what has happened under certain circumstances under the Steller sea lion protection measures. VMS is used to determine catch location in the Atka mackerel fishery in the AI. But even VMS, although it provides continuous fishing location reports, does not solve the problem of what percentage of the catch is taken from within a protected area. If a vessel goes into an area and its tow crosses an area restricted to protect Steller sea lion habitat, the conditions of the area apply to the entire tow. Furthermore, to ensure accurate reporting of the exact catch location and amount of catch, two observers are required on the vessels.

Another added complexity in terms of managing and enforcing the gear restrictions imposed under Alternative 2 would be the need to verify when pelagic and bottom-trawl gear were used. Under Alternative 2, pelagic trawl gear could be used for rockfish, but bottom-trawl gear would be restricted to targets other than rockfish in the designated protection areas. However, a vessel can carry multiple nets onboard, so it would not be possible to determine which fish onboard were taken with which net. Some catcher vessels and catcher-processors targeting rockfish use pelagic trawls for mid-water schooling species such as Pacific ocean perch, then switch nets to bottom trawls to obtain benthic-oriented

rockfish and other valuable species, particularly sablefish, that are closed to directed fishing, but may still be retained up to the maximum retainable amount (MRA) defined in regulations (50 CFR 679).

To a limited extent, observers can verify which trawls are in use. Currently, observers report which trawls are used for the portion of the total number of hauls that are observed. They are not, however, responsible for monitoring which type of trawl is being used on all hauls. Under Alternative 2, it would be difficult to verify claims made by vessels carrying both types of nets aboard, that the rockfish species aboard were taken in compliance with the restrictions.

It is not clear whether Alternative 2 would allow fishermen to use bottom trawls to take rockfish as incidental catch while targeting other fish. Presumably, they would be allowed to do so, as otherwise the alternative might as well simply ban bottom trawling altogether in the designated areas. Allowing vessels to take rockfish as incidental catch could undermine the intent of establishing these protected areas to protect habitat. For example, vessels fishing in the closed area might be able to target rex or Dover sole. When these species are open to directed fishing in the central GOA, vessels may retain up to 15 percent of combined (for example) shortraker/rougheye and thorny head rockfish. In other words, for every 100 mt of Dover sole retained, the vessel can retain 15 mt of rockfish. The rockfish may be caught incidentally to the Dover sole or it may be actively pursued after the Dover sole are taken, up to the 15 percent mark, which is known as "topping off." Under these conditions, and especially with the problems outlined above regarding the concise definition of catch location, the alternative as it is written would still allow some fishing for slope rockfish with bottom trawls in the protected habitat.

Fishing behaviors might even change to circumvent the intent of establishing the protected areas. The fishing fleet using bottom nets to catch rockfish might switch from rockfish and instead target a flatfish species that is of very low value and easy to catch, which could function as a basis for targeting higher-valued rockfish and sablefish within the closed area. If that happened, the goal of reducing the impact on the benthos would be undermined; indeed, impacts on habitat might increase if the new target species, previously not pursued, was found in areas previously not fished. If an alternate target flatfish fishery were to develop, regulations to deal with that activity might have to be drawn up much in the same manner that new regulations constraining the arrowtooth flounder target were adopted in August 1994 (59 FR 38132, July 27, 1994), prohibiting the practice of catching arrowtooth flounder strictly as a basis for retaining sablefish.

Pelagic trawls are also often fished in contact with the bottom, so if the intent was to ensure that all trawl gear is to be fished off bottom at all times, a new monitoring program would need to be established as well. In summary, Alternative 2 would present some challenges to management and enforcement. It would be difficult under the current reporting system to obtain accurate data on catch by area and by gear type, and the intention of the regulations to protect habitat could be undermined by changes in fishing behavior.

4.3.3.4 Effects of Alternative 2 on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – The 11 designated rockfish bottom trawl fishery closure areas in Alternative 2 do not fall within state waters, and therefore would not directly impact catch in the state waters of Pacific cod, PWS pollock, sablefish, and rockfish fisheries.

Lingcod are harvested in the CG and WG under state management using jig gear. They settle in kelp and eelgrass beds in their larval stage, moving to rocky reefs as adults. Similarly, black rockfish are a pelagic, nearshore species, with most catch occurring with jig gear in nearshore waters. The rockfish

bottom trawl fishery does not generally bycatch lingcod or black rockfish, and these closure areas are too far offshore to likely impact either species.

The State of Alaska manages demersal shelf rockfish in the EG. Most of the EG is already closed to bottom trawling, and the EFH fishing gear impact minimization on the slope included in Alternative 2 is likely to have no effect on this fishery.

State-managed Crab and Invertebrate Fisheries (E+) – Alternative 2 closes 11 relatively small areas to bottom trawling for rockfish in the central and western GOA, where Tanner and king crab stocks have been depressed in recent years. Species such as deep water Tanners (C. *angulatus and C. tanneri*) and golden king crab (*Lithodes aquispina*) are known to inhabit depths included in this alternative's closure areas. Thus these species could potentially benefit from the undisturbed habitat these closed areas would yield. However, the magnitude of this added benefit is unknown and must be considered an addition to the current habitat protection already in place, including the Type I, II, and III no bottom trawl areas designed to protect crab habitat around Kodiak and the closure of most nearshore waters to bottom trawl. Alternative 2 fishing impact minimization is likely to have no effect on state-managed invertebrate species harvested in nearshore waters or on Korean hair crabs stocks or fisheries in the EBS.

Herring Fisheries (Ø) – Herring inhabit and are harvested in nearshore waters in the GOA (Kruse et al. 2000) and would not be affected by the mitigation measures in Alternative 2.

Halibut Fisheries (Ø) – Alternative 2 would have no measurable effect on halibut fisheries. If effort in the rockfish trawl fishery is displaced as a result of the closures in Alternative 2, it is possible (although not expected) that rates and spatial distribution of halibut bycatch could change.

4.3.3.5 Effects of Alternative 2 on Protected Species

The discussion on protected species provided in this section relative to Alternative 2 is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (Ø) – Under Alternative 2, fishing patterns would change very little from Alternative 1. Any changes that did occur would be limited to the GOA, with potentially very minor shifts in trawl effort, out of the 11 closed areas and presumably into other adjacent areas or even other fisheries. Because the potential changes are so small, the current levels of mortality or potential injury to ESA-listed marine mammals, which currently are near zero, would remain about the same. Under Alternative 2, no additional, measurable impacts would occur from fishery-related prey removal, an issue which is primarily a concern only for Steller sea lions. Thus, Alternative 2 would have no additional adverse effects on ESA-listed marine mammals.

Other Marine Mammals (Ø) – Alternative 2 would likely result in a small amount of displaced effort in the GOA slope rockfish trawl fishery. The changes would have minimal impact on other marine mammals. These fishing activities would not likely impact sea otters or harbor seals, because this fishery occurs in offshore locations distant from sea otter and harbor seal habitat. Fur seals would have little chance of encountering these fisheries, except for brief periods of time during which seals are in transit to seasonal habitats that are not located in the GOA; similarly Alternative 2 would not likely affect the ice seals and walrus because they only inhabit the EBS. Other cetaceans are not currently adversely affected by GOA fisheries, either through injury or other taking or because of fishery removal of prey; thus it is reasonable to assume that only a very minor change in the overall pattern of

groundfish fishing in the GOA would not change this. Overall, Alternative 2 would have no adverse effect on other marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Under Alternative 2, the pattern of incidental take of ESA-listed salmon and steelhead in the groundfish fisheries of the GOA would likely continue to be the same as in Alternative 1. It is likely that very few endangered or threatened salmon or steelhead are taken as bycatch in the trawl fisheries in the GOA. Some take of these species has been documented from coded wire tag returns in the salmon bycatch of the GOA trawl fisheries. This bycatch is almost exclusively in the GOA midwater pollock trawl fishery. Since Alternative 2 does not affect this fishery, it is unlikely that there would be any effects on ESA-listed salmon or steelhead. There could be slightly increased levels of midwater trawl fishing from the displaced fishing activities from the EFH closed areas; with this might come some additional salmon bycatch. Take in past years, however, has been very small and largely undefined; thus any shift in fishing patterns that could increase midwater trawl fishing in the GOA under Alternative 2 could result in some small, but likely unmeasurable, bycatch of salmonid ESUs.

While salmon are considered a PSC in the GOA, there are currently no set limits in the GOA for salmon bycatch. However, PSC species must be discarded, adding some additional effort and thus cost to fishing operations, and thus areas of higher salmon bycatch would likely be avoided by GOA fisheries to the degree practicable. By avoiding areas of high salmon bycatch in general, this would likely help reduce the opportunity for taking ESA-listed salmonids also, as they likely co-mingle with other stocks of salmon on the high seas.

ESA-listed Seabirds (Ø) – The short-tailed albatross would not likely be affected by the redistribution of fishing effort resulting from Alternative 2 because to date there has not been a recorded mortality to this species from the trawl industry and the changes to this fishery would be very small. It is unlikely that trawl fishing vessels would convert to longline gear to fish for slope rockfish, so the incidental catch should not change. Steller's and spectacled eiders are not likely present in the offshore areas of the GOA where fishing activities affected by this alternative are prosecuted. Thus Alternative 2 would have no adverse effect on ESA-listed seabirds.

Other Seabirds (Ø) – Under Alternative 2, the incidental catch of northern fulmars, albatrosses, and shearwaters would likely continue at status quo levels, with the potential for a very slight increase in bycatch from displaced fishing activities. This may be countered by reduced mortality to these seabirds in the EFH bottom trawl closed areas. Because fishing patterns under Alternative 2 would be similar to the current status quo patterns, it is thus likely that Alternative 2 would have minimal effect on red-legged kittiwakes and Kittlitz's murrelets. For similar reasons, Alternative 2 would not have measurable adverse effects on piscivorous or planktivorous seabirds, although there could be some slight increase in the overlap of the displaced trawl fishing with some piscivorous seabirds that forage near several large colonies in the GOA. Seabird vessel strikes would likely not change from the status quo under Alternative 2. Programs to reduce seabird bycatch would continue under Alternative 2, which would be expected to help reduce bycatch in future years.

4.3.3.6 Effects of Alternative 2 on Ecosystems

Predator-Prey Relationships (Ø) – Alternative 2 is not expected to change in any substantial way biomass or numbers in prey populations, increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem due to Alternative 2 because catches of the main species affected (Pacific ocean perch)

would be expected to be the about same as the status quo (less than a 2 percent reduction). Similarly, trophic level of the catch would not be much different from status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators is expected under Alternative 2.

Energy Flow and Balance (Ø) – The amount and flow of energy flow in the ecosystem would be the same as the status quo with regards to the total level of catch biomass removals from groundfish fisheries. No substantial catch reductions, and no changes in discarding of any species would be expected.

Diversity (Ø) – Alternative 2 would likely have little change in species level diversity relative to the status quo, except that it could potentially help to maintain productive fish habitat and thereby help sustain fish populations that rely on slope areas. Functional (structural habitat) diversity could increase in the GOA if the bottom trawl closures overlap with coral distribution. Genetic diversity could slightly increase under Alternative 2 if older, more heterozygous individuals were left in the populations of Pacific ocean perch or other slope rockfish. Nevertheless, any changes in age distribution would be expected to be minimal under this alternative, because very little of the catch has come from the closure areas (less than 5 percent), and the closures are small enough that fish are likely to move into areas where they would be vulnerable to harvesting. Overall, this alternative was judged to have no substantial effect on diversity.

4.3.4 Effects of Alternative 3

4.3.4.1 Effects of Alternative 3 on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type differed from status quo for this alternative. LEIs for both status quo and Alternative 3 were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make then relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in the center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Habitat Complexity (E+) – Alternative 3 closes the entire GOA slope to rockfish fishing. The rockfish trawl fishery is the fishery with the most effect on the living structure habitat type and also is the most likely of the major fisheries on the GOA slope (deepwater flatfish being the other) to fish on the more sensitive hard substrates. LEI values were substantially reduced for soft bottom bio- (-37 percent) and nonliving (-17 percent) structure, hard bottom bio- (-43 percent), and nonliving (-45 percent) structure (Appendix B). Estimated increased effects on the adjacent deep shelf habitats from fishing redistribution were small proportional increases (less than 6 percent) to effects that were already small (less than 5 percent). Therefore, reducing the effects of the GOA slope rockfish fishery would provide an increased opportunity for complex bottom habitats to develop.

Effects on Biodiversity (E+) – The LEI value for coral on the GOA slope was lowered by 37 percent due to the slope closure to rockfish fishing. While the closure continues to allow some bottom trawling, elimination of the principal hard bottom fishery from the slope would be likely to substantially reduce the areas exposed to even minimal levels of bottom trawling, thus improving protection of corals.

4.3.4.2 Effects of Alternative 3 on Target Species

4.3.4.2.1 Effects on Groundfish

4.3.4.2.1.1 Walleye Pollock (EBS and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the EBS, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and WCGOA walleye pollock are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are nearly entirely outside of walleye pollock habitat and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on walleye pollock. Relative to the status quo, therefore, no substantial changes in EBS or WCGOA walleye pollock fishing mortality would be expected as a result of adopting Alternative 3.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – Because the area closed to fishing generally does not correspond with locations where walleye pollock reside, Alternative 3 would probably have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are nearly entirely outside of walleye pollock habitat and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on walleye pollock. Relative to the status quo, therefore, no substantial changes in the process of spawning and breeding would be expected as a result of adopting Alternative 3.

Feeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are nearly entirely outside of pollock habitat and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on pollock. Relative to the status

quo, therefore, no substantial changes in the process of feeding would be expected as a result of adopting Alternative 3.

Growth to maturity (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are nearly entirely outside of walleye pollock habitat and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on walleye pollock. Relative to the status quo, therefore, no substantial changes in the process of growth to maturity would be expected as a result of adopting Alternative 3.

4.3.4.2.1.2 Pacific Cod (EBS and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in Pacific cod fishing mortality would be expected as a result of adopting Alternative 3.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in spatial-temporal concentration of the Pacific cod catch would be expected as a result of adopting Alternative 3.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of spawning and breeding would be expected as a result of adopting Alternative 3.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of feeding would be expected as a result of adopting Alternative 3.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 3 is the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 are outside of Pacific cod EFH and because those additional closures apply only to vessels targeting rockfish, Alternative 3 is virtually identical to Alternative 1 with respect to its likely impacts on Pacific cod. Relative to the status quo, therefore, no substantial changes in the process of growth to maturity would be expected as a result of adopting Alternative 3.

4.3.4.2.1.3 Sablefish (EBS and GOA)

Stock Biomass (Ø) – Alternative 3 closes the GOA to slope rockfish bottom trawling. About 7 percent of the sablefish total catch comes from the slope rockfish bottom trawl fishery (1996 to 2000, Sigler et al. 2002). Thus Alternative 3 likely would result in a small, yet inconsequential, increase in sablefish biomass compared to the status quo, unless pelagic trawling or longlining substantially replace the banned rockfish bottom trawling.

Fishing currently is classified as directed based on the catch composition for the trip or the week. Thus fishermen can target rockfish in one or more tows, but the fishing not be classified as directed towards rockfish if the cumulative rockfish catch for the trip or week are not large enough. Thus some targeting of rockfish still might occur under Alternative 3 unless the classification scheme for directed fishing is changed.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 3 would decrease the spatial/temporal concentration of trawl fishing mortality compared to the status quo. The decrease would be small and probably inconsequential because the slope rockfish bottom trawl fishery only accounts for a small portion (10 to 12 percent) of the total sablefish catch. The effect would lessen if pelagic trawling or longlining substantially increased.

Spawning/Breeding (Ø) – Changes to the slope rockfish trawl fishery have no effect on sablefish spawning because sablefish spawning occurs during winter whereas the slope rockfish trawl fishery is open during summer. Habitat-mediated effects on sablefish spawning due to physical structure are projected to decrease substantially under Alternative 3 compared to the status quo.

Feeding (Ø) – Benthic prey (epifauna and infauna) are substantial prey items for sablefish. The slope rockfish trawl fishery closure areas for Alternative 3 might increase availability of benthic prey to sablefish to the extent that reduced slope rockfish trawling improves habitat (minor improvements are

projected compared to the status quo). On the other hand, trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Habitat-mediated effects on sablefish feeding due to physical structure are projected to decrease substantially under Alternative 3 compared to the status quo.

Growth to maturity (Ø) – The slope rockfish closure areas for Alternative 3 probably would have little effect on growth to maturity of sablefish. On the other hand, trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Habitat-mediated effects on sablefish growth to maturity due to physical structure are projected to decrease compared to the status quo. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may improve under Alternative 3, thereby increasing juvenile survivorship especially for areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity currently is high.

The slope rockfish closure areas for Alternative 3 likely would have some, but not substantial, effects on sablefish compared to the status quo. Sablefish abundance may increase slightly and benthic prey availability might increase. On the other hand, trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Habitat-mediated effects on sablefish due to physical structure are projected to decrease compared to the status quo. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may improve under Alternative 3, thereby increasing juvenile survivorship especially for areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity currently is high.

4.3.4.2.1.4 Atka Mackerel (EBS and GOA)

Stock Biomass (Ø) – This alternative would likely have little or no impact on the stock biomass of Atka mackerel relative to the status quo. Alternative 3 only affects bottom trawling in the GOA for species in the slope rockfish management. Closure of bottom trawling for slope rockfish might somewhat reduce the bycatch of GOA Atka mackerel in the slope rockfish fisheries, but the amounts would be negligible, and the rating for stock biomass is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – Because the fishing closures are in the GOA where there is no directed fishery for Atka mackerel, Alternative 3 would not have an effect on the spatial/temporal concentration of catch and the rating is no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Because the fishing closures are in the GOA where there is no directed fishery for Atka mackerel, Alternative 3 is not likely to have an effect on the spawning and breeding and the rating is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. In addition, the closed area in Alternative 3 is mostly directed at the GOA Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so in theory any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for Atka mackerel. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative were implemented, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to status quo. Therefore the rating for feeding is no effect.

Growth to maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The directed fishery in the AI overlaps with older juvenile/mature adult habitat at depths of generally less than 200 m.

Alternative 3 closes areas in the GOA to slope rockfish bottom trawling. There is no directed fishery for Atka mackerel in the GOA, and the rating for growth to maturity is no effect.

4.3.4.2.1.5 Yellowfin Sole (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS yellowfin sole would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.6 Greenland Turbot (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS Greenland turbot would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.7 Arrowtooth Flounder (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA arrowtooth flounder biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA arrowtooth flounder since there would be no changes in the spatial/temporal concentration of the catch. Since GOA arrowtooth flounder are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA arrowtooth flounder since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Adult feeding (Ø) – Relative to the status quo, Alternative 3 is not expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 3 would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.4.2.1.8 Rock Sole (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS rock sole would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.9 Flathead Sole (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA and EBS flathead sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA and EBS flathead sole are managed as separate stocks and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA and EBS flathead sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 is not expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 3 would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.4.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 3 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA rex sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA rex sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA rex sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 is not expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 3 would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.4.2.1.11 Alaska Plaice (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS Alaska plaice would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA shallow water flatfish complex, the effect of Alternative 3 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA rock sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA rock sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA rock sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 3 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since federal fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.4.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the deep water flatfish complex, the effect of Alternative 3 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA Dover sole, since there would be no changes in the spatial/temporal concentration of the catch. Since GOA Dover sole are managed as a single stock and the harvest can be characterized as lightly exploited, spread out over time and space, it is not expected that the current harvest practices have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 3 would have no effect on GOA Dover sole, since there would be no changes in the current management practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 is not expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 3 would have no effect on the growth to maturity for Dover sole. Within the first year of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since federal fishing does not occur at inshore nursery grounds, there is no effect from fishing on survival and growth to maturity.

4.3.4.2.1.14 Pacific Ocean Perch (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS Pacific ocean perch would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – Alternative 3 could have a substantial impact on the catch of Pacific ocean perch compared to the status quo, but it will depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, the effort may move onto the shelf and into the gullies. Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope may convert to pelagic trawl gear. In either case, the stock biomass is likely to remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – Closing the slope to directed rockfish bottom trawling could have a substantial impact on the spatial/temporal concentration of Pacific ocean perch catch compared to the status quo, but it will depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies. This could result in increased fishing pressure in these areas and under a short duration open access fishery could increase the risk of localized depletion in these areas.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, and current levels of fishing pressure on the slope could continue.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, Alternative 3 would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 3 on Pacific ocean perch spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 3.

Growth to Maturity (Ø) – Alternative 3 could have a positive impact on the growth to maturity of Pacific ocean perch compared to the status quo. The fishing closures are geographically large, but probably do not coincide with juvenile Pacific ocean perch habitat. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults, and may also be associated with epifauna that provides structural relief on the bottom. Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. However, if the bottom trawl closures coincide with juvenile habitat then damage to this epifauna by bottom trawls would be reduced in closed areas.

Areas of the slope closed only to bottom trawling would not likely serve as refugia for Pacific ocean perch because trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002).

4.3.4.2.1.16 Shortraker and Rougheye Rockfish (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects on EBS rougheye and shortraker rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – This alternative would likely have little impact on the stock biomass of shortraker and rougheye rockfish compared to the status quo. Alternative 3 closes directed bottom trawling for species in the slope rockfish management group; however, there is no directed fishery for shortraker/ rougheye, and about 40 percent of the shortraker/rougheye catch in recent years has come from longline fisheries that target on sablefish and halibut (Heifetz et al. 2002). These fisheries are open continuously between March and November, which causes the catch to be spread out over this period. Since shortraker and rougheye are only taken as bycatch and because distribution is evenly spread over a wide geographical area, it is unlikely that the measures under Alternative 3 would have an effect on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – Fishery data indicates shortraker and rougheye rockfish catches are evenly spread along the continental slope of the GOA and occur as bycatch to other target fisheries, which does not indicate any specific concentration of effort or removals. Since there are multiple target fisheries including longline fisheries that routinely harvest shortraker/rougheye, there

is little evidence to suggest that the spatial/temporal concentration of catch would change if the slope rockfish bottom trawl fishery were closed.

Spawning/Breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur in February through August for shortraker rockfish, and in December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish is unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp, and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small in size, they are generally not taken in bottom-tending fishing gear. Consequently, Alternative 3 probably has little or no direct effect on prey availability to adult shortraker and rougheye rockfish. The closure areas are large in total geographic area but are closed only to directed slope rockfish fishing, which generally is only a few weeks in duration. Therefore, it is unlikely the effects of Alternative 3 would lead to a change in food availability to shortraker or rougheye rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to firmly conclude that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the proposed closures in this alternative are only closed to directed rockfish bottom trawling and would still be open to other directed fisheries, which may continue to damage sensitive benthic fauna. To really evaluate this possible problem, additional research is needed to determine how essential are these associations to the health of the stocks and how much damage is actually being done by fishing gear. Therefore, it is unknown at this time what effects Alternative 3 would have on these species.

4.3.4.2.1.18 Northern Rockfish (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects on EBS northern rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. This alternative would likely have little impact on the stock biomass of northern rockfish compared to the status quo. The closed slope areas in the GOA are all 200 to 1,000 m deep. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, the areas that the alternative would close to rockfish bottom trawling do not appear to coincide with areas of high northern rockfish concentrations.

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST, and this alternative would likely result in GOA northern rockfish sustaining

themselves above MSST. Closing the slope to directed rockfish bottom trawling could have an impact on the spatial/temporal concentration of northern rockfish catch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, movement of the Pacific ocean perch bottom trawl fishery could result in increased fishing pressure in areas of high northern rockfish concentrations and under a short duration open access fishery could increase the risk of overfishing and or localized depletion in these areas.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear which would have little effect on northern rockfish.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, Alternative 3 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 3 on northern rockfish spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 3.

Growth to Maturity (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. However, this alternative could have a negative impact on the growth to maturity of northern rockfish compared to the status quo. The fishing closures are geographically large, but probably do not coincide with adult or juvenile northern rockfish habitat. Studies using submersibles have indicated that several species of rockfish appear to use rocky, shallower habitats during their juvenile stage (Carlson and Straty 1981, Kreiger 1993). Although these studies did not specifically observe northern rockfish, it is reasonable to suspect that juvenile northern rockfish also use these shallower habitats as refuge areas. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Northern rockfish appear to be associated with relatively rough bottoms on these banks, and they are mostly demersal in their distribution (Pers. comm. Dave Clausen). Observations from a submersible in the AI have also identified adult northern rockfish associated with boulders and sponges in mixed sand/gravel on the shallow (less than 200 m) slope. Consequently, there is some anecdotal evidence to suggest that adult and juvenile northern rockfish may be associated with living and nonliving structure on the bottom which could be negatively impacted by the effects of bottom trawling. Pacific ocean perch are caught in the commercial fishery on the shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies where concentrations of northern rockfish are found.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, which would have little effect on northern rockfish.

4.3.4.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA is comprised of three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on this species as a proxy for the pelagic shelf rockfish management group.

Stock Biomass (Ø) – Alternative 3 would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo. Alternative 3 only affects bottom trawling for species in the slope rockfish management group, and the directed bottom trawl fishery for light dusky rockfish would continue similar to its present state. Closure of bottom trawling for slope rockfish might somewhat reduce the bycatch of light dusky rockfish in the slope rockfish fisheries, but the closure only applies to waters of the continental slope at depths from 200 to 1,000 m, where few light dusky rockfish are found.

Spatial/Temporal Concentration of the Catch (Ø) – Because the area closed to fishing generally does not correspond with locations where light dusky rockfish are abundantly caught (the closed area is too deep), Alternative 3 would probably have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring (based on observations of ripe females sampled on a research cruise in April in the central GOA). Because of this lack of knowledge, the effects of Alternative 3 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution and they are so small they are not retained by any fishing gear, Alternative 3 probably has little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closed area in Alternative 3 is mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch so, in theory, any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for light dusky rockfish. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative went into effect, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to light dusky rockfish would be unchanged compared with the status quo.

Growth to maturity (Ø) – Alternative 3 would have little or no effect on growth to maturity of light dusky rockfish. Closing certain areas to bottom trawling could potentially have a benefit to light dusky

rockfish because evidence suggests the fish may be associated with epifauna and rocky substrates. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the large closed area in this alternative is located in deeper water than that inhabited by most light dusky rockfish and therefore provides little benefit to these fish.

4.3.4.2.1.21 Other Rockfish Species (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS other rockfish would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.22 Shortspine Thornyheads (EBS)

Alternative 3 does not affect harvest policies in the EBS, and thus the effects of Alternative 3 on EBS shortspine thornyheads would be expected to remain identical to those discussed under Alternative 1.

4.3.4.2.1.23 Forage Species (EBS and GOA)

Stock Biomass (Ø) – The impact of Alternative 3 on forage species would likely be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 3 would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 3 are not in areas of significant forage species bycatch. Alternative 3 would be expected to have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 3 are not thought to be important to the spawning and breeding of forage species. Alternative 3 would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 3 are not thought to be important to the feeding ecology of forage species. Alternative 3 would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 3 are not thought to be important to the feeding ecology of forage species. Alternative 3 would have minimal effect on the growth to maturity of forage species.

4.3.4.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.4.2.2.1 Salmon

Stock Biomass (Ø) – No changes in the catch of salmon would be expected under Alternative 3, so no effects would be anticipated.

Spatial/Temporal Concentration (Ø) – None of the alternatives considered would affect the salmon fisheries. Thus, no changes in the distribution and intensity of fishing effort for salmon would be expected under Alternative 3.

Spawning/Breeding (Ø) – No fisheries in Alaska are thought to adversely affect salmon habitat given almost no effort (except some very small recreational and subsistence fisheries) in freshwater spawning and rearing areas. Alternative 3 does not modify any activities in these areas, thus no effects on spawning and breeding of salmon would be expected under Alternative 3.

Feeding (Ø) – No changes would be expected in the catch of prey for salmon under Alternative 3, so Alternative 3 would be expected to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in the habitat used by juvenile salmon, or the survival of juvenile salmon would be expected under Alternative 3. The bycatch amounts of juvenile salmon in the GOA rockfish fisheries is in the order of only a few fish per year (NMFS data). Thus, the closures to rockfish fisheries under Alternative 3 would be expected to have no effect on the growth to maturity of salmon.

4.3.4.2.2.2 Crabs

Stock Biomass (Ø) – The catch of EBS crabs would not be affected by GOA trawl closures under Alternative 3, so no effects on stock biomass would be anticipated.

Spatial/Temporal Concentration (Ø) – The distribution and intensity of fishing effort in the EBS crab fisheries would not be affected by GOA trawl closures under Alternative 3, so no effects on spatial/temporal concentration of catch would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of EBS crabs would be expected under Alternative 3.

Feeding (Ø) – GOA trawl closures would have no effect on EBS crab feeding, and thus Alternative 3 is considered to have no effects on feeding of crab species.

Growth to Maturity (Ø) – GOA trawl closures of Alternative 3 would have no effect on EBS crab habitat or juvenile survival.

4.3.4.2.2.3 Scallops

Stock Biomass (Ø) – None of the trawl closure areas proposed for Alternative 3 overlap with scallop distribution. Therefore, Alternative 3 is anticipated to have no effect on scallop stock biomass.

Spatial/Temporal Concentration (Ø) – No substantial changes in the distribution and intensity of fishing effort is expected under Alternative 3.

Spawning/Breeding (Ø) – Alternative 3 closures, which do not overlap with scallop distribution at all, would have no effect on spawning and breeding of weathervane scallops.

Feeding (Ø) – No redistribution of fishing effort by dredge or trawl gear to areas with scallops would be expected, and thus no effects on the feeding of scallops would be anticipated.

Growth to Maturity (Ø) – No additional dredge effort is expected under Alternative 3, and thus no changes in survival or growth to maturity would be expected.

4.3.4.3 Effects of Alternative 3 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 3 on federally managed fisheries. For additional detail and supporting analysis, refer to the RIR/IRFA (Appendix C).

4.3.4.3.1 Effects on Passive Use Values (E+)

Under the simplifying analytical convention that Alternative 3 was in effect in 2001, NPT fishing activities targeting rockfish along the slope (200 to 1,000 m) of the GOA would have been eliminated. While it is not possible at this time to provide an empirical estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 3 would yield some incremental increase in the passive-use benefit of EFH over the status quo Alternative 1. Alternative 3 would minimize the impact of NPT fishing for slope rockfish over 29,059 sq. km of GOA shelf and slope edge habitat, or 10.4 percent of the existing fishable area of 279,874 sq. km. Whether this additional habitat protection would provide increased productivity over the status quo Alternative 1 or other action alternatives is unknown at this time.

4.3.4.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)
Had it been implemented in 2001, Alternative 3 would have placed $2.65 million of gross revenue at risk in the GOA NPT slope rockfish target fisheries, including the value of retained bycatch. This was equal to 28.3 percent of the reported 2001 status quo total revenue of $9.36 million. Alternative 3 would have imposed no EFH fishing impact minimization measures in the EBS and AI. Within the GOA, the largest amount of revenue at risk would have been in the CG, with $2.2 million at risk, or 28.0 percent of the $7.95 million 2001 status quo revenue. The revenue at risk in the WG would have totaled $220,000, or 27.3 percent of the 2001 total status quo revenue of $790,000. The revenue at risk in the EG would have totaled $210,000, or 33.3 percent of status quo revenue (EG).

The only fishery that would have been directly affected by the EFH fishing impact minimization measures under Alternative 3 is the NPT slope rockfish fishery in the GOA. The total revenue at risk in this fishery was $2.65 million, or 28.3 percent of the status quo revenue of $9.36 million in 2001.

The catcher-processor fleet would have had the greatest amount of revenue at risk, equaling $2.2 million, or 31.5 percent of the status quo total revenue of $7.04 million. The catcher-vessel fleet would have $430,000 of ex-vessel revenue at risk, or 18.6 percent of the total ex-vessel revenue of $2.33 million, recorded in 2001. The catcher-vessel fleet would have revenue at risk primarily in the CG, whereas the catcher-processor fleet would have revenue at risk in both the CG and WG. Catcher-processor fleet revenue at risk in the CG would have equaled $1.80 million, or 31.9 percent of the 2001 status quo in the CG. In the WG, revenue at risk would have equaled $220,000, or 27.3 percent of status quo. In the EG, catcher-processor revenue at risk would have accounted for nearly all of the $210,000 revenue at risk in that region.

The EFH fishing impact minimization measure areas described under Alternative 3 would have been imposed upon the GOA shelf and slope edge, between 200 m and 1,000 m. Although some slope rockfish are caught at depths shallower than 200 m in the GOA with NPT, a majority of the NPT commercial catch of the slope rockfish complex occurs at depths in excess of 150 m (NMFS 2002d). There is limited fishing area for slope rockfish in the 150 to 200 m slope edge adjacent to the 200 to

1,000 m area designated for EFH fishing impact minimization measures. This suggests that there would have been limited areas where the revenue at risk might have been mitigated, in whole or in part, by a redeployment of NPT fishing effort. Approximately 20 percent of the catch of the primary slope rockfish species, Pacific ocean perch, is taken by PTR fished by larger catcher-vessel and catcher-processor fleet components. Between 30 and 50 percent of the shortraker/rougheye rockfish in the slope rockfish complex are taken incidentally by hook and line gear in the sablefish and halibut fisheries.

Under Alternative 3, it is likely that not all revenue at risk could have been recovered by redeployment of fishing effort to adjacent areas or switching to PTR gear by most of the fleet components involved in the fishery. The smaller catcher-vessel fleet targeting slope rockfish almost exclusively uses NPT gear and has neither sufficient horsepower to fish PTR, nor the revenue from participation in this fishery to warrant the investment necessary to utilize PTR gear. The larger catcher vessels (which also target pollock) and the catcher-processors either already have PTR gear available or have sufficient horsepower to convert to PTR to target slope rockfish.

Under Alternative 3, while the revenue at risk might have been recovered by vessels fishing adjacent areas not affected by EFH fishing impact minimization measures or by switching to PTR gear within the EFH fishing impact minimization measure area, there would likely have been a transference of catch share, and thus revenue in the fishery, from the smaller catcher-vessel fleet component to the larger catcher-vessel and catcher-processor fleet components. The magnitude of this transfer is impossible to estimate without specific knowledge of the redeployment fishing effort strategies that would have been followed by the different fleet components. Nor is it possible to estimate the total amount of the revenue at risk under Alternative 3 that could have been recovered by redeployment of fishing effort to adjacent areas or to alternative fishing gears. Such an estimate is not possible without a thorough understanding of the fishing strategies that would have actually been employed by fishermen in response to the impacts of the EFH fishing impact minimization measures imposed by Alternative 3.

Revenue impacts from changes in product quality would have been possible under Alternative 3, particularly for the smaller catcher-vessel fleet component that could be required to expend additional fishing effort to recover the revenue at risk. This could lengthen fishing trips and result in diminished product quality. Product quality might not have been affected in the catcher-processor fleet component, since these vessels process the catch onboard the vessel.

Operating Costs (E-)

Operating costs under Alternative 3 would likely have been greater overall for both the catcher vessel and catcher-processor fleet components. CPUE of slope rockfish caught with PTR gear and with NPT gear at depths shallower than 200 m along the GOA slope edge is very likely to have been lower than the CPUE of NPT gear in the depth range of 200 m and greater normally fished for these species. If this were not the case, one would expect to observe this behavior in the absence of regulations that make it necessary. This may have resulted in increased fishing effort and associated increased operational costs to make up the catch and revenue at risk.

Costs to U.S. Consumers (E-)

Alternative 3 would have been likely to have imposed some impact on costs to consumers because, although some or all of the revenue at risk may have been recovered by redeployment of fishing effort, there would likely have been some operational cost increases for the fleet components. These operational cost increases due to Alternative 3 EFH fishing impact minimization measures may have resulted in a measurable increase in price to consumers of species caught in fisheries directly or indirectly affected by redeployment of the fishing effort, had these measures been in place for the 2001

fisheries. There may also have been welfare costs imposed on consumers from changes in availability of supply, product mix, and/or quality.

Safety (E-)
Alternative 3 could have adversely affected safety in all fleet components of the GOA slope rockfish fishery, given the likelihood of significant changes in the operational aspects of these fleets and possible increased fishing effort to mitigate the revenue at risk.

Impacts to Related Fisheries (E-)
There may very well have been an impact on related fisheries from Alternative 3, had it been in place in 2001, because a substantial amount of NPT fishing effort for slope rockfish would likely have been redeployed into adjacent areas shallower than 200 m and not affected by EFH fishing impact minimization measures. Other fisheries already utilize these areas, including halibut longline, Pacific cod longline (if open), and other NPT fisheries such as shallow water flatfish. Increased NPT fishing effort at depths less than 200 m along the GOA shelf edge may have imposed substantial negative externalities on these fisheries.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs would have been likely to increase under Alternative 3, although it is not possible to estimate by what amount. Section 3.1.2.7 of Appendix C contains some additional detail on the NMFS Enforcement and Coast Guard responses to resource demands connected with monitoring and enforcement provisions of Alternative 3. Additional on-water enforcement (including boarding and inspection), VMS, or 100 percent observer coverage could have been required of all vessels targeting slope rockfish with NPT gear in the GOA to assure compliance with the EFH fishing impact minimization measures under Alternative 3.

4.3.4.3.3 Effects on Communities and Shoreside Industries (Ø)

Overview
Impacts on dependent communities and shoreside industries would likely have been insignificant at the community level under Alternative 3, although a number of individual operations may have experienced adverse impacts. The only fisheries directly affected by this alternative would have been GOA slope rockfish species within the overall rockfish category, and the only gear group directly affected (for both catcher vessels and catcher-processors) would have been non-pelagic trawl. Using 2001 fleet data, 39 vessels (catcher vessels and catcher-processors) would have been affected by this alternative: 12 in Alaska, 8 from Oregon, 18 from Washington, and 1 from another state. Using 2001 processor data, 16 shoreside processors in Alaska would have been potentially affected by this alternative.

Catcher Vessels
For catcher vessels, revenue at risk would have been exclusively concentrated in the CG and would have represented 18.6 percent of the 2001 status quo value (about $430,000 out of $2.33 million) for rockfish fishery harvest of the affected vessels in this area. As discussed earlier, given the location and size of the closure areas and the proportion of catch that would have been at risk, it is assumed that, as an overall sector, it is possible that vessels could have recovered any potential losses in catch through additional effort (although the associated costs are unknown) or gear switching (to pelagic trawl gear). However, as noted earlier, the smaller vessels in the fleet targeting rockfish almost exclusively use non-pelagic trawl gear and do not have the same flexibility to switch gear as the larger vessels in the fleet. Therefore, even if there were no large net change in catcher-vessel harvest amounts, the smaller vessel

fleet may have experienced marked adverse impacts (through an effective flow of catch to larger vessels).

Based on 2001 data, Pacific Northwest vessels outnumber Alaska vessels with at-risk revenues, with ownership almost evenly split between Washington (seven vessels) and Oregon (eight vessels). Within Alaska, ownership of relevant vessels is concentrated in Kodiak (nine vessels), with only Anchorage having additional Alaska ownership (one vessel). While all catcher vessels involved in the at-risk harvest are classified as large (over 60 feet), ownership of the vessels at the lower end of the large range is concentrated in Kodiak, so it is likely there would have been some net flow away from the community if smaller vessels lose share to larger vessels. For the relevant Kodiak fleet in 2001, the at-risk revenues in the rockfish fishery represent somewhat more than 2 percent of total ex-vessel payments to these vessels for all fisheries in all areas combined. As noted elsewhere, figures given for catcher vessels represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities if examined alone. Values for first wholesale revenues at risk for shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. Individual entities within Kodiak may have experienced adverse impacts were this alternative in effect in 2001, particularly smaller vessels, as there may have been shifts in harvests away from smaller vessels to both larger catcher vessels and catcher-processors, but the magnitude of this potential shift is unknown. Further, as noted elsewhere, the methodology employed to assign distribution of catch within statistical reporting areas may tend to somewhat underestimate the actual concentration of catch within the specific closure areas within statistical blocks, particularly for slope rockfish closures and, therefore, would underestimate revenue at risk in a similar manner. It is unlikely, however, that the overall loss of revenue and/or the shift from small vessels would have resulted in impacts that would have been significant at the community level in Kodiak, due to the relatively small proportion of rockfish value compared to the overall value of the harvest for the involved vessels as a fleet in 2001 (although some individual vessels may experience increased cost and/or decreased catch). No significant impacts would have been likely for any dependent community outside of Kodiak as a result of changes that would have been associated with catcher vessels under this alternative. No significant community-level impacts would have been likely for Pacific Northwest communities, due to the size and diversity of the local economic base in 2001(although there may have been some loss of revenue or catch for a number of involved vessels).

Catcher-Processors

For catcher-processors, revenue at risk would have been concentrated in the CG, but not exclusively so, and would have represented 31.53 percent of the 2001status quo value (about $2.22 million out of $7.04 million) for rockfish fishery revenues for the affected vessels in the entire GOA. The revenue at risk would have represented between 1 and 2 percent of the combined total revenue of the harvest that these vessels took from all the fisheries in which they participated in 2001, so the overall impact on the affected fleet would have been minimal (although impacts to any particular operation may have been greater, depending on specific operational characteristics). Similar to the larger catcher vessels, it is assumed that catcher-processors may have been able, with additional effort, to make up foregone harvests from closed areas by changing location or gear strategies, but the costs associated with the extra effort are not known. In this particular case, at-risk harvest could have been recovered, in part or in whole, specifically by effort directed toward shallower areas, or a switch to pelagic trawl gear. The catcher-processors involved in the at-risk harvest are head and gut vessels, and ownership of these vessels is concentrated in the Pacific Northwest, with Washington ownership accounting for 11 out of the 15 vessels with at-risk revenue according to the 2001 data. Kodiak is the only Alaska community with relevant vessel ownership with three catcher-processors with at-risk revenues (and one vessel is

owned in another state). The small number of entities precludes disclosure of value data for the Kodiak vessels, but it is assumed that, while there may have been hardships for some of the entities involved, no significant impacts are likely for the community of Kodiak as a result of changes that would have been associated with catcher-processors under this alternative. For Washington communities, it is unlikely that significant community-level impacts would have resulted from this alternative, given the size and diversity of the local economy, although individual firms may have experienced adverse impacts under this alternative. Further, while patterns of distribution between Kodiak and Washington vessels cannot be disclosed, the likelihood of significant impacts on either Kodiak or the Washington communities is reduced by the small proportion the at-risk revenues would have contributed to overall catcher-processor harvest revenues for all fisheries in which they participated in 2001.

Shoreside Processors

For shore-based processors, in general, no substantial impacts would likely have occurred under this alternative because it is expected that catcher-vessel harvest levels would have remained at or near status quo levels, and it is not expected that substantial change in the fishery that would have affected delivery patterns would have occurred (although there may have been some redistribution of catch among individual vessels). There may have been some increased costs due to increased catcher vessel effort, but the amount of this increase is unknown. Based on 2001 data, processors involved in the at-risk harvest are concentrated in Kodiak, with nine entities operating. A number of other communities had one or two processors that processed at least some groundfish from vessels with revenues that would have been at risk under this alternative: Akutan and Unalaska/Dutch Harbor (two each), along with King Cove, Seward, and Cordova (one each). The total first wholesale value that would have been at risk of catch delivered inshore for processing represents approximately 16 percent of the 2001 total status quo value (about $1.73 million out of $10.79 million) of the relevant fisheries of the CG area, but no breakdown by port of landing is available. Caution must be exercised in the interpretation of these wholesale value data as (1) they are not additive with ex-vessel values presented above and (2) they cannot be used as a proxy for potential levels of impacts to specific communities without considering the basic caveats laid out in the introductory paragraphs of the shoreside processor section of the Alternative 2, Effects on Communities, discussion presented above. Given the comparatively modest overall value of the target slope rockfish fishery to shoreside processors and the low level of revenue that would have been at risk compared to overall processing in these communities, however, no significant impacts would have been likely to occur for Kodiak or any other dependent community as a result of changes that would have been associated with processors under this alternative, although some individual processing entities may experience greater impacts than others.

Multi-Sector Impacts

Multiple sector impacts are unlikely to have been significant at the community level under Alternative 3. Among Alaska communities, 2001 data show that only Kodiak participates in more than one sector with at-risk revenues, with nine locally owned catcher vessels, three locally owned catcher-processors, and multiple locally operating shoreside processing plants having at least some revenue that would have been at risk under this alternative. Revenue at risk for relevant catcher vessels and catcher-processors would have been roughly 2 percent of total revenues for these vessels, but individual vessels may have experienced lesser or greater losses. As noted, impacts to shoreside processors are likely to have been insignificant due to the low volumes at risk and the assumption that overall delivery patterns would have been unlikely to change under this alternative.

Some additional Alaska (and specifically Kodiak) resident crew positions on vessels owned elsewhere, but that spend at least part of the year in Alaska ports, may have had some compensation at risk, but overall potential for employment and wage or crew share compensation loss would have been small.

Transient vessels, owned outside of Alaska, typically also make expenditures in ports of landing, which, in this case, would have been concentrated in Kodiak. Given the assumption of general landing patterns remaining consistent, however, any vessel-expenditure-associated impacts are likely to have been minor. Overall, while community impacts in Alaska would have been concentrated in Kodiak, it is unlikely that these impacts would have risen to the level of significance at the community level, given the relatively few vessels that would have been affected by the alternative compared to the overall community fleet, and the relatively low magnitude of the revenue that would have been at risk when compared to the overall revenues of the involved vessels, much less those of the local fleet overall.

4.3.4.3.4 Effects on Regulatory and Enforcement Programs

Alternative 3, which would prohibit the use of bottom-trawl gear to target GOA slope rockfish species in the entire slope area, would, like Alternative 2, increase the complexity of management of the fisheries for rockfish in the GOA. Some of the same potential effects discussed in Alternative 2 are again reviewed here.

Alternative 3 differs from Alternative 2 in that it would define the restricted area by a contour, which is not an easy type of boundary to manage and enforce. NMFS would have to change its industry and observer reporting requirements and enforcement activity to deal with the creation of a continuous area associated with the depth contour of the GOA. To make this enforceable, the designated areas would have to be defined by coordinates so that enforcement personnel patrolling the area in either boats or aircraft would be able to tell if a vessel was in the restricted area.

Catch accounting from inside and outside the restricted area is one basis for determining compliance with the bottom gear prohibition. The restrictions would, in effect, create new reporting areas. The status of the fishery for rockfish for vessels using bottom-trawl gear would change from open to closed once the vessel crossed the boundary into the restricted area.

As under Alternative 2, a complication would arise from the fact that catcher vessels report on the basis of State of Alaska statistical areas, and these do not perfectly align with the proposed closed areas. If a vessel reported catch from a statistical area straddling the boundary of the restricted area, the agency would not know whether the catch came from inside or outside it. For catcher-processors, reporting requirements would not change, except that there would be new areas to report on.

Again, two management and enforcement agencies would be unable to completely verify any fishing vessel's activity relative to sensitive habitat protection areas through reporting. The fact that observers use haul retrieval locations to report catch taken in a tow means that vessels that start fishing on the inside of a protected area and finish outside would report their entire catch from the outside area. Although vessels could be required to give their trawl deployment location, that would still not ensure an accurate picture of how much catch was taken inside and outside the protected area. Even a requirement to use VMS would not solve the problem of how much catch came from within a protected area, as VMS provides a continuous report of geographic fishing location, but does not provide information as to what percentage of the tow is taken at each location. Conservative accounting rules might be required that would apply regulatory conditions in the restricted area to the entire catch if a vessel fished inside the restricted area at any time during the tow. Such conditions would have the effect of a *de facto* expansion of the closed area.

Unlike Alternative 2, Alternative 3 describes the area affected by the restriction as the upper slope area (200 to 1,000 m). The implied depth contours result in a complex curving line that does not provide an

explicit, simple border for USCG or NMFS enforcement agents to enforce. Simple boundaries are important for concise reporting on the part of vessel operators and observers. To determine the exact location of the contour line boundary to within a meter in depth, and then translate that curve to a geographic location so that aircraft and vessels at sea, including the fishing industry and law enforcement, would have a clear, enforceable definition of the area, would be difficult.

The approval of pelagic trawl gear for slope rockfish and the restriction of bottom gear to targets other than slope rockfish in the restricted area under Alternative 3 also complicate management and enforcement, as with Alternative 2. Because vessels can carry multiple nets on board, it would not be possible to determine which fish on board were taken with which net. Observers could, to a limited extent, verify which trawls are in use. However, currently observers report which gear trawls are used for the portion of the total number of hauls that are observed. They are not tasked with monitoring which gear is being used on all hauls. Vessels that carry both types of nets aboard would be able to claim that the rockfish species aboard were taken in compliance with the restrictions.

Pelagic trawls can be fished in contact with the bottom as well, so if the intent is that all trawls are to be fished off bottom at all times a new monitoring program would need to be initiated.

Vessels would also be able to target species other than slope rockfish with bottom gear in the restricted areas and take rockfish as incidentally caught, as was explained in Section 4.3.3.3.4 describing the effects of Alternative 2 on management and enforcement. Fishing behaviors may change as well. The fishing fleet using bottom nets might switch from rockfish to find a flatfish species that is of very low value and easy to catch to function as a basis for targeting higher valued rockfish and sablefish within the closed area. Such a strategy would undermine the goal of reducing fishing impact on the benthos, and might even increase the impact if the new target species were concentrated in areas not heavily fished previously. Regulations dealing with such an event might need to be developed, as happened when the practice of catching arrowtooth flounder strictly as a basis for sablefish was prohibited by regulation in August of 1994.

One effect on management from Alternative 3 that would differ from the effects from Alternative 2, stems from its particular focus on slope rockfish as a species group requiring protection.

Currently, directed fishing for the "other rockfish" category is closed to all gear types throughout the GOA. Except in the southeast outside district, slope rockfish (the predominate group by volume) and demersal shelf rockfish are lumped together in the "other rockfish" category. In the southeast outside district, demersal shelf rockfish are managed as a separate species group, and "other rockfish" are defined as slope rockfish.

In 2003, the combined ABC of "other rockfish" for the GOA is 5,050 mt, 82 percent of which is assigned to the slope rockfish category in the southeast outside district. Use of any gear other than non-trawl gear is prohibited in the southeast outside district pursuant to 50 CFR 679.22 (b)(4), which was implemented in 1998 under Amendment 41. A high portion of the habitat associated with slope rockfish is therefore protected from all trawling.

The "other rockfish" category has been closed to directed fishing in the central and western GOA since 1995. Limited amounts of directed fishing with trawl gear occurred in the West Yakutat District until 2000, but generally less than 100 mt was taken per year. In 2002, 400 mt of slope rockfish were taken in the western and central regulatory areas and the West Yakutat district. Ninety percent of the slope rockfish was taken with trawl gear, and 70 percent of that amount was taken in Area 630 of the central

regulatory area. Slope rockfish is taken incidentally, predominately in rockfish trawl fisheries that are open to directed fishing (e.g., Pacific ocean perch and northern rockfish); in 2002, approximately 70 percent of slope rockfish taken by trawl gear was discarded.

This information indicates that for the area in the GOA where the preponderance of slope rockfish occur, the southeast outside district, all trawling is prohibited. With the exception of some very limited fisheries in the West Yakutat District, trawling for other rockfish has been prohibited in the GOA since 1996. Slope rockfish that are taken incidentally to other directed rockfish fisheries are generally discarded, which indicates that there is little active interest in marketing these species. Therefore, the effect of closing the areas outlined in Alternative 3 to protect EFH may be redundant under current management practice, may have no effect on fishing practice, may have no impact on where bottom trawling occurs, and may not decrease impact on EFH. Other than providing a restriction that would prevent an expansion of the slope rockfish fishery should the population grow significantly and the market develop, there is little to distinguish the effect of Alternative 3 from Alternative 1.

However, enforcing Alternative 3 would be complex, given the problems outlined above in terms of the difficulty of defining protected areas by using contour lines, verifying how much catch is caught inside and outside of such areas, and verifying how much is caught with pelagic gear versus bottom-trawl gear.

4.3.4.4 Effects of Alternative 3 on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – Effects on state-managed fisheries are negligible under this alternative, as was discussed previously for Alternative 2.

State-managed Crab and Invertebrate Fisheries (E+) – Effects on state-managed fisheries are very similar to those discussed previously for Alternative 2. Benefits to deepwater Tanner crab would be anticipated under this alternative. Because more area is closed under Alternative 3, it is possible that the potential benefit to deep-water crab species could be slightly greater.

Herring Fisheries (Ø) – Herring inhabit and are harvested in nearshore waters in the GOA (Kruse et al. 2000) and would not be affected by the mitigation measures in Alternative 3.

Halibut Fisheries (Ø) – Alternative 3 would have no effect or very limited effects on halibut fisheries. If effort in the rockfish trawl fishery is displaced further inshore as a result of the closures in this alternative, it is possible that halibut bycatch rates and spatial distribution could change slightly.

4.3.4.5 Effects of Alternative 3 on Protected Species

The discussion on protected species provided in this section relative to Alternative 3 is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (Ø) – Under Alternative 3, fishing patterns would change moderately, probably only in the GOA, with some moderate shifts in bottom trawl effort out of the upper slope area and presumably into other adjacent areas or even other fisheries. Increased fishing activities that may result in increased encounters with ESA-listed marine mammals in the areas where fishing is displaced may be offset to some degree by the reduced fishing in the EFH closed area. The net effect would likely be a small increase in fishing activities in the GOA. Because the potential changes are small, the current levels of mortality or potential injury to ESA-listed marine mammals, which are very low, would likely remain about the same. Under Alternative 3, no additional, measurable impacts from fishery-related

prey removal would occur, which would be primarily an issue only for Steller sea lions. Alternative 3 would likely not result in increased levels of take or injury to these species above those levels predicted under Alternative 1, nor would Alternative 3 result in appreciably increased removals of prey items used by these marine mammals. Thus Alternative 3 would have no further or additional adverse effects on ESA-listed marine mammals.

Other Marine Mammals (Ø) – Alternative 3 would likely result in a moderate amount of displaced fishing effort in the GOA slope rockfish trawl fishery, which presumably would then be prosecuted in adjacent areas that remain open to rockfish bottom trawling or in other trawl fisheries. This would be accompanied by reduced levels of trawl fishing in the EFH closed area. The net changes would be very small, however, and would have very minimal impact on other marine mammals. These fishing activities would not likely occur in sea otter and harbor seal habitat because this fishery occurs in offshore locations distant from sea otter and harbor seal habitat. Fur seals would have little chance of encountering these fisheries except for brief periods in transit to seasonal habitats that are not located in the GOA, as would the ice seals and walrus because they only inhabit the northern EBS. Other cetaceans are not currently adversely affected by GOA fisheries, either through injury or other take or because of fishery removal of prey; thus it is reasonable to assume that a small net change in the overall pattern of groundfish fishing in the GOA would not change this. Overall, Alternative 3 would have no effect on other marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Under Alternative 3, the pattern of incidental take of ESA-listed salmon and steelhead in the groundfish fisheries of the GOA and EBS would likely continue to be the same as described in Alternatives 1 and 2. It is likely that very few endangered or threatened salmon or steelhead are taken as bycatch in the trawl fisheries in the GOA and EBS, although data are not available to completely document the degree of this take for all ESA-listed ESUs. Some take of these species has been documented from CWT returns in the salmon bycatch of the GOA trawl fisheries. This bycatch is almost exclusively in the GOA midwater pollock trawl fishery. Since Alternative 3 does not change this fishery, it is unlikely that there would be any effects on ESA-listed salmon or steelhead. In addition, since salmon are a PSC species, and groundfish fisheries may avoid areas of high salmon bycatch to the degree practicable, the incentive to reduce salmon bycatch in the GOA may afford some moderate protection to the co-mingled stocks of ESA-listed salmonids.

ESA-listed Seabirds (Ø) – Fishing activities under Alternative 3 would likely include small changes in the specific locations and how frequently trawl third-wire gear may encounter short-tailed albatross, although there is the potential for continued or very slightly increased encounters in areas where fishing might be concentrated and short-tailed albatross may be more common. As previously stated, it is unlikely that trawl vessels would switch to using longline gear to catch slope rockfish. Because the changes in fishing patterns are likely to be small, and since no short-tailed albatross mortalities have been documented to date for Alaskan groundfish trawl fisheries, it is likely that the effects of Alternative 3 would be very minor, although there are not sufficient data to fully characterize how trawl fishing affect this species.

New cooperative programs in the trawl industry to reduce the chances for albatross or other seabird take in trawl third-wire gear may benefit this seabird. Short-tailed albatross are surface feeders and consume squid, fish, and invertebrates, and thus do not target prey harvested in the GOA groundfish fisheries. Steller's and spectacled eiders overlap very little with the groundfish fisheries off Alaska. Spectacled eiders are not present in the GOA and thus would not be affected by Alternative 3. Steller's eiders winter along the coast of the Alaska Peninsula and AI, but they remain in bays and nearshore areas and would not likely encounter any offshore fisheries.

Other Seabirds (Ø) – Under Alternative 3, the incidental take in trawl bycatch and by trawl third-wire gear of northern fulmars, albatrosses, gulls, and shearwaters would likely continue but not appreciably above status quo levels, with the potential for a slight increase in bycatch from displaced fishing activities. This may be countered by reduced mortality to these seabirds in the EFH bottom trawl closed area. Kittlitz's murrelets and red-legged kittiwakes are species of concern because of their declining population sizes, but do not appear to be impacted by groundfish fisheries at present. Because fishing patterns under Alternative 3 would be similar to those discussed in Alternative 2 where impacts on these seabirds were judged to be minor, it is thus likely that under Alternative 3 there would be minimal additional mortality to red-legged kittiwakes and Kittlitz's murrelets. For similar reasons, Alternative 3 would not have appreciably increased adverse effects on piscivorous or planktivorous seabirds, although there could be some slight increase in the overlap of the displaced trawl fishing with some piscivorous seabirds that forage near several large colonies in the GOA. Seabird vessel strikes would likely be similar to those described for Alternatives 1 and 2 and are not considered a threat to their populations. Programs to reduce seabird bycatch would continue under Alternative 3, which would be expected to reduce bycatch in future years.

4.3.4.6 Effects of Alternative 3 on Ecosystems

Predator-Prey Relationships (Ø) – Alternative 3 is judged to have no effect on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, or increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem due to Alternative 3, although catches of most GOA slope rockfish species would be expected to be somewhat reduced from status quo. Similarly, trophic level of the catch would not be much different from status quo, and little change in the functional species composition of the groundfish community, or in the removal of top predators, is expected.

Energy Flow and Balance (Ø) – The amount and flow of energy flow in the ecosystem would be the same as the status quo with regards to the total level of catch biomass removals from groundfish fisheries. No substantial catch reductions in groundfish (except perhaps some reduction in the catch of GOA slope rockfish species), and no substantial changes in discarding of any species would be expected.

Diversity (E+) – Alternative 3 is judged to have slightly positive effects on species diversity in the GOA. Because bottom trawling would be much reduced on the slope areas, particularly those areas with complex bottom structure, species level diversity may increase Relative to the status quo. Closure of the slope to the primary trawl fishery, slope rockfish, in the area may help to maintain (or even enhance) productive fish habitat and thereby help sustain fish populations that rely on slope areas. Structural habitat diversity would improve in the GOA but not in the AI where most corals are found. Genetic diversity could slightly increase under Alternative 3 if older, more heterozygous individuals were left in the populations of Pacific ocean perch or other slope rockfish. About 25 percent of the catch of GOA slope rockfish has been taken in the slope areas (200 to 100 m) designated for closure under this alternative. Breeding and spawning of these species occurs primarily on the slope, and Alternative 3 would result in less disturbance on any spawning aggregations of slope rockfish. Overall, Alternative 3 was judged to have slightly positive effects on diversity.

4.3.5 Effects of Alternative 4

4.3.5.1 Effects of Alternative 4 on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type differed from status quo for Alternative 4. LEIs for both status quo and Alternative 4 were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make them relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Benthic Biodiversity (E+) – Alternative 4 is expected to have positive effect on the protection of coral due to trawl closures in the AI.

GOA – Alternative 4 does not change the amount of the slope area closed to all bottom trawling, since fishing for species besides rockfish would be allowed. Although some reduction in fishing at these sites may occur, this is not considered a substantial improvement in coral protection.

AI – In the AI, Alternative 4 closes four areas to all bottom trawl fishing. Limited recent fishing has been done in these areas. Two areas, Bower's Ridge and Stalemate Bank, are very remote, while Seguam Pass and Semisopochnoi are closed to fishing for pollock, cod, and Atka mackerel. These represent a significant area of closure to all bottom trawling, especially in the deep habitat (20 percent of total deep area) important to hard corals. Because of limited recent fishing, it is more likely that resident corals have not been removed, although parts of Seguam Pass were heavily fished before the sea lion closures. Because of the increased protection of additional potential coral habitat, this alternative has a positive effect on epibenthic structure.

Effects on Habitat Complexity (Ø) – Alternative 4 would not have substantial positive effects on epibenthic structure in the AI or the GOA and would only have substantial benefits in the EBS if the gear modifications proved effective. Because the effectiveness of these gear requirements is speculative at this time, a no effect rating was assigned.

GOA – In the GOA, Alternative 4 institutes closures to rockfish trawling in 11 areas. All of these areas mostly enclose slope habitat. Only small changes in LEI values resulted and all were for the GOA slope (proportional reductions – soft bottom biostructure -4 percent, hard bottom bio- and nonliving structure -5 percent, and coral -5 percent). These changes were not considered substantial, resulting in a no effect rating.

AI – In the AI, Alternative 4 closes four areas to all bottom trawl fishing. Limited recent fishing has been done in these areas. Two areas, Bower's Ridge and Stalemate Bank, are very remote, while Seguam Pass and Semisopochnoi are closed to fishing for pollock, cod, and Atka mackerel. Hence, the LEI reductions from these closures were fairly small (-2 to -3 percent for bio- and nonliving structure) and are not considered substantial effects.

EBS – In the EBS, Alternative 4 established rotating bottom trawl closures over a large area of sand/mud and slope habitats and full bottom trawl closures of large areas of sand, sand/mud, and mud habitats of the northeastern BS. The rotating closure area has been moderately fished recently, while the full closure area excludes very little recent effort. Rotations close one fourth of the area at all times.

The biostructure feature of the EBS sand/mud and slope habitats had the highest LEI values of the analysis. This was only reduced by 4 percent for both sand/mud and slope habitats due to the closures.

An additional feature of Alternative 4 is a required modification to the bottom-contact gear of all bottom trawls that provides at least 3 inches of open spacing under 90 percent of the area swept by trawls. These modifications are already common for most but not all trawl footropes, but are not used for the bridles and sweeps, which provide 80 to 85 percent of the coverage of bottom trawls used in the EBS. Bridles and sweeps in current use are mostly of constant diameter, providing no space for organisms to pass beneath except when raised by ridges and bumps on the seafloor. The reduction of damage to biological structure organisms by providing such a space is conceptual and speculative at this point and it would require testing before implementation. Many of the EBS structure forming organisms are small enough to pass though a gap that size. A run of the analysis was done to see what effect a 50-percent reduction in mortality for organisms passing through the spaces would have on biostructure reductions. The result was a 15-percent reduction in slope LEI and a 17-percent reduction in sand/mud LEI (in combination with the closures). If that level of mortality reduction were confirmed, this would have a positive effect.

4.3.5.2 Effects of Alternative 4 on Target Species

4.3.5.2.1 Effects on Groundfish

4.3.5.2.1.1 Walleye Pollock (EBS and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the EBS, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

For the GOA, this alternative is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4.

In the EBS, the rotational closed areas proposed under Alternative 4 overlap regions occupied by juvenile pollock. As was noted in Chapter 3, some juvenile walleye pollock assume a demersal existence at or near the end of the first year of life. Juvenile pollock maintain this existence for 1 year after which they assume a pelagic existence for 1 to 2 additional years. The impact of trawling on the feeding success and survival of juvenile walleye pollock is unknown. The impact of the no trawl zones on the feeding success of juvenile pollock is unknown.

4.3.5.2.1.2 Pacific Cod (EBS and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 4 is the inclusion of additional areas closed to bottom trawling. Because the additional

closures in the GOA fall outside of Pacific cod EFH and because they apply only to vessels targeting rockfish, they would not be expected to impact Pacific cod fishing mortality in the GOA. In the EBS, it is possible that the additional closed areas might cause catches to be lower if the full TAC could not be taken by fishing in the remaining open areas. However, the additional proportions of Pacific cod EFH in the EBS that would be closed under Alternative 4 are relatively small. Even if some decrease in fishing mortality were realized under Alternative 4, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 4 is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH and because they apply only to vessels targeting rockfish, they would not be expected to impact the spatial concentration of Pacific cod catch in the GOA. How the additional closures in the EBS would affect the spatial concentration of the catch in that region is unclear, because spatial concentration depends not just on the relative sizes of the open and closed areas, but on the magnitude and spatial distribution of catch within the open and closed areas as well. Even if some decrease in spatial concentration of the EBS catch were realized under Alternative 4, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 4 is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH and because they apply only to vessels targeting rockfish, they would not be expected to impact the spawning and breeding success of Pacific cod in the GOA. In the EBS, the additional portions of Pacific cod EFH that would be closed under Alternative 4 appear to encompass only a small proportion of the known Pacific cod spawning grounds. Even if some increase in spawning and breeding success were realized under Alternative 4, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 4 is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH and because they apply only to vessels targeting rockfish, they would not be expected to impact the feeding success of Pacific cod in the GOA. In the EBS, the additional proportions of Pacific cod EFH that would be closed under Alternative 4 are small. Even if some increase in feeding success were realized under Alternative 4, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 4 is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH and because they apply only to vessels targeting rockfish, they would not be expected to impact the successful growth to maturity of Pacific cod in the GOA. In the EBS, the additional proportions of Pacific cod EFH that would be closed under Alternative 4 are small. Even if some increase in successful growth to maturity were realized under Alternative 4, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

4.3.5.2.1.3 Sablefish (EBS and GOA)

For the GOA, Alternative 4 is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4 for the GOA.

The rotational closures in the EBS lie outside areas where intensive bottom trawling and sablefish concentrations overlap. Thus the effects of Alternative 4 for the EBS differ little from the status quo.

Any benefits of the rotational closures depends on the recovery rate of the affected species. The 10-year length of the closures may be sufficient for fast-recovery species, but insufficient for slow-recovery species.

The closure areas in the AI lie outside areas where sablefish are concentrated in the AI, except for the Seguam foraging area. The Seguam foraging area is a relatively small part of the AI area. Thus the effects of Alternative 4 for the AI area differ little from the status quo.

4.3.5.2.1.4 Atka Mackerel (EBS and GOA)

Stock Biomass (Ø) – This alternative is not expected to impact the stock biomass of Atka mackerel relative to status quo. Alternative 4 prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, and Semisopochnoi Island in the AI. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 4 also closes areas in the GOA to rockfish bottom trawling (as in Alternative 2), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for stock biomass is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – This alternative is not expected to impact the spatial/temporal concentration of the catch of Atka mackerel relative to status quo. Alternative 4 prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds of the Atka mackerel fishery. Alternative 4 also closes areas in the GOA to rockfish bottom trawling (as in Alternative 2), but there is no directed fishery for Atka mackerel in the GOA. The rating for spatial/temporal concentration of the catch is no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar

based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Alternative 4 is not expected to affect the spawning and breeding of Atka mackerel relative to status quo. Alternative 4 prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 4 also closes areas in the GOA to rockfish bottom trawling (as in Alternative 2), but there is no directed fishery for Atka mackerel in the GOA. Therefore the rating for spawning and breeding is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. In addition, the closed area in the GOA for Alternative 4 is mostly directed at the GOA Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so that in theory, any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for Atka mackerel. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative were implemented, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to status quo. Therefore the rating for feeding is no effect.

Growth to maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The directed fishery in the AI overlaps with late juvenile/mature adult habitat at depths of generally less than 200 m.

Alternative 4 is not expected to effect the growth to maturity of Atka mackerel relative to status quo. Alternative 4 prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 4 also closes areas in the GOA to rockfish bottom trawling (as in Alternative 2), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for growth to maturity is no effect.

4.3.5.2.1.5 Yellowfin Sole (EBS)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS yellowfin sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Nichol 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on EBS yellowfin sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS yellowfin sole harvest does not occur in the designated bottom trawl closure areas, which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS yellowfin sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for yellowfin sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for yellowfin sole. Within the first year of life, yellowfin sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.6 Greenland Turbot (EBS)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS Greenland turbot biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Ianelli et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on the spatial/temporal concentration of the EBS Greenland turbot catch in most years except when the portion of the closed areas include slope waters. Since most of the EBS Greenland turbot harvest does not occur in the designated bottom trawl closure areas in the other years and because their exploitation rate is so small, there is no expected negative effect or future benefit to the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS Greenland turbot since there would be limited changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for Greenland turbot since the modeled benthic disturbance for infauna and epifauna prey are not relevant to their diet. Adult feeding on pollock, squid, and deep water fish species primarily occurs during summer throughout the deep slope waters and to a lesser extent on the upper slope/shelf margins. Most of the Greenland turbot feeding behavior is observed to take place off bottom and is not related to the benthic food availability.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for Greenland turbot. Within the first year of life, Greenland turbot metamorphose from free-

swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.7 Arrowtooth Flounder (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA arrowtooth flounder biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA arrowtooth flounder since there would be no regulatory rule to change the spatial/temporal concentration of the catch. Therefore there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA arrowtooth flounder since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.8 Rock Sole (EBS)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS rock sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on EBS rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS rock sole harvest does not occur in the designated bottom trawl closure areas which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS rock sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.9 Flathead Sole (EBS and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA flathead sole, since there would be no regulation to enact change in the spatial/temporal concentration of the catch from the past few years. It is not expected that the current harvest practices have made a negative impact on the future genetic diversity of the stock.

Relative to the status quo, Alternative 4 would also have little effect on EBS flathead sole, since there would be only minor changes in the spatial/temporal concentration of the catch from the past few years. Since most of the EBS flathead sole harvest has not recently occurred in the designated bottom trawl closure areas, which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA and EBS flathead sole, since there would be no change in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 4 on stock biomass is unknown. The status of rex sole relative to estimates of MSSt is unknown. Therefore, the impacts of fishing on the stocks ability to sustain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on GOA rex sole, since there would be no change in the spatial/temporal concentration of the catch.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA rex sole, since there would be no change to the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.11 Alaska Plaice (EBS)

Stock Biomass (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS Alaska plaice biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on EBS Alaska plaice since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS Alaska plaice harvest does not occur in the designated bottom trawl closure areas which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on EBS Alaska plaice since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for Alaska plaice since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, marine worms, and, to a lesser extent, bivalves. Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for Alaska plaice. Within the first year of life, Alaska plaice metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species. The status of the members of the shallow water flatfish complex is unknown. Therefore, the impact of this alternative on the stock's ability to remain above its MSST is unknown.

Stock Biomass (U) – Because the value of MSST is unknown for the shallow water flatfish complex, the effect of Alternative 4 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on GOA rock sole, since there would be no change in the spatial/temporal concentration of the catch. Since most of the GOA rock sole harvest does not occur in the designated bottom trawl

closure areas, which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA rock sole, since there would be no change to the current harvest practices. Fishing is not expected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer throughout the continental shelf on benthic infauna and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species. The status of the members of this complex is unknown. Therefore, the impact of this alternative on the stock's ability to sustain itself above MSST is unknown.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA deep water flatfish complex, the effect of Alternative 4 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 4 would have little effect on GOA Dover sole, since there would be no change in the spatial/temporal concentration of the catch. Since most of the GOA Dover sole harvest does not occur in the designated bottom trawl closure areas which are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 4 would have no effect on GOA Dover sole, since there would be no change to the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 is not expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete

worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 4 would have no effect on the growth to maturity for Dover sole. Within the first year of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 4, there is no effect from fishing on survival and growth to maturity.

4.3.5.2.1.14 Pacific Ocean Perch (EBS)

Stock Biomass (Ø) – Under Alternative 1, total biomass (ages 3 through 21+) of EBS Pacific ocean perch is above the MSST and expected to remain above the MSST, resulting in a rating of no effect of fishing on stock biomass. Because Alternative 4 has additional habitat protections in the EBS area, the stock biomass would also be expected to remain above the MSST, and the effect of fishing on stock biomass is also rated as no effect.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for Pacific ocean perch harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. Similarly, the closure areas in the AI are located in areas where few Pacific ocean perch are caught and thus have little effect on the spatial/temporal concentration of the catch. Thus, the expected pattern of fishing for Pacific ocean perch under Alternative 4 is expected to be similar to that in Alternative 1 and have no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo (Alternative 1) management, resulting in a rating of no effect of fishing on spawning habitat. As was mentioned above, the expected pattern of fishing for Pacific ocean perch in the EBS area is expected to be similar to Alternative 1, and Alternative 4 is expected to have no substantial effects on essential spawning habitat.

Feeding (Ø) – Pacific ocean perch are plankton feeders, with juvenile Pacific ocean perch eating calanoid copepods and adults eating largely euphausiids (Yang 1993, 1996). Fishing activity under Alternative 4 would be expected to have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. The pattern of fishing under Alternative 4 is expected to be similar to that under Alternative 1, and fishing is thus anticipated to have no substantial effect on the survival of fish to maturity.

4.3.5.2.1.15 Pacific Ocean Perch (GOA)

For the GOA, Alternative 4 is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4.

4.3.5.2.1.16 Shortraker and Rougheye Rockfish (EBS)

Stock Biomass (U) – EBS shortraker and rougheye rockfish are not currently assessed with an age-structured population model, and the MSSTs have not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for shortraker and rougheye rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. Large catches of rougheye rockfish are occasionally taken just outside of Seguam Pass, and would fall outside of the proposed Seguam Pass area closure. Small amounts of rougheye and shortraker rockfish are harvested within the other proposed closure areas. The spatial/temporal concentration of the catch under Alternative 4 is not expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas of the AI is expected to have little effect on the spawning and breeding habitat of shortraker/rougheye rockfish because relatively few shortraker rougheye are caught within the proposed closed areas. Thus, under Alternative 4, the effect of fishing on spawning habitat is expected to be similar to that in Alternative 1. However, because the MSSTs for shortraker and rougheye rockfish are unknown, the effect of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Pandalid and hippolytid shrimp are the largest components of the rougheye rockfish diet (Yang 1993, 1996). The diet of shortraker rockfish is largely unknown, but a limited number of samples suggest that squid is a major component. The reduction of epifaunal prey could affect the diet of rougheye rockfish, but the percent reductions in these prey are so small (0 to 3 percent) that fishing is anticipated to have no effect on the diet of shortraker/rougheye rockfish under Alternative 4.

Growth to Maturity (U) – Little information is available on the habitat of juvenile rougheye/shortraker rockfish. Because the MSSTs for rougheye and shortraker rockfish are unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.5.2.1.17 Shortraker and Rougheye Rockfish (GOA)

For the GOA, Alternative 4 is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4.

4.3.5.2.1.18 Northern Rockfish (EBS)

Stock Biomass (U) – EBS northern rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for northern rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. The Semisopochnoi Island and Seguam Pass area closures may reduce effort from the Atka mackerel fishery in these areas, and also bycatch of northern rockfish. The spatial/temporal concentration of the catch under Alternative 4 is not expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas where northern rockfish have been taken as bycatch, such as Semisopochnoi Island and Seguam Pass, may have some positive effect on the effect of fishing on spawning habitat relative to the status quo. However, the magnitude of this effect, as reflected by changes in the stock size relative to the MSST, is unknown.

Feeding (Ø) – Northern rockfish are largely plankton feeders, eating mainly euphausiids but also copepods, hermit crabs, and shrimp (Yang 1993). Fishing activity under Alternative 4 would be expected to have no effect on the largely pelagic diet of northern rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile northern rockfish. Because the MSST for northern rockfish is unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.5.2.1.19 Northern Rockfish (GOA)

For the GOA, Alternative 4 is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4.

4.3.5.2.1.20 Pelagic Shelf Rockfish (GOA)

For the GOA, Alternative 4 is exactly the same as Alternative 2. Refer to the text for Alternative 2 for a discussion of the effects of Alternative 4.

4.3.5.2.1.21 Other Rockfish Species (EBS)

Stock Biomass (Ø) – The closure areas in the AI, except for the Seguam Pass area, are areas where little to no light dusky rockfish have been observed. In the EBS, the closure areas are in the northern parts of the shelf and slope region, which are areas of little to no observations of light dusky rockfish. Therefore, Alternative 4 would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Because little or no light dusky rockfish have been observed in the closure areas, Alternative 4 would likely have little or no impact on the spatial/temporal concentration of light dusky rockfish catch compared to the status quo.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, therefore due to this lack of knowledge, the effects of Alternative 4 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). Although any direct or indirect effects of fishing on euphausiid abundance is not presently known, these closure areas probably have no effect on their abundance.

Growth to maturity (Ø) – The closure areas are not in locations of known concentrations of light dusky rockfish, therefore, Alternative 4 would have little or no effect on growth to maturity of light dusky rockfish.

4.3.5.2.1.22 Shortspine Thornyheads (EBS)

Stock Biomass (Ø)
The peak abundance for shortspine thornyheads is along the slope from 300 to 1,000 m. Although the suggested 25 percent rotational closure areas in the EBS do extend over the slope, only a small fraction of it is actual shortspine thornyhead habitat area. Additionally, the displaced fishery catch of shortspine thornyhead, in these areas, would be minimal (Reuter and Spencer 2001). In 2001, the observed fishery catch of shortspine thornyhead was only 41 mt. (ABC for other rockfish was 676 mt in 2001), therefore, there would be little to no effect on their stock biomass as compared to the status quo under Alternative 4.

Spatial/Temporal Concentration of the Catch (Ø)
No stock structure has been found for shortspine thornyheads in the EBS. Their spatial distribution is uniform along the slope of the EBS, therefore, Alternative 4 would likely have a little to no effect on their catch as compared to the status quo.

Spawning/Breeding (Ø)
Larval and juveniles of this species are pelagic for up to 15 months after spawning. Therefore, the effect of the closures under Alternative 4 on the habitat of this life stage is probably minimal to none.

Feeding (U)
The major prey of adult shortspine thornyheads appears to be pandalid shrimp (based on the limited food information available for this species) (Yang 1993). Any direct or indirect effects of fishing on pandalid shrimp abundance is not presently known.

Growth to maturity (Ø)
The peak spawning biomass for shortspine thornyheads on the west coast is at depths from 800 to 1,000 m (Wakefield 1990). Although the suggested 25-percent rotational closure areas in the EBS do extend over the slope only a small fraction of it is the habitat of reproductively mature shortspine thornyheads. Additionally, the displaced fishery catch of shortspine thornyhead in these areas would be minimal in both the EBS and AI (Reuter and Spencer 2001). Therefore, under Alternative 4 there would be little to no effect on their growth potential as compared to the status quo.

4.3.5.2.1.23 Forage Species (EBS and GOA)

Stock Biomass (Ø) – The impact of Alternative 4 on forage species is likely to be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 4 would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 4 are not in areas of significant forage species bycatch. Alternative 4 is thought to have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 4 are not thought to be important to the spawning and breeding of forage species. Alternative 4 would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 4 are not thought to be important to the feeding ecology of forage species. Alternative 4 would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 4 are not thought to be important to the feeding ecology of forage species. Alternative 4 would have minimal effect on the growth to maturity of forage species.

4.3.5.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.5.2.2.1 Salmon

Stock Biomass (Ø) – The salmon fishery is not impacted by measures that would be implemented under Alternative 4. In addition, the bycatch of salmon would not change, as the closures do not affect the pollock fishery, which takes a majority of the salmon bycatch. Thus, no changes in the catch of salmon would be expected under Alternative 4, so no effects on biomass would be expected.

Spatial/Temporal Concentration (Ø) – The salmon fishery is managed such that catch limits are established for separate river drainages or regions to avoid potential concentration of the fisheries. No changes in the distribution and intensity of salmon fishing effort is expected under Alternative 4.

Spawning/Breeding (Ø) – No fisheries in Alaska are thought to adversely affect salmon habitat because there is almost no fishing effort (except some very small recreational and subsistence fisheries) in freshwater spawning and rearing areas. No changes in the distribution of salmon fisheries in these areas would occur under this alternative, and thus no effects on spawning and breeding of salmon would be expected under Alternative 4.

Feeding (Ø) – Fisheries are considered not to have any impact on freshwater or pelagic habitats used by juvenile salmon; however, fisheries do catch some species eaten by piscivorous species of salmon in the ocean, including squid, capelin, and juvenile herring. No substantial changes in the catch of these prey species is expected under Alternative 4, so this alternative was judged to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alternative 4. Bycatch of juvenile salmon has been relatively small in the fisheries primarily affected by this alternative (EBS flatfish trawl fishery and GOA slope rockfish), and no substantial changes in bycatch amounts would be anticipated due to fleet redistribution. Thus, Alternative 4 is considered to have no effect on the growth to maturity of salmon.

4.3.5.2.2.2 Crabs

Stock Biomass (Ø) – Alternative 4 would not affect the catch of crabs in the directed fisheries. However, Alternative 4 would be expected to have slight reductions in the bycatch amounts taken in groundfish trawl fisheries (due to the minimum bobbin/roller gear requirements of this alternative). Nevertheless, bycatch of crabs is very small relative to total population size (Witherell and Pautzke 1997), and would not result in any change in stock biomass. Thus, stock biomass would not be substantially affected by Alternative 4.

Spatial/Temporal Concentration (Ø) – Alternative 4 would not modify the distribution and intensity of fishing effort in the crab fisheries, so no effects would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of crabs would be expected under Alternative 4. The closure areas designated by Alternative 4 only overlap substantially with the opilio crab stock (although there is a small portion of the St. Matthew and Pribilof Islands blue king crab stocks, Tanner crab stock, and golden king crab stock). Bottom trawl effort from the closed areas of the northwest area of the EBS would likely redistribute to adjacent areas that likely have similar abundance of female opilio crab in any given year (the distribution of these crab has shown significant changes over time). For that reason, Alternative 4 was judged to have no effect on spawning and breeding of crab stocks.

Feeding (Ø) – Fisheries are considered not to have any substantial effects on the prey of crab species. Alternative 4 is considered to have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas in the EBS overlap with opilio crab EFH areas of concentration. The trawl closure areas may improve habitat and reduce bycatch mortality for opilio crab within the closure area by eliminating potential impacts due to bottom trawling. However, it is likely that trawl fishing effort would redistribute to nearby adjacent areas also used by these crab, and this redistribution would likely dampen potential habitat benefits or reductions in bycatch resulting from these closures. The requirement for large bobbins and rollers on trawl gear footropes and sweeps is expected to reduce crab bycatch and unobserved mortality by reducing the amount of gear hitting the bottom. The nets and sweeps should simply pass over the crabs without touching them, resulting in a higher survival rate. Overall, positive changes in habitat effects and survival would be expected under Alternative 4.

4.3.5.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 4 is anticipated to have no substantial effects on scallop stock biomass, as catches would not be affected by these measures.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of scallop fishing effort is expected under Alternative 4.

Spawning/Breeding (Ø) – None of the closure areas designated under Alternative 4 overlap with scallop populations. Therefore, Alternative 4 is anticipated to have no substantial effects on spawning and breeding of weathervane scallops.

Feeding (Ø) – Sediment resuspension by dredges can have positive or negative effects on scallop feeding. None of the closure areas designated under this alternative overlap with scallop populations, and fishing effort is not projected to increase in areas with scallops. Thus, Alternative 4 was judged to have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in scallop dredge effort is expected under Alternative 4, and therefore no changes in juvenile survival would be expected.

4.3.5.3 Effects of Alternative 4 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 4 on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.5 of the RIR/IRFA (Appendix C).

4.3.5.3.1 Effects on Passive Use Values (E+)

Had Alternative 4 been in place in 2001, NPT fishing activities targeting slope rockfish in 11 designated areas of the GOA would have been eliminated; use of NPT gear would have been closed in 25 percent of five areas in the EBS on a 10-year rotational basis, with bobbins required on NPT gear fished in other areas; and the use of NPT gear would be prohibited in designated areas of the AI. While it is not possible at this time to provide an empirical estimate of the passive-use value attributable to this level of protection of EFH, it is assumed that Alternative 4, had it been in place in 2001, would have yielded some incremental increase in the passive-use benefit of EFH over the status quo Alternative 1.

Each year, Alternative 4 would reduce the impact of NPT fishing for slope rockfish over 10,228 sq. km of GOA shelf and slope edge habitat, NPT fishing for all species over an average of 47,986 sq. km of EBS habitat, and 22,883 sq. km of AI habitat, for 81,097 sq. km. This would affect 3.6 percent of the current 279,874 sq. km of GOA shelf and slope edge habitat, 6.0 percent of the current 798,870 sq. km of EBS habitat, and 19.7 percent of the current 105,243 sq. km of AI habitat, for a total of 6.8 percent of the total fishable area in the GOA, EBS, and AI combined. Alternative 4 would have been expected to further reduce NPT fishing impacts in the EBS by requiring disks and bobbins on trawl sweeps and footropes used in open areas. Whether these fishing impact minimization measures would provide increased future productivity and use benefits over the status quo Alternative 1 or other action Alternatives 2, 3, 5A, 5B, or 6 is unknown at this time.

4.3.5.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)
Depending upon the EBS rotational areas closed, Alternative 4 would have placed a total of $3.53 million to $6.11 million of gross revenue at risk in NPT fisheries in the GOA, EBS, and AI, or 2.2 to 3.8 percent of the status quo total revenue of $156.86 million to $162.79 million.

EBS Region
In the EBS, Alternative 4 would have placed between $1.82 million and $4.40 million in revenue at risk, or 2.0 to 4.5 percent of the $90.92 million to $96.74 million in 2001 status quo revenue in the affected fisheries depending upon the rotational areas affected. Alternative 4 would have placed revenues at risk in a number of NPT target fisheries in the EBS, including flathead sole, yellowfin sole, rock sole, other flatfish, Pacific cod, and others. However, the largest revenue at risk would have occurred in the flathead sole fishery, where $1.23 million to $1.34 million of revenue would have been at risk, equaling 8.5 to 23.1 percent of the $14.46 million 2001 status quo revenue, depending upon the rotational area affected. In the EBS, substantially all of the revenue at risk would have occurred in the catcher-processor fleet component.

In the EBS, Alternative 4 would have imposed a closure to NPT fishing in 25 percent of five areas, with each 25 percent area rotating on a 10-year basis. Had these EFH fishing impact minimization measures been in place in 2001, they would have placed approximately 2.9 to 4.8 percent of that year's status quo revenue at risk, depending upon the rotation areas affected. The EBS revenue at risk would have accrued mainly in the catcher-processor fleet component. The revenue at risk in the EBS may have been capable of being mitigated by fishing with NPT gear in adjacent areas not affected by EFH fishing impact minimization measures. There may have been additional revenue placed at risk in the EBS under Alternative 4 by the requirement to use bobbins and disks on trawl sweeps for all NPT gear used in open areas; however, the additional adverse economic impact is unknown.

It is not possible to estimate the amount of the revenue at risk under Alternative 4 that could have been recovered by redeployment of fishing effort to adjacent areas or to alternative fishing gears without a thorough understanding of the fishing strategies that would actually have been employed by fishermen in response to the impacts of the EFH fishing impact minimization measures imposed by Alternative 4.

Alternative 4 would require the use of bobbins and disks on NPT footropes and trawl sweeps used in open areas. The use of bobbins and disks may reduce the CPUE of some bottom-dwelling species such as flatfish, resulting in increased fishing time and associated increased operational costs to attain the status quo catch and revenue in these fisheries. This operational impact would occur primarily in the catcher-processor fleet component in the EBS.

GOA Region

Within the GOA, the largest amount of revenue at risk would have been in the CG, with $640,000 at risk, or 8.1 percent of the $7.95 million 2001 status quo revenue in the CG. The revenue at risk in the WG would have totaled $230,000, or 28.9 percent of the 2001 total status quo revenue of $790,000. There would have been very little revenue at risk in the EG, equaling $22,711, or 3.6 percent of the $620,000 2001 total status quo revenue.

In the GOA, the only fishery that would have been affected by the EFH fishing impact minimization measures under Alternative 4 was the NPT slope rockfish fishery. The total revenue at risk in this fishery would have been $900,000, or 9.6 percent of the status quo revenue of $9.36 million in 2001.

In the GOA, the catcher-processor fleet would have had the greatest amount of revenue at risk, equaling $870,000, or 12.3 percent of the 2001 status quo total revenue. The catcher-vessel fleet would have had $28,570 of ex-vessel revenue at risk, or 1.2 percent of the 2001 total ex-vessel revenue of $2.33 million. The catcher-vessel fleet would have had revenue at risk only in the CG, whereas the catcher-processor fleet would have had revenue at risk mainly in the CG ($620,000, or 10.9 percent of status quo), but also in the WG ($230,000, or 28.9 percent of the $790,000 2001 status quo gross revenue), and nearly all of the $22,711 revenue at risk in the EG.

The 11 designated EFH fishing impact minimization measure areas described under Alternative 4 are discreet and widely spaced along the GOA outer shelf and slope edge. There is substantial slope rockfish fishing area adjacent to the 11 areas designated for EFH fishing impact minimization measures where some, or possibly all, of the revenue at risk might be mitigated by a redeployment of fishing effort. Additionally, slope rockfish are caught with pelagic trawl gear (PTR) used primarily by the larger catcher-vessel and catcher-processor fleet components (NMFS 2002d). Continuing with the analytical convention adopted above, the revenue at risk in the catcher-vessel fleet would have been very small compared with the status quo revenue, had Alternative 4 been in place in 2001. Therefore, the revenue at risk might have been mitigated, in part or in whole, by redeploying NPT fishing effort into adjacent areas not affected by the EFH fishing impact minimization measures under Alternative 4. Although the revenue at risk in the catcher-processor fleet under Alternative 4 would have been larger than that in the catcher-vessel fleet, representing more than 12 percent of the total 2001 status quo revenue in the catcher-processor fleet component of this fishery, catcher-processor revenue at risk might also have been partially or completely mitigated by redeploying NPT fishing effort for slope rockfish to fishing areas adjacent to the EFH-affected areas.

AI Region

In the AI, $820,000 of revenue would have been placed at risk, or 1.4 percent of the $56.70 million 2001 status quo revenue in the affected fisheries. In the AI, Alternative 4 would have placed revenue at risk

in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The largest revenue at risk in the AI would have been in the NPT rockfish fishery, where $460,000 or 8.6 percent of the total status quo revenue value of $5.4 million would have been placed at risk. The impact on the Atka mackerel fishery would have placed $80,000 at risk, or 0.2 percent of the $41.16 million 2001 status quo value in this fishery.

In the AI, the catcher-processor NPT fleet would have accounted for substantially all of the $820,000 revenue at risk, or 1.4 percent of the total 2001 status quo revenue of $56.7 million. The AI revenue at risk under Alternative 4, that would have occurred mainly in the catcher-processor fleet component, might have been mitigated by redeploying NPT fishing effort to adjacent areas not affected by the EFH fishing impact minimization measures.

In the AI, Alternative 4 would have placed a relatively small amount of the 2001 status quo revenue at risk and may not have resulted in significant increases in operating costs of either the catcher-vessel or catcher-processor fleet components. Similarly, Alternative 4 may not have significantly affect the safety of any of the fleet components in the AI, because fishing effort would likely be redeployed to adjacent fishing areas. However, there may have been impacts on related fisheries in the AI if vessels using NPT gear were displaced into adjacent areas where other gear groups such as hook and line and pot vessels were operating.

Revenue impacts from changes in product quality would have been possible under Alternative 4, particularly for the smaller catcher-vessel fleet component that may have been required to expend additional fishing effort to recover displaced catch, which may have lengthened fishing trips and resulted in diminished product quality. Product quality may not have been affected in the catcher-processor fleet component, since these vessels process the catch on board the vessel, although product mix could have been adversely impacted (e.g., if the average size of fish declines).

Operating Costs (E-)

Operating cost impacts under Alternative 4 in the GOA may be minimal for the catcher-vessel fleet, given the small amount of revenue at risk for this fleet component. Operational costs for the catcher-processor fleet component may increase due to the redeployment of fishing effort necessary to mitigate the losses imposed by Alternative 4; in 2001 these would have been 12.3 percent of the status quo revenue estimated to be at risk for this fleet component. Fishing effort redeployed into areas adjacent to the EFH fishing impact minimization measure areas may have lower CPUE of slope rockfish, requiring additional fishing effort to mitigate the catch and revenue at risk.

Catcher-processors operating in the EBS NPT flathead sole fishery may likely have some increased operational costs had Alternative 4 been in place in 2001, due to increased running time to reach northern fishing areas when the more southerly areas are closed. They could have also experienced increased operational costs associated with increased fishing effort to mitigate the revenue at risk in these fisheries. It is impossible to estimate the increase in operational costs without fully understanding the fishing effort redeployment strategy that the operators would follow to mitigate revenue placed at risk under Alternative 4; in 2001 these rules would have placed 8.5 to 23.1 percent of the status quo revenues at risk.

Alternative 4 would require the use of bobbins and disks on NPT footropes and trawl sweeps used in open areas. The use of bobbins and disks may reduce the CPUE of some bottom-dwelling species such as flatfish, resulting in increased fishing time and associated increased operational costs to attain the

status quo catch and revenue in these fisheries. This operational impact would occur primarily in the catcher-processor fleet component in the EBS.

In the AI, Alternative 4 would have placed a relatively small amount of the status quo revenue at risk and may not result in significant increases in operating costs of either the catcher-vessel or catcher-processor fleet components.

Costs to U.S. Consumers (E-)
Some impact on the cost to consumers from Alternative 4 would have been likely to occur because, although some or all of the revenue at risk may be recovered by redeployment of fishing effort, there would likely have been some operational cost increases for the fleet components. These operational cost increases due to Alternative 4 EFH fishing impact minimization measures may have resulted in a measurable increase in the price to consumers of species caught in fisheries directly or indirectly affected by redeployment of fishing effort. There may also have been costs imposed on consumers from changes in availability of supply, product mix, and/or quality.

Safety (E-)
If implemented for the 2001 season, Alternative 4 may not have significantly affected the safety of any of the fleet components in the GOA because fishing effort would likely have been redeployed to adjacent fishing areas with similar CPUE and attributes (e.g., distance from port, distance from safe harbor or shelter, etc.).

In the EBS, catcher-processors targeting flathead sole, other flatfish, and Pacific cod would have been restricted from fishing some areas closer to their home ports during some time periods, depending upon the EFH fishing impact minimization measure area affected by the rotational closures to NPT gear. When more southerly areas are closed, vessels fishing NPT gear would have to travel farther north and farther from ports of call, possibly adversely impacting safety.

Alternative 4 may not significantly affect the safety of any of the fleet components in the AI because fishing effort would likely have been redeployed to adjacent fishing areas.

Impacts to Related Fisheries (Ø)
There may not have been significant impacts on related fisheries from Alternative 4, in 2001, in the GOA because NPT fishing effort for slope rockfish would likely have been redeployed into adjacent areas where NPT fishing for slope rockfish already occurs. There may have been impacts on related fisheries in the EBS and AI if vessels using NPT gear are displaced into adjacent areas where other gear groups such as hook and line and pot vessels were operating.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs may increase under Alternative 4, although it is not possible to estimate by what amount. Additional on-water enforcement (including boarding and inspection) may be required to assure compliance with the EFH fishing impact minimization measures applied in the GOA, EBS, and AI. A VMS or 100 percent observer coverage could be required of all vessels targeting slope rockfish with NPT gear in the GOA and all vessels using NPT gear in the EBS and AI to assure compliance with the EFH fishing impact minimization measures under Alternative 4. Section 3.1.2.7 of Appendix C contains some additional detail on the NMFS Enforcement and Coast Guard responses to resource demands connected with monitoring and enforcement provisions of Alternative 4.

4.3.5.3.3 Effects on Communities and Shoreside Industries (Ø)

Overview

Impacts on dependent communities and shoreside industries would not have been significant at the community level under Alternative 4, although a number of individual operations may have experienced adverse impacts. The only fisheries directly affected by this alternative would have been groundfish fisheries. Unlike Alternatives 2 and 3, however, groundfish fisheries in addition to the targeted rockfish fishery would have been affected by this alternative. Further, this alternative would have had impacts on GOA, EBS, and AI fisheries, but the only gear group directly affected for both catcher vessels and catcher-processors would have been non-pelagic trawl. Using 2001 fleet data, 43 vessels (both catcher vessels and catcher-processors) would have been affected by this alternative: 4 in Alaska, 3 from Oregon, 31 from Washington, and 5 from other states. Using 2001 processor data, between 11 and 19 shoreside processors in Alaska would potentially have been affected by this alternative, depending on specific closure configurations.

For the GOA, impacts to catcher vessels, catcher-processors, and processors would have been identical to those that would have been seen under Alternative 2. As a result, as in Alternative 2, no significant impacts to dependent communities in the GOA would likely have occurred under this alternative. Potential impacts to EBS fishery associated communities are described in the following subsections.

Catcher Vessels

Based on 2001 data, Alaska-owned catcher vessels that would have been affected by this alternative are associated with Kodiak (two vessels) and Anchorage (one vessel). Overall ownership was dominated by the Pacific Northwest, with 13 to 16 vessels from Washington and 3 to 4 vessels from Oregon (and 1 vessel from another state). For catcher vessels in the EBS, the only potentially affected fisheries would have been Pacific cod and pollock. The revenue at risk under any of the rotational area closure scenarios would have represented a negligible portion (less than 0.03 percent) of the total 2001 status quo revenues (less than $2,000 out of $5.85 million) for these species for relevant catcher vessels in this area. For catcher vessels in the AI, the only potentially affected fishery would have been for Pacific cod, and the potential revenue at risk would have represented a negligible portion (0.12 percent or less) of the total 2001 status quo revenues for this species for relevant catcher vessels in this area (less than $2,000 out of $1.21 million to $1.32 million). As noted elsewhere, figures given for catcher vessels represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities, if examined separately. Values for first wholesale revenues at risk for shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. As a result of the negligible at-risk portion of the total groundfish fishery in either the EBS or AI, no significant impacts to dependent communities related to catcher vessels would have been likely for any area.

Catcher-Processors

In 2001, 24 catcher-processors would have had revenue at risk under Alternative 4. Ownership of these vessels was concentrated in Washington (18 vessels), while Alaska-based ownership was exclusively in Kodiak (2 vessels). Vessels from other states account for the remaining four entities. For catcher-processors in the EBS, there would have been a wide range of potentially affected groundfish species. The catcher-processors involved in the at-risk harvest are generally head and gut vessels. The revenue that would have been at risk under any of the rotational area closure scenarios would have represented a small portion (2.11 to 4.94 percent) of the total status quo revenues for the relevant species for the affected catcher-processors in this area ($2.10 million to $4.94 million out of $99.42 million to $100 million), and it is assumed that at least some portion of this already minimal at-risk revenue could have

been made up by fishing in other areas with very little increase in effort. For catcher-processors in the AI, there would also have been a range of potentially affected groundfish species, but fewer than seen in the EBS. The revenue that would have been at risk would have represented a small portion (1.48 percent) of the total status quo revenues for the relevant species for the catcher-processors in this area ($820,000 out of $55.38 million). As a result of the small at-risk portion of the total groundfish fishery that would have occurred in either the EBS or AI, no significant impacts to dependent communities related to catcher-processors would have been likely.

Shoreside Processors

For shoreside processors, no substantial impacts would have been likely to occur under this alternative because catcher vessel harvest levels would likely have remained constant, and no substantial change that would have affected inshore delivery patterns in the fishery would have been expected to occur (although there may have been some relatively minor redistribution of catch among individual vessels). Based on 2001 data, processors involved in the at-risk harvest were concentrated in Kodiak (with five to eight entities, depending on closure configurations), with a secondary concentration in Unalaska/Dutch Harbor (with one to five entities, depending on closure configurations). Four other communities each had a single processor that would have processed at least some groundfish from vessels with what would have been at-risk revenues under this alternative (Sand Point, King Cove, Homer, and Seward), while Akutan would have had one or two entities, depending on closure configurations. The total first wholesale value that would have been at risk, of catch delivered inshore for processing, would have represented approximately 1 percent of the total 2001 status quo value (about $149,000 out of $10.78 million) of the relevant fisheries of the CG area and far less than 1 percent in the AI and EBS areas, but no breakdown by port of landing is available. Caution must be exercised in the interpretation of these wholesale value data as (1) they are not additive with ex-vessel values presented above and (2) they cannot be used as a proxy for potential levels of impacts to specific communities without considering the basic caveats laid out in the introductory paragraphs of the shoreside processor section of the Alternative 2, Effects on Communities, discussion presented above. Given the very minor potential changes, however, no significant impacts are likely to have occurred for any dependent community as a result of changes that would have been associated with processors under this alternative.

Multi-Sector Impacts

Multiple sector impacts are unlikely to have been significant at the community level under Alternative 4. Among Alaska communities, only Kodiak participates in more that one sector that would have had at-risk revenues, and then with only two to three catcher vessels or catcher-processors and multiple locally operating shoreside processors. As noted, impacts to shoreside processors would likely have been insignificant, due to the low volumes at risk and the assumption that overall delivery patterns would have been unlikely to have changed under this alternative. Some additional Alaska resident crew positions on vessels owned elsewhere may have had some compensation at risk, but overall potential for employment and wage or crew share compensation loss would have been small. Transient vessels, owned outside of Alaska, typically also make expenditures in ports of landing, which in this case would have been concentrated in Kodiak (and, perhaps, Dutch Harbor). Given the assumption of general landing patterns remaining consistent, however, any vessel expenditure associated impacts are would likely have been minor.

4.3.5.3.4 Effects on Regulatory and Enforcement Programs

The prohibition of bottom-trawl gear for certain areas in the EBS and AI proposed in this alternative would be simpler to manage and enforce than the Alternative 4 proposal for the GOA, which is identical

to the Alternative 2 proposal prohibiting bottom-trawl gear in the rockfish fisheries only, in 11 restricted areas in the GOA.

The alternative phrases the restrictions for the EBS and AI as follows: "Prohibit the use of bottom-trawl gear for all groundfish fisheries in designated areas… ." If the restriction is meant to prohibit any use of bottom-trawl gear at any time within these areas or perhaps even to prohibit carrying bottom-trawl gear onboard the vessels that transit the area, then the restriction is clear-cut, and, while additional responsibilities are created, enforcement of the restriction would be relatively straightforward. However, if the intention would be to prohibit the use of bottom-trawl gear to target groundfish, while allowing it to take groundfish as a "maximum retainable amount" as is currently done, then management and enforcement of the regulation becomes increasingly complex. The distinction turns around the interpretation of the term "fisheries." Does this mean that any time a net is put in the water, a fishery is occurring, or does it mean that only the target fishery is to be restricted to pelagic nets? In the following discussion, the interpretation of "fishery" is expanded to include the more complex condition.

In the EBS, the rotating closed areas would, in effect, create new reporting areas. The status of the fishery for vessels using bottom-trawl gear would change from open to closed once the vessel crossed the boundary into the closed area. Catch accounting from inside and outside the restricted area is important for determining compliance with the bottom gear prohibition. The current reporting process for vessels that are not observed and are self-reporting catch cannot independently verify the location of catch and fishing activity. If a new requirement to use VMS systems were imposed, it could provide independent verification of the vessel's location for the period reported.

The issues raised by the proposed Alternative 4 restrictions in several selected sites in the AI are very similar to the issues involved in the restrictions proposed in the GOA in this alternative, and in Alternative 2. That discussion is, in general, reiterated here.

Catch accounting from inside and outside the restricted area is one basis for determining compliance with the bottom gear prohibition. The restrictions would, in effect, create new reporting areas. The status of all groundfish fisheries for vessels using bottom-trawl gear would change from open to closed once the vessel crossed the boundary into the restricted area.

Catch is accounted for in two ways, by reports from the industry and from observers. The industry currently reports catch by federal reporting areas or State of Alaska statistical areas. Catcher vessels report on the basis of State of Alaska statistical areas that do not perfectly align with the closed areas. If a vessel were to report catch from a statistical area that straddled the boundary of the restricted area, the agency would not know whether the catch was from inside or outside the habitat protection area. For catcher-processors fishing in any federal reporting area, including one of the new protected areas, reporting would not differ from current practice, except that the new protection areas would be added to the list. However, under current procedures, management and enforcement agencies are unable to completely verify any fishing vessel's activity relative to sensitive habitat protection areas, through reporting.

The restrictions provided in Alternative 4 for the GOA are the same as those in Alternative 2. The effects considered in Alternative 2 are reiterated here, as the same issues are relevant.

This alternative results in increasing the complexity of management of the fisheries for rockfish in the GOA. Creation of the 11 areas (within which bottom trawling for rockfish would be prohibited) would require changes in industry and observer reporting requirements and enforcement activity.

Catch accounting from inside and outside the restricted area is one basis for determining compliance with the bottom gear prohibition. The restrictions would, in effect, create new reporting areas. The status of the fishery for rockfish for vessels using bottom-trawl gear would change from open to closed once the vessel crosses the boundary into the restricted area.

Observers provide location specific fishery information from a portion of the fleet. Because current regulations do not require complete observer coverage on all vessels using trawl gear, catch from inside and outside the restricted area could not be strictly verified on all vessels without changes in those requirements. For vessels that do carry observers, catch locations are defined by the haul retrieval locations. For vessels that fish from inside to outside of a restricted area, the catch would accrue to the external area and, consequently, the regulatory conditions for outside the restricted area would apply to the entire tow. NMFS could require that the trawl deployment location be included as well as the haul retrieval location, but that would not solve the problem of determining how much of the catch came from inside a protected area and how much from outside, in the course of a tow that crossed the boundary. Management might therefore apply conservative accounting rules requiring that the regulatory conditions in the restricted area apply to the catch if a vessel fishes inside the restricted area at any time during a period over which catch is aggregated and reported. These conditions could have the effect of a *de facto* expansion of the closed area.

A vessel monitoring system provides more information, giving a continuous record of fishing locations instead of just the beginning and end points of a tow. However, if an observed haul transited the boundary of a protected area under Alternative 4, VMS would not solve the problem of how much catch came from within the area, although it would provide the basis for erring on the side of caution and assigning the entire catch to the restricted area, along the same lines as in the Atka mackerel harvest limit area (HLA) fishery in the AI, under the Steller sea lion protection measures. In that situation, two observers are required on every vessel.

Approval of pelagic trawl gear for rockfish fisheries and the restriction of bottom gear to targets other than rockfish in the restricted area would complicate management and enforcement. Because retention of rockfish would be allowed if they were taken with pelagic nets, and a vessel can carry multiple nets onboard, it would not be possible to determine which fish onboard were taken with which net. In some situations a species might be closed to directed fishing with bottom-trawl gear, but could be taken as incidental catch in the course of targeting another species. A similar situation occurs in the existing fishery, as some catcher vessels and catcher-processors targeting rockfish, for example, use pelagic trawls for mid-water schooling species, such as Pacific ocean perch, and then switch nets to bottom trawls to obtain benthic-oriented rockfish and other valuable species such as sablefish that are closed to directed fishing, but are still retainable at the maximum retainable amount (defined in 50 CFR 679). The percentage of time that bottom trawls are not on the substrate is a factor of the portion of the total catch in the rockfish fishery associated with catching Pacific ocean perch. Pelagic trawls can also be fished in contact with the bottom, so if the intent of this alternative is that they are to be fished off bottom at all times, a new monitoring program would need to be established as well.

Observers can to a limited extent verify which trawls are in use. Currently, observers report which type of trawls are used for the portion of the total number of hauls that are observed. They are not tasked with monitoring which type of gear is being used on all hauls. Vessels that carry both types of nets aboard would be able to claim that the rockfish species aboard were taken in compliance with the restrictions.

Vessels would also be able to target species other than rockfish with bottom gear in the restricted areas and take rockfish as incidentally caught catch. For example, vessels fishing in the closed area might be able to target rex or Dover sole, but take rockfish as incidental catch. The catch of rockfish might be incidental to the Dover sole or the rockfish could be actively pursued after the Dover sole are taken, if the 15 percent MRA mark has not be previously attained. Under these conditions, and especially in light of the problems outlined above in determining the catch location, bottom trawls could be used to fish for rockfish under Alternative 4 in the protected habitat.

Fishing behaviors might change as well. The fishing fleet using bottom nets could switch from rockfish to find a flatfish species that is of very low value and easy to catch to function as a basis for targeting higher valued rockfish and sablefish within the closed area. If that occurred, the impact of fishing on the benthos would not be reduced under this alternative. Impacts in some areas might even increase, if the new target species was not previously pursued. If an alternate target flatfish fishery were developed, regulations to deal with that activity might have to be developed much in the same manner that the arrowtooth flounder target had to be constrained; the practice of catching arrowtooth flounder strictly as a basis for sablefish was prohibited by regulation in August of 1994 (59 FR 38132, July 27, 1994).

Introduction of closed areas might have the effect of crowding vessels using bottom-trawl gear and increase the potential for incidental catch of undesired species. Unintended catch could include groundfish species that might be at risk of overfishing and would thereby generate closures to other fisheries to prevent overfishing or induce accelerated closures of prohibited species that are under the authority of the extant regulations.

Adding a requirement to have disks/bobbins on trawl sweeps and footropes in the EBS would require additional monitoring on the part of enforcement agents. Since these modifications would only be required of a vessel while it was fishing in the restricted area, monitoring would have to occur on the vessel at those times. The observers, whose current scientific responsibilities fill their work hours, would be the only people available for such monitoring.

4.3.5.4 Effects of Alternative 4 on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – The effects of Alternative 4 in the GOA would be identical to those for Alternative 2, so please refer to discussion of Alternative 2 for the evaluation of Alternative 4 on GOA state-managed groundfish species.

State-managed groundfish fisheries do not occur in the EBS or in the specific areas closed in the AI in this alternative. Alternative 4 would have no additional effect on state-managed groundfish fisheries, over what was previously discussed.

State-managed Crab and Invertebrate Fisheries (Ø) – The effects of Alternative 4 in the GOA would be identical to those under Alternative 2, so please refer to Section 4.3.3.4 for the evaluation of this alternative on GOA state-managed crab and invertebrate species.

Alternative 4 sets up rotating closures in the EBS for bottom trawl groundfish. This area encompasses the state-managed Korean hair crab fishing grounds. It is unlikely that there would be any additional benefit to the hair crab stock from the closures. Most of the Pribilof Islands area is already closed to bottom trawling, and hair crab bycatch in the groundfish trawl fisheries is not currently a management concern.

There would be no apparent impacts to state-managed fisheries from the AI closures in Alternative 4.

Herring Fisheries (Ø) – Herring inhabit and are harvested in nearshore waters in the GOA (Kruse et al. 2000) and would not be affected by the GOA mitigation measures in this alternative. In the EBS, the rotational closures that would prohibit the use of bottom-trawl gear for groundfish would likely have no impact on the herring fisheries or the herring stock in the EBS for the following reasons. Herring is rarely caught in bottom trawl fisheries, but when it is, there are herring PSC caps that prohibit further bycatch. The Winter Herring Savings Area already provides bycatch protection for herring northwest of the Pribilof Islands on their wintering grounds.

Halibut Fisheries (Ø) – Alternative 4 would have no measurable effect on halibut fisheries. If effort in the GOA rockfish trawl fishery or EBS groundfish trawl fisheries is displaced, it is possible that halibut bycatch rates and spatial distribution could change.

4.3.5.5 Effects of Alternative 4 on Protected Species

The discussion on protected species provided in this section relative to Alternative 4 is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (Ø) – Alternative 4 could increase bottom trawling in Steller sea lion critical habitat, but the level of fishing would likely be small and the potential increased disturbance or removals of prey likely would not likely cause jeopardy to the sea lion population because the sea lion protection measures currently in place will remain the same under Alternative 4. There likely would be no major effect on species of great whales, although there is some concern over potentially increased fishing activity in areas of the EBS where right whales have been observed. Overall, however, Alternative 4 would likely have no effect on these ESA-listed marine mammal populations.

Other Marine Mammals (Ø) – Effects of Alternative 4 in the GOA would be the same as those described for Alternative 2. In the EBS, Alternative 4 would likely result in an increase in bottom trawling activities in habitat used by other cetaceans and fur seals, but the potential for adverse effect on these populations is very low. Sea otters and harbor seals inhabit more coastal areas and would not likely come in contact with bottom trawling activities. There is some potential for increased bottom trawl fishery overlap with spotted, ribbon, and bearded seal habitat in the northern portions of the EBS and with walrus in the eastern portion of the EBS, but, again, the increased fishing would likely be localized, small, and not likely to adversely affect these marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Impacts of Alternative 4 in the GOA would be the same as those described for Alternative 2. That section concluded there would likely be no effects of this alternative on threatened or endangered salmon or steelhead. In the EBS, Alternative 4 would reduce bottom trawl activity in some areas and likely increase bottom trawling in other areas. The percentages of each displaced bottom trawl fishery are small, however. Probably most of the additional bottom trawl effort would occur in areas that have historically exhibited high CPUE for the particular target species. Given the large size of areas of the EBS that would remain open, coupled with a relatively small amount of increased bottom trawling in these areas, it is unlikely that there would be an increase in mortality to salmonid ESUs. Also, in the EBS, salmon bycatch limits would continue to provide some protection for the salmonid ESUs that might be taken as bycatch. However, fewer ESUs have been reported to occur in the EBS as documented by CWT returns, and most salmon ESUs have been taken in the pollock pelagic trawl fishery. Since Alternative 4 addresses bottom trawl fishery changes, the small increases in bottom trawl fishing effort in the EBS due to area closures for this gear type

would likely not increase the bycatch of ESA-listed salmon or steelhead. It is not likely that the small amounts of displaced bottom trawl fishing would even remotely affect the prey field for ESA-listed salmonids.

ESA-listed Seabirds (Ø) – Impacts of Alternative 4 in the GOA would be the same as was described for Alternative 2. That section concluded there would likely be no effects of this alternative on ESA-listed seabirds. In the BSAI, Alternative 4 would reduce bottom trawl activity in some areas and likely increase bottom trawling in other areas. No longline fisheries would be affected. Short-tailed albatross would be susceptible to take in these fisheries, possibly from trawl third-wire gear. But the increased effort by bottom trawlers in the EBS and AI under Alternative 4 would be very small, and lethal encounters with this gear would likely be rare. The USFWS may issue a take limit for short-tailed albatross in the trawl fisheries since this seabird is an endangered species and there exists a potential for a trawl vessel to interact with a short-tailed albatross. Under Alternative 4, the cooperative studies involving the USFWS, NMFS, and industry would continue to develop, and presumably the program would result in a mitigation strategy that would minimize trawl third-wire mortality to seabirds. Steller's and spectacled eiders overlap very little with the groundfish fisheries off Alaska. Spectacled eiders are present in the northern BS during winter months, and could encounter groundfish fishing activities in this area in winter if the fisheries occur near the sea ice polynyas south of St. Lawrence Island. However, seasonal sea ice generally moves fisheries further to the south, and the potentially very small amounts of displaced bottom trawl activities would not likely provide a chance for take of this seabird. In winter, the Steller's eider occurs in critical habitat along the Alaska Peninsula and some segments of the EBS coast in winter, such as the Kuskokwim Shoals, and it also is present throughout the AI. These birds do not forage or otherwise use as habitat most of the marine waters of the EEZ, and thus the altered fishing effort patterns under Alternative 4 would not likely result in adverse impacts on this species.

Other Seabirds (Ø) – Alternative 4 may increase groundfish trawl fishing levels in some areas and could result in some slightly increased levels of fulmar mortality from take in bycatch, or third wire or vessel strikes. Incidental mortality from trawl fishing operations would continue to take albatrosses and shearwaters because these seabirds are fairly susceptible to incidental take because of their feeding behavior; some slight increase in mortality under Alternative 4 could affect these species. Some of these concerns would be alleviated with implementation of new seabird bycatch reduction programs in the longline fisheries. Alternative 4 would likely have minimal effect on red-legged kittiwakes and Kittlitz's murrelets. Although there are few concerns over fishery-related depletion of seabird prey, some concerns would continue over the occasional intense fishing activity near seabird colonies that might interrupt or displace seabird foraging. Alternative 4 may slightly increase potential overlap of trawl fishing activities and seabird foraging areas. Seabirds would continue to strike vessels and suffer mortality, particularly such species as storm-petrels, fulmars, some albatrosses, and crested auklets, perhaps at very slightly increased levels under Alternative 4. Overall, however, the effects of Alternative 4 on seabirds would be minimal.

4.3.5.6 Effects of Alternative 4 on Ecosystems

Predator-Prey Relationships (Ø) – Alternative 4 is judged to have no effect on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, or increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem due to Alternative 4, although catches of EBS other flatfish and AI rockfish may be somewhat reduced from status quo. Similarly, trophic level of the catch would not be much different from status quo, and little change in the

functional species composition of the groundfish community or in the removal of top predators is expected.

Energy Flow and Balance (Ø) – The amount and flow of energy flow in the ecosystem would be the same as the status quo with regards to the total level of catch biomass removals from groundfish fisheries. No substantial changes in groundfish catch or discarding (except perhaps some reduction in the catch of EBS other flatfish species) would be expected.

Diversity (E+) – Bottom trawling would be much reduced on some GOA slope areas, some AI areas, and some areas in the northwest BS. Although most of this effort would be redistributed to adjacent areas, the closed areas provide protection against species extinction to sensitive, sessile organisms within the areas closed to bottom trawling. Thus, species level diversity might be enhanced relative to the status quo. Closure of the areas to bottom trawling may help to maintain (or even enhance) productive fish habitat and thereby help sustain fish populations that rely on these areas. This alternative provides protection to structural habitat diversity in both the GOA and the AI. Genetic diversity could slightly increase under Alternative 4 if older, more heterozygous individuals were left in the populations of AI slope rockfish or EBS other flatfish. However, the exact spawning locations of these species is unknown, so the effects of the alternative on this aspect of diversity remain unknown. Overall, Alternative 4 was judged to have positive effects on diversity.

4.3.6 Effects of Alternative 5A

4.3.6.1 Effects of Alternative 5A on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type differed from status quo for Alternative 5A. LEIs for both status quo and Alternative 5A were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make then relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in the center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Benthic Biodiversity (E+) – Alternative 5A would provide substantially improved protections to coral through trawl closures in both the GOA and AI.

GOA – Alternative 5A institutes closures to all bottom trawling in ten areas in the GOA and to rockfish trawling in the slope habitat. LEI values were substantially reduced for coral (-47 percent). Besides being the trawl fishery with the most effect on this habitat type, the rockfish fishery is also the most likely of the major fisheries there (deepwater flatfish being the other) to fish on substrates conducive to coral growth. While the full slope closure continues to allow some bottom trawling, elimination of the principal hard bottom fishery from the slope would be likely to substantially reduce the areas exposed to even minimal levels of bottom trawling, thus improving protection of corals.

AI – Alternative 5A adds one more closure (Yunaska) to the four Aleutian areas closed to all bottom trawl fishing in Alternative 4. Limited recent fishing has been also done in this area. They represent a significant area of additional closure to all bottom trawling, mostly in the deep habitat important to hard corals. Total closures under this alternative make up 18 percent of the shallow habitat and 31 percent of the deep. Because of limited recent fishing, it is more likely that resident corals in those areas have not been removed, although parts of Seguam Pass were heavily fished before the sea lion closures. Because

of the increased protection of additional potential coral habitat, this alternative has a positive effect on epibenthic structure.

Effects on Habitat Complexity (E+) – Alternative 5A would be expected to result in positive effects on epibenthic structure forming organisms, mainly through reduced effects on the GOA slope. Gear modifications and closures in the EBS may also provide improvements, but the effectiveness of gear requirements is speculative at this time.

In the GOA, Alternative 5A institutes closures to all bottom trawling in ten areas and to rockfish trawling in the slope habitat. Besides being the trawl fishery with the most effect on this habitat type, the rockfish fishery is also the most likely of the major fisheries there (deepwater flatfish being the other) to fish on the more sensitive hard substrates. All of the 10 areas mostly enclose slope habitat. LEI values were substantially reduced for soft bottom bio- (-47 percent) and nonliving (-24 percent) structure, hard bottom bio- (-54 percent) and nonliving (-57 percent) structure. Estimated increased effects on the adjacent deep shelf habitats from fishing redistribution were small proportional increases (less than 5 percent) to effects that were already small (less than 5 percent).

In the AI, Alternative 5A adds one more closure (Yunaska) to the four areas closed to all bottom trawl fishing in Alternative 4. Limited recent fishing has also been done in this area. The LEI reductions from the combined closures were still fairly small (-2 to -4 percent for bio and nonliving structure) and do not indicate a substantial improvement for epibenthic structure.

In the EBS, Alternative 5A establishes rotating bottom trawl closures over a large area of sand/mud and slope habitats and full bottom trawl closures of large areas of sand, sand/mud and mud habitats of the northeastern BS. The rotating closure area has been moderately fished recently, while the full closure area excludes very little recent effort. Rotations close one third of the area at all times. The biostructure feature of the EBS sand/mud and slope habitats had the highest LEI values of the analysis. This was only reduced by 6 percent for both sand/mud and slope habitats due to the closures.

An additional feature of Alternative 5A was a required modification to the bottom-contact gear of all bottom trawls that provides at least 3 inches of open spacing under 90 percent of the area swept by trawls. These modifications are already common for most, but not all, trawl footropes, but are not used for the bridles and sweeps, which provide 80 to 85 percent of the coverage of bottom trawls used in the EBS. Bridles and sweeps in current use are mostly of constant diameter, providing no space for organisms to pass beneath except when raised by ridges and bumps on the seafloor. The reduction of damage to biological structure organisms by providing such a space is conceptual and speculative at this point, and it would require testing before implementation. Many of the EBS structure forming organisms are small enough to pass though a gap that size. A run of the analysis was done to see what effect a 50-percent reduction in mortality for organisms passing through the spaces would have on biostructure reductions. The result was a 16-percent reduction in slope LEI and a 19-percent reduction in sand/mud LEI (in combination with the closures). If that level of mortality reduction were confirmed, this would have a positive effect.

4.3.6.2 Effects of Alternative 5A on Target Species

4.3.6.2.1 Effects on Groundfish

4.3.6.2.1.1 Walleye Pollock (BSAI and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the BSAI, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and WCGOA walleye pollock stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to Alternative 1, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact walleye pollock fishing mortality in the GOA. In the BSAI, the additional closed areas are not expected to impact walleye pollock fishing mortality because they are taken by pelagic trawl. Even if some decrease in fishing mortality were realized under Alternative 5A, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or WCGOA walleye pollock stocks that materially impact either stocks's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. These closures are not expected to impact the spatial concentration of walleye pollock in the GOA or BSAI. There is no evidence that Alternative 5A would alter the EBS stock's ability to maintain itself above its MSST.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact the spawning and breeding success of walleye pollock in the GOA. In the BSAI, the additional portions of walleye pollock habitat that would be closed under Alternative 5A appear to encompass only small portions of the known walleye pollock spawning grounds. Even if some increase in spawning and breeding success were realized under Alternative 5A, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Feeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact the feeding success of walleye pollock in the GOA. In the EBS and AI, additional proportions of walleye pollock habitat that would be closed under Alternative 5A. In the EBS, the proposed closed areas overlap regions occupied by adult pollock in the summer. The primary prey of adult pollock are euphausiids and forage fish. The impact of the no trawl zones on pelagic prey species is likely to be minor. Even if some change in feeding success were realized under Alternative 5A, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Growth to maturity (EBS U, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact the successful growth to maturity of walleye pollock in the GOA. In the EBS and AI, additional proportions of walleye pollock habitat that would be closed under Alternative 5A. In the EBS, the proposed closed areas overlap regions occupied by juvenile pollock. As was noted in Chapter 3, some juvenile walleye pollock assume a demersal existence at or near the end of the first year of life. Juvenile pollock maintain this existence for 1 year after which they assume a pelagic existence for 1 to 2 additional years. The impact of trawling on the feeding success and survival of juvenile walleye pollock is unknown. The impact of the no trawl zones on the feeding success of juvenile pollock is unknown.

4.3.6.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the BSAI and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH, they would not be expected to impact Pacific cod fishing mortality in the GOA. In the BSAI, it is possible that the additional closed areas might cause catches to be lower if the full TAC could not be taken by fishing in the remaining open areas. However, the additional proportions of Pacific cod EFH that would be closed in the BSAI under Alternative 5A are small. Even if some decrease in fishing mortality were realized under Alternative 5A, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the BSAI or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH,

they would not be expected to impact the spatial concentration of Pacific cod catch in the GOA. How the additional closures in the BSAI would affect the spatial concentration of the catch in that region is unclear, because spatial concentration depends not just on the relative sizes of the open and closed areas, but on the magnitude and spatial distribution of catch within the open and closed areas as well. Even if some decrease in spatial concentration of the BSAI catch were realized under Alternative 5A, however, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH, they would not be expected to impact the spawning and breeding success of Pacific cod in the GOA. In the BSAI, the additional portions of Pacific cod EFH that would be closed under Alternative 5A appear to encompass only a small proportion of the known Pacific cod spawning grounds. Even if some increase in spawning and breeding success were realized under Alternative 5A, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH, they would not be expected to impact the feeding success of Pacific cod in the GOA. In the BSAI, the additional proportions of Pacific cod EFH that would be closed under Alternative 5A are small. Even if some increase in feeding success were realized under Alternative 5A, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 5A is the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA fall outside of Pacific cod EFH, they would not be expected to impact the successful growth to maturity of Pacific cod in the GOA. In the BSAI, the additional proportions of Pacific cod EFH that would be closed under Alternative 5A are small. Even if some increase in successful growth to maturity were realized under Alternative 5A, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

4.3.6.2.1.3 Sablefish (BSAI and GOA)

The rotational closures in the EBS lie outside areas where intensive bottom trawling and sablefish concentrations overlap. Thus the effects of Alternative 5A for the EBS differ little from the status quo.

The closure areas in the AI lie outside areas where sablefish are concentrated in the AI, except for the Seguam foraging area. The Seguam foraging area is a relatively small part of the AI area. Thus the effects of Alternative 5A for the AI area differ little from the status quo.

Stock Biomass (Ø) – Alternative 5A closes the GOA to slope rockfish bottom trawling and additionally closes 11 slope areas to all bottom trawling. About 6 percent of the sablefish total catch comes from the slope rockfish bottom trawl fishery (1996 to 2000, Sigler et al. 2002). Thus Alternative 5A likely would result in a small increase in sablefish biomass compared to the status quo, unless pelagic trawling or longlining substantially replaced the banned rockfish bottom trawling.

Fishing currently is classified as directed based on the catch composition for the trip or the week. Thus fishermen can target rockfish in one or more tows, but the fishing may not be classified as directed towards rockfish if the cumulative rockfish catch for the trip or week are not great enough. Thus some targeting of rockfish still might occur under Alternative 5A unless the classification scheme for directed fishing is changed.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 5A would decrease the spatial/temporal concentration of trawl fishing mortality compared to the status quo. The decrease would be small because the slope rockfish bottom trawl fishery only accounts for a small portion of the total sablefish catch (about 7 percent, average 1996 to 2000, Sigler et al. 2002). The effect would lessen if pelagic trawling or longlining substantially increased.

Alternative 5A would increase the spatial/temporal concentration of trawl fishing mortality due to the deepwater flatfish trawl fishery compared to the status quo. The closed areas are relatively small in the central GOA, so that the increase in concentration would be small. The closed areas are relatively larger in West Yakutat and especially in the western GOA, so the increase in concentration would be higher, up to one third higher in the western GOA. However the trawl fishery is small relative to the longline fishery, which remains open in all areas. Thus Alternative 5A would not significantly change the spatial-temporal concentration of total fishing mortality (trawl and longline combined) compared to the status quo.

Spawning/Breeding (Ø) – Changes to the slope rockfish trawl fishery likely would have no direct effect on sablefish spawning because sablefish spawning occurs during winter whereas the slope rockfish trawl fishery is open during summer. Changes that affect the flatfish fisheries probably would not change any effect on sablefish spawning because total fishing effort likely would remain the same. Currently the flatfish fisheries are open much of the year. Habitat-mediated effects on sablefish spawning due to physical structure are projected to decrease substantially under Alternative 5A compared to the status quo.

Feeding (Ø) – Benthic prey (epifauna and infauna) are substantial prey items for sablefish. The slope rockfish trawl fishery closure areas for Alternative 5A might increase availability of benthic prey to sablefish, to the extent that reduced slope rockfish trawling improves habitat (minor improvements are projected compared to the status quo). The increase likely would be reduced by movement of flatfish trawl fishing effort from the ten closure areas to the remaining open areas. On the other hand, trawl fishing for deepwater flatfish would cease in the ten closure areas, so that habitat-mediated effects of fishing would discontinue in these areas and the habitat would recover from any effects of fishing. Habitat-mediated effects on sablefish feeding due to physical structure are projected to decrease substantially compared to the status quo.

Growth to maturity (Ø) – The slope rockfish closure areas for Alternative 5A probably would have little effect on growth to maturity of sablefish. On the other hand, trawl fishing for deepwater flatfish would cease in the ten closure areas, so that habitat-mediated effects of fishing would discontinue in these areas and the habitat would recover from any effects of fishing. Habitat-mediated effects on sablefish growth to maturity due to physical structure are projected to decrease substantially compared to the status quo. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may improve under Alternative 5A, thereby increasing juvenile survivorship especially for areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity currently is high.

The slope rockfish closure areas for Alternative 5A probably would have little overall effect on sablefish habitat. Sablefish abundance would increase slightly and benthic prey availability might increase, though the increase likely would be reduced by movement of flatfish trawl fishing effort from the ten closure areas to the remaining open areas. On the other hand, trawl fishing for deepwater flatfish would cease in the ten closure areas, so that habitat-mediated effects of fishing would discontinue in these areas and the habitat would recover from any effects of fishing. Habitat-mediated effects on sablefish due to physical structure are projected to decrease substantially compared to the status quo. Other fishing effects not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) may improve under Alternative 5A, thereby increasing juvenile survivorship especially for areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity currently is high.

4.3.6.2.1.4 Atka Mackerel (BSAI and GOA)

Stock Biomass (Ø) – This alternative is not expected to impact the stock biomass of Atka mackerel relative to status quo. Alternative 5A prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island in the AI. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 5A also closes areas in the GOA bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for stock biomass is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – This alternative is not expected to impact the spatial/temporal concentration of the catch of Atka mackerel relative to status quo. Alternative 5A prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas do not overlap with the Atka mackerel fishery. Alternative 5A also closes areas in the GOA to rockfish bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for spatial/temporal concentration of the catch is no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m, and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Alternative 5A is not expected to effect the spawning and breeding of Atka mackerel relative to status quo. Alternative 5A prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 5A also

closes areas in the GOA to rockfish bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for spawning and breeding is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. In addition, the closed areas in the GOA for Alternative 5A are mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so in theory any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for Atka mackerel. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative were implemented, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to status quo. Therefore, the rating for feeding is no effect.

Growth to maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The directed fishery in the AI overlaps with late juvenile/mature adult habitat at depths of generally less than 200 m.

Alternative 5A is not expected to effect the growth to maturity of Atka mackerel relative to status quo. Alternative 5A prohibits the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. Alternative 5A also closes areas in the GOA to rockfish bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for growth to maturity is no effect.

4.3.6.2.1.5 Yellowfin Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS yellowfin sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Nichol 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on EBS yellowfin sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS yellowfin sole harvest does not occur in the designated bottom trawl closure areas that are scheduled for rotating closures, there is not expected to be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS yellowfin sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for yellowfin sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as

in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for yellowfin sole. Within the first year of life, yellowfin sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.6 Greenland Turbot (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS Greenland turbot biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Ianelli et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on the spatial/temporal concentration of the EBS Greenland turbot catch in most years except when the portion of the closed areas include slope waters. Since most of the EBS Greenland turbot harvest does not occur in the designated bottom trawl closure areas in the other years and because their exploitation rate is so small, there is no expected negative effect or future benefit to the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS Greenland turbot since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for Greenland turbot since the modeled benthic disturbance for infauna and epifauna prey are not relevant to their diet. Adult feeding on pollock, squid, and deep water fish species primarily occurs during summer throughout the deep slope waters and to a lesser extent on the upper slope/shelf margins. Most of the Greenland turbot feeding behavior is observed to take place off bottom and is not related to the benthic food availability.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for Greenland turbot. Within the first year of life, Greenland turbot metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at

inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.7 Arrowtooth Flounder (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA arrowtooth flounder biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on GOA arrowtooth flounder since there would be only minor changes in the spatial/temporal concentration of the catch. Recent summer surveys indicate that 90 percent of the stock biomass resides at depths less than 200 m. Harvesting under Alternative 5A is not expected to cause a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA arrowtooth flounder since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.8 Rock Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS rock sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on EBS rock sole, since there would be only minor changes in the spatial/temporal

concentration of the catch. Since most of the EBS rock sole harvest does not occur in the designated bottom trawl closure areas that are scheduled for rotating closures, there is not expected to be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS rock sole, since there would be few changes in the current harvest practices. Fishing is not expected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.9 Flathead Sole (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on GOA and EBS flathead sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Bottom trawl surveys conducted during summer indicate that 95 percent of the flathead sole biomass is at depths less than 200 m. Therefore it is not expected that future harvest under this scenario would differ much from Alternative 1 and is not expected to be a negative effect on the future genetic diversity of the stock. Also, since most of the recent EBS flathead sole harvest has not occurred in the designated bottom trawl closure areas that are scheduled for rotating closures, there is not expected to be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA and EBS flathead sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs

during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what effect the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 5A on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on GOA rex sole, since there would be no change in the spatial/temporal concentration of the catch.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA rex sole, since there would be no change to the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.11 Alaska Plaice (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS Alaska plaice biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on EBS Alaska plaice since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS Alaska plaice harvest does not occur in the designated bottom trawl closure areas that are scheduled for rotating closures, there is not expected to be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on EBS Alaska plaice since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for Alaska plaice since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, marine worms, and, to a lesser extent, bivalves. Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for Alaska plaice. Within the first year of life, Alaska plaice metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA shallow water flatfish complex, the effect of Alternative 5A on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A would have little effect on GOA rock sole and other shallow water flatfish since they primarily inhabit waters less than 200 m deep.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA rock sole, since there are no expected changes in harvest practices under this alternative and since fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA deep water flatfish complex, the effect of Alternative 5A on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5A may have some effect on the GOA Dover sole harvest due to the 200-m restriction. Trawl surveys indicate that nearly half of the summertime biomass are at depths less than 200 m so it is possible that the harvest could be taken entirely in the shallow areas. It is unknown what effect this would have on the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5A would have no effect on GOA Dover sole, since they spawn in deep water and harvest practices would be restricted under this alternative. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A is not expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5A would have no effect on the growth to maturity for Dover sole. Within the first year of life, Dover sole metamorphose from free-swimming

larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5A, there is no effect from fishing on survival and growth to maturity.

4.3.6.2.1.14 Pacific Ocean Perch (BSAI)

Stock Biomass (Ø) – Under Alternative 1, total biomass (ages 3 through 21+) of BSAI Pacific ocean perch is above the MSST and expected to remain above the MSST, resulting in a rating of no effect of fishing on stock biomass. Because Alternatives 5A and 5B have additional habitat protections (and TAC reductions under Alternative 5B) in the BSAI area, the stock biomass would also be expected to remain above the MSST and the effect of fishing on stock biomass is also rated as no effect.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for Pacific ocean perch harvest in EBS are located on the slope to the southeast of the EBS closure areas, which thus have little effect on the fishery. Similarly, the closure areas in the AI are located in areas where few Pacific ocean perch are caught and thus have little effect on the spatial/temporal concentration of the catch. The pattern of fishing for Pacific ocean perch is expected to be similar to that in Alternative 1 and thus have no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo (Alternative 1) management, resulting in a rating of no effect of fishing on spawning habitat. As was mentioned above, the pattern of fishing for Pacific ocean perch in the BSAI area is expected to similar to Alternative 1, and Alternatives 5A and 5B would be expected to have no substantial effects on essential spawning habitat.

Feeding (Ø) – Pacific ocean perch are plankton feeders, with juvenile Pacific ocean perch eating calanoid copepods and adults eating largely euphausiids (Yang 1993, 1996). Fishing activity under Alternatives 5A and 5B would be expected to have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. The pattern of Pacific ocean perch fishing under Alternatives 5A and 5B is expected to be similar to that under Alternative 1, and fishing is thus anticipated to have no substantial effect on the survival of fish to maturity.

4.3.6.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – The ten areas in the GOA that Alternative 5A would close to all groundfish bottom trawling cover a relatively small portion of the slope, geographically, and do not appear to coincide with many areas of high Pacific ocean perch concentrations.

The closure of the slope to directed rockfish bottom trawling could have a substantial impact on the catch of Pacific ocean perch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the

shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, the effort may move onto the shelf and into the gullies. Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope may convert to pelagic trawl gear. In either case, the stock biomass is likely to remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – Because the ten areas in the GOA that Alternative 5A would close to all groundfish bottom trawling are geographically small and generally not in areas with high Pacific ocean perch concentrations, this portion of the alternative would have a negligible effect on the spatial/temporal concentration of catch.

The closure of the slope to directed rockfish bottom trawling could have a substantial impact on the spatial/temporal concentration of Pacific ocean perch catch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies. This could result in increased fishing pressure in these areas and, under a short duration, open access fishery could increase the risk of localized depletion in these areas.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear and current levels of fishing pressure on the slope could continue.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, this alternative would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 5A on Pacific ocean perch spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

The ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally not in areas with high Pacific ocean perch concentrations, but they do create no-take zones or refugiua for Pacific ocean perch in these areas, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited rockfish populations (Yoklavich 1988). In particular, the closed areas may allow increased survival of larger and older fish that produce significantly more offspring. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit Pacific ocean perch.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 5A.

Growth to Maturity (Ø) – The ten areas in the GOA that Alternative 5A would close to all groundfish bottom trawling are geographically small and generally not in areas with high Pacific ocean perch

concentrations. This portion of the alternative would likely have little impact on the growth to maturity of Pacific ocean perch compared to the status quo.

Conceivably, closing the slope to directed rockfish bottom trawling could have a positive impact on the growth to maturity of Pacific ocean perch compared to the status quo. The fishing closures are geographically large, but probably do not coincide with juvenile Pacific ocean perch habitat. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. If the bottom trawl closures coincide with juvenile habitat then damage to this epifauna by bottom trawls would be reduced in closed areas

Areas of the slope closed only to bottom trawling would not likely serve as refugia for Pacific ocean perch because trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002).

4.3.6.2.1.16 Shortraker and Rougheye Rockfish (BSAI)

Stock Biomass (U) – BSAI shortraker and rougheye rockfish are not currently assessed with an age-structured population model, and the MSSTs have not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for shortraker and rougheye rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. Large catches of rougheye rockfish are occasionally taken just outside of Seguam Pass, and would fall outside of the proposed Seguam Pass area closure. Small amounts of rougheye and shortraker rockfish are harvested within the other proposed closure areas. The spatial/temporal concentration of the catch under Alternatives 5A and 5B is not expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling under Alternative 5A in some areas of the AI is expected to have little effect on the spawning and breeding habitat of shortraker/rougheye rockfish because relatively few shortraker rougheye are caught within the proposed closed areas. Thus, the effect of fishing on spawning habitat is expected to be similar to that in Alternative 1. However, because the MSSTs for shortraker and rougheye rockfish are unknown, the effect of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Pandalid and hippolytid shrimp are the largest components of the rougheye rockfish diet (Yang 1993, 1996). The diet of shortraker rockfish is largely unknown, but a limited number of samples suggest that squid is a major component. The reduction of epifaunal prey could affect the diet of rougheye rockfish, but the percent reductions in these prey are so small (0 to 3 percent) that fishing is anticipated to have no effect on the diet of shortraker/rougheye rockfish under Alternative 5A.

Growth to Maturity (U) – Little information is available on the habitat of juvenile rougheye/shortraker rockfish. Because the MSSTs for rougheye and shortraker rockfish are unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.6.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – Alternative 5A would likely have little or no impact on the stock biomass of shortraker/rougheye rockfish compared to the status quo. This appears to be true even though the alternative combines the measures in Alternatives 2 and 3, and in addition prohibits bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope. Fishery data indicate catches of shortraker and rougheye rockfish are rather evenly spread along the continental slope of the GOA, especially in the central GOA and west Yakutat areas, where most of the catch is taken. This lack of geographic catch concentration may be due to Council regulations that allow these species to only be taken as bycatch in other fisheries. About 40 percent of the shortraker/rougheye catch in recent years has come from longline fisheries that target on sablefish and halibut (Heifetz et al. 2002). Since shortraker and rougheye are only taken as bycatch, are taken by both trawl and longline fisheries, and because distribution is evenly spread over a wide geographical area it is unlikely that the closures proposed under Alternative 5A would have an effect on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – Because fishery data indicates shortraker/rougheye catches are spread out evenly along the continental slope of the GOA and because shortraker/rougheye are taken only as bycatch in several major fisheries including longline fisheries it is unlikely that the closures proposed under Alternative 5A would change the spatial/temporal concentration of the catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur in February through August for shortraker rockfish and in December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish is unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp, and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small in size, they are generally not taken in bottom-tending fishing gear. This alternative combines the measures in Alternatives 2 and 3, and in addition prohibits bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope and would likely not effect the prey availability to adult shortraker and rougheye rockfish. Therefore, it is unlikely the effects of Alternative 5A would lead to a change in food availability to shortraker and rougheye rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to firmly conclude that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the majority of proposed areas in this alternative are only closed to directed rockfish bottom trawling and would still be open to other directed fisheries which may continue to damage sensitive benthic fauna. The ten areas that are closed to all bottom trawling are small and cover a relatively small portion of the slope. Since it is unknown if a reduction in bottom trawl effort in such small areas may improve benthic habitat and

since habitat requirements are mostly unknown for shortraker/rougheye it is unknown what effects Alternative 5A would have on these species.

4.3.6.2.1.18 Northern Rockfish (BSAI)

Stock Biomass (U) – BSAI northern rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for northern rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. The Semisopochnoi Island and Seguam Pass area closures may reduce effort from the Atka mackerel fishery in these areas and also bycatch of northern rockfish. The spatial/temporal concentration of the catch under Alternatives 5A and 5B are not be expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas where northern rockfish have been taken as bycatch, such as Semisopochnoi Island and Seguam Pass, may have some positive effect on the effect of fishing on spawning habitat relative to the status quo. However, the magnitude of this effect, as reflected by changes in the stock size relative to the MSST, is unknown.

Feeding (Ø) – Northern rockfish are largely plankton feeders, eating mainly euphausiids but also copepods, hermit crabs, and shrimp (Yang 1993). Fishing activity under Alternative 5A would be expected to have no effect on the largely pelagic diet of northern rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile northern rockfish. Because the MSST for northern rockfish is unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.6.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. Alternative 5A would likely have little impact on the stock biomass of northern rockfish compared to the status quo.

The ten areas in the GOA that the alternative would close to all groundfish bottom trawling cover a relatively small portion of the slope, geographically, and do not appear to coincide with areas of high northern rockfish concentrations.

The closed slope areas in the GOA are all 200 to 1,000 m deep. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, the areas that Alternative 5A would close to rockfish bottom trawling do not appear to coincide with areas of high northern rockfish concentrations.

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST, and Alternative 5A would likely result in GOA northern rockfish sustaining themselves above MSST. Because the ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally not in areas with high northern

rockfish concentrations, this portion of the alternative would have a negligible effect on the spatial/temporal concentration of catch.

Closing the slope to directed rockfish bottom trawling could have an impact on the spatial/temporal concentration of northern rockfish catch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, movement of the Pacific ocean perch bottom trawl fishery could result in increased fishing pressure in areas of high northern rockfish concentrations and under a short duration open access fishery could increase the risk of overfishing and or localized depletion in these areas.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, which would have little effect on northern rockfish.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, this alternative would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 5A on northern rockfish spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 5A.

Growth to Maturity (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. The ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally not in areas with high northern rockfish concentrations. This portion of Alternative 5A would likely have little impact on the growth to maturity of northern rockfish compared to the status quo.

Closing the slope to all bottom trawling could have a negative impact on the growth to maturity of northern rockfish compared to the status quo. The fishing closures are geographically large, but probably do not coincide with adult or juvenile northern rockfish habitat. Studies using submersibles have indicated that several species of rockfish appear to use rocky, shallower habitats during their juvenile stage (Carlson and Straty 1981, Kreiger 1993). Although these studies did not specifically observe northern rockfish, it is reasonable to suspect that juvenile northern rockfish also use these shallower habitats as refuge areas. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Northern rockfish appear to be associated with relatively rough bottoms on these banks, and they are mostly demersal in their distribution (Pers. comm. Dave Clausen). Observations from a submersible in the AI have also identified adult northern rockfish associated with boulders and sponges in mixed sand/gravel

on the shallow (less than 200 m) slope. Consequently, there is some anecdotal evidence to suggest that adult and juvenile northern rockfish may be associated with living and nonliving structure on the bottom which could be negatively impacted by the effects of bottom trawling. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope is closed to bottom trawling, Pacific ocean perch fishing effort may move onto the shelf and into the gullies where concentrations of northern rockfish are found.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope is closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, which would have little effect on northern rockfish.

4.3.6.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA is comprised of three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on this species as a proxy for the pelagic shelf rockfish management group.

Stock Biomass (Ø) – Alternative 5A would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo. This appear to be true even though the alternative combines the measures in Alternatives 2 and 3 and in addition prohibits bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope, and all are in depths more than 200 m. In contrast, the fishing grounds that account for most of the catch of light dusky rockfish are all on the outer shelf in depths less than 200 m. The large closure area for all slope waters 200 to 1,000 m only affects bottom trawling for species in the slope rockfish management group, and the directed bottom trawl fishery for light dusky rockfish would continue similar to its present state. This large closure might somewhat reduce the bycatch of light dusky rockfish in the slope rockfish fisheries, but the closure only applies to waters of the continental slope at depths of 200 to 1,000 m, where few light dusky rockfish are found.

Spatial/Temporal Concentration of the Catch (Ø) – Because the areas closed to fishing generally do not correspond with locations where light dusky rockfish are abundantly caught (the closed areas are all too deep), Alternative 5A would probably have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring, based on observations of ripe females sampled on a research cruise in April in the central GOA. Because of this lack of knowledge, the effects of Alternative 5A on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than

benthic in their distribution and they are so small they are not retained by any fishing gear, Alternative 5A probably has little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closed areas in Alternative 5A are mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so in theory any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for light dusky rockfish. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited in all the closed areas, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If Alternative 5A went into effect, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to light dusky rockfish would be unchanged compared with the status quo.

Growth to maturity (Ø) – Alternative 5A would have little or no effect on growth to maturity of light dusky rockfish. Closing certain areas to bottom trawling could potentially have a benefit to light dusky rockfish because evidence suggests the fish may be associated with epifauna and rocky substrates. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the closure areas in this alternative are all located in deeper waters (more than 200 m) that are inhabited by relatively few light dusky rockfish, so they provide little benefit to these fish.

4.3.6.2.1.21 Other Rockfish Species (BSAI)

Stock Biomass (Ø) – The Alternative 5A closure areas in the AI, except for the Seguam Pass area, are areas where little to no light dusky rockfish have been observed. In the EBS, the closure areas are in the northern parts of the shelf and slope region which are areas of little to no observations of light dusky rockfish. Therefore, Alternative 5A would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Similar rationale as for stock biomass, this alternative would likely have little or no impact on the spatial/temporal concentration of light dusky rockfish catch compared to the status quo.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, therefore due to this lack of knowledge, the effects of Alternative 5A on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). Although any direct or indirect effects of fishing on euphausiid abundance is not presently known these closure areas probably have no effect on their abundance.

Growth to maturity (Ø) – The closure areas are not in locations of known concentrations of light dusky rockfish. Therefore, Alternative 5A would have little or no effect on growth to maturity of light dusky rockfish.

4.3.6.2.1.22 Shortspine Thornyheads (BSAI)

Stock Biomass (Ø) – The peak abundance for shortspine thornyheads is along the slope from 300 to 1,000 m. Although the suggested 33.3 percent rotational closure areas in the BSAI do extend over the slope, only a small fraction of it is actual shortspine thornyhead habitat area. Additionally, the displaced fishery catch of shortspine thornyhead, in these areas, would be minimal (Reuter and Spencer 2001). Therefore, under Alternative 5A there would be little to no effect on their stock biomass as compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – No stock structure has been found for shortspine thornyheads in the BSAI. Their spatial distribution is uniform along the slope of the BSAI. Therefore, Alternative 5A would likely have little to no effect on their catch as compared to the status quo.

Spawning/Breeding (Ø) – Larval and juveniles of this species are pelagic for up to 15 months after spawning. Therefore, the effect of the closures on the habitat of this life stage is probably minimal to none.

Feeding (U) – The major prey of adult shortspine thornyheads appears to be pandalid shrimp (based on the limited food information available for this species) (Yang 1993). Any direct or indirect effects of fishing on pandalid shrimp abundance is not presently known.

Growth to maturity (Ø)
The peak spawning biomass for shortspine thornyheads on the west coast is at depths from 800 to 1,000 m (Wakefield 1990). Although the suggested 33.3 percent rotational closure areas in the BSAI do extend over the slope, only a small fraction of it is the habitat of reproductively mature shortspine thornyheads. Additionally, the displaced fishery catch of shortspine thornyhead in these areas would be minimal in both the EBS and AI (Reuter and Spencer 2001). Therefore, there would be little to no effect on their growth potential under Alternative 5A as compared to the status quo.

4.3.6.2.1.23 Forage Species (BSAI and GOA)

Stock Biomass (Ø) – The impact of Alternative 5A on forage species is likely to be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 5A would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 5 are not in areas of significant forage species bycatch. Alternative 5A would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 5A are not thought to be important to the spawning and breeding of forage species. Alternative 5A would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 5A are not thought to be important to the feeding ecology of forage species. Alternative 5A would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 5A are not thought to be important to the feeding ecology of forage species. Alternative 5A would have minimal effect on the growth to maturity of forage species.

4.3.6.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.6.2.2.1 Salmon

Stock Biomass (Ø) – The salmon fishery is not impacted by measures proposed under Alternative 5A. In addition, the bycatch of salmon would not change, as the closures do not affect the pollock fishery, which takes a majority of the salmon bycatch. Thus, no changes in the catch or bycatch of salmon would be expected, so no effects on biomass would be expected.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of salmon fishing effort is expected under Alternative 5A.

Spawning/Breeding (Ø) – No changes in the distribution of fisheries in salmon spawning and breeding areas would occur under this alternative, and thus no effects would be expected under Alternative 5A.

Feeding (Ø) – No substantial changes in the catch of prey species eaten by salmon (herring, squid, capelin) is expected under Alternative 5A, so this alternative was judged to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alternative 5A, so no effects would be anticipated. Bycatch of juvenile salmon has been relatively small in the fisheries primarily affected by this alternative (BSAI flatfish trawl fishery and GOA slope rockfish), and no substantial changes in bycatch amounts would be anticipated due to fleet redistribution.

4.3.6.2.2.2 Crabs

Stock Biomass (Ø) – Alternative 5A would not affect the catch of crabs in the directed fisheries. This alternative would be expected to have slight reductions in the bycatch amounts taken in groundfish trawl fisheries (due to the minimum bobbin/roller gear requirements of this alternative). Nevertheless, bycatch of crabs is very, very small relative to total population size (Witherell and Pautzke 1997), and would not result in any change in stock biomass. Thus, stock biomass would not be substantially affected by Alternative 5A.

Spatial/Temporal Concentration (Ø) – Alternative 5A would not modify the distribution and intensity of fishing effort in the crab fisheries, so no effects would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of crabs would be expected under Alternative 5A. The closure areas designated by this alternative only overlap substantially with the opilio crab stock (although there is a small portion of the St. Matthew and Pribilof Islands blue king crab stocks, Tanner crab stock, and golden king crab stock). Bottom trawl effort from the closed areas of the northwest area of the EBS would likely redistribute to adjacent areas that likely have similar abundance of female opilio crab in any given year (the distribution of these crab has shown significant changes over time). For that reason, Alternative 5A was judged to have no effect on spawning and breeding of crab stocks.

Feeding (Ø) – Fisheries are considered not to have any substantial effects on the prey of crab species. Alternative 5A is considered to have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas in the EBS overlap with opilio crab EFH areas of concentration. The trawl closure areas may improve habitat and reduce bycatch mortality for opilio crab within the closure area by eliminating potential impacts due to bottom trawling. However, it is likely that trawl fishing effort would redistribute to nearby adjacent areas also used by these crab, and this redistribution would likely dampen potential habitat benefits or reductions in bycatch resulting from these closures. The requirement for large bobbins and rollers on trawl gear footropes and sweeps is expected to reduce crab bycatch and unobserved mortality by reducing the amount of gear hitting the bottom. The nets and sweeps should simply pass over the crabs without touching them, resulting in a higher survival rate. Overall, positive changes in habitat effects and survival would be expected under Alternative 5A.

4.3.6.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 5A is anticipated to have no substantial effects on scallop stock biomass, as catches would not be affected by these measures.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of scallop fishing effort is expected under Alternative 5A.

Spawning/Breeding (Ø) – None of the closure areas designated under Alternative 5A overlap with scallop populations. Therefore, Alternative 5A is anticipated to have no substantial effects on spawning and breeding of weathervane scallops.

Feeding (Ø) – None of the closure areas designated under Alternative 5A overlap with scallop populations, and fishing effort is not projected to increase in areas with scallops. Thus this alternative was judged to have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in scallop dredge effort is expected under Alternative 5A and no changes in effort redistribution to scallop grounds would be expected, so Alternative 5A was judged to have no effect on growth to maturity.

4.3.6.3 Effects of Alternative 5A on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects that Alternative 5A would have had on federally managed fisheries were it in place in 2001. For additional detail and supporting analysis, refer to Section 3.6 of the RIR/IRFA (Appendix C).

4.3.6.3.1 Effects on Passive Use Values (E+)

Under Alternative 5A, NPT fishing activities for all species in ten designated areas and for slope rockfish along the entire slope (200 to 1,000 m) in the GOA would be eliminated. Use of NPT gear would be closed over 33 1/3 percent of five areas in the EBS on a 5-year rotational basis, with bobbins required on NPT gear fished in other areas. The use of non-pelagic trawl gear would be prohibited for all species in designated areas of the AI.

Alternative 5A would minimize the impact of NPT fishing over 31,904 sq. km of GOA shelf and slope edge habitat (11.4 percent of the current 279,874 sq. km of habitat), an average 63,975 sq. km of EBS habitat (8.0 percent of the current 798,870 sq. km of habitat), and 32,235 sq. km of AI habitat (30.6 percent of the current 105,243 sq. km of habitat), for a total of 128,114 sq. km, or 10.8 percent of the combined fishable area of 1,183,987 sq. km. Alternative 5A would further reduce NPT fishing impacts in the EBS by requiring disks and bobbins on trawl sweeps and footropes used in open areas.

Alternative 5A would reduce the effects on EFH of NPT fishing in the GOA, EBS, and AI beyond measures currently in place or planned as part of other fishery management actions. As such, Alternative 5A would contribute additional management measures that would further reduce the impacts of fishing on EFH. While it is not possible at this time to provide an empirical estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 5A would yield some incremental increase in passive-use benefits over the status quo Alternative 1. Whether these fishing impact minimization measures would provide increased future use and productivity benefits over the status quo Alternative 1 or other action Alternatives 2, 3, 4, 5B, or 6 is unknown at this time.

4.3.6.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)

Assuming that Alternative 5A had been implemented for the 2001 fishing season, it would have placed $7.92 million to $10.90 million of gross revenue at risk in NPT fisheries in the GOA, EBS, and AI, or 4.4 to 6.0 percent of the status quo total revenue of $180.66 million to $181.30 million, depending upon which rotational areas are affected in the EBS.

EBS Region

In the EBS, Alternative 5A includes the following closures and management measures: a closure of NPT fishing in 33 1/3 percent of five areas, with each area rotating on a 5-year basis. These EFH fishing impact minimization measures would have placed between $2.63 million and $5.61 million of revenue at risk, or 2.7 to 5.8 percent of the $96.27 million to $96.91 million 2001 status quo revenue in the fisheries affected. The EBS revenue at risk would have occurred mainly in the catcher-processor fleet component.

Alternative 5A would have placed revenues at risk in a number of NPT target fisheries in the EBS including flathead sole, yellowfin sole, rock sole, other flatfish, Pacific cod, and others. However, the largest revenue at risk would have occurred in the flathead sole fishery, where $1.70 million to $4.23 million of revenue would be at risk, or 11.8 to 29.3 percent of the $14.46 million 2001 status quo revenue, depending upon the rotational area affected. The total revenue that would have been at risk in the EBS NPT Pacific cod fishery would have ranged from $190,000 to $980,000, or 1.3 to 6.8 percent of the status quo revenue of $14.33 million.

In the EBS, substantially all of the revenue at risk would have accrued to the catcher-processor fleet component. A total of $2.63 million to $5.61 million of revenue would have been at risk, or 2.9 to 6.2 percent of the $90.45 million to $91.08 million 2001 status quo revenue, depending upon the rotational areas affected.

Some or all of the revenue at risk in the EBS might be capable of being mitigated by fishing with NPT gear in adjacent areas not affected by EFH fishing impact minimization measures. However, there could have been additional revenue placed at risk in the EBS under Alternative 5A by the requirement to

use bobbins and disks on trawl sweeps for all NPT gear used in open areas. The amount of this additional revenue at risk is unknown.

GOA Region

Within the GOA, the largest amount of revenue at risk would have been in the CG, with $2.55 million in revenue at risk, equaling 12.3 percent of the $20.69 million 2001 status quo revenue in the CG. The revenue at risk in WG would have equaled $810,000, or 13.0 percent of the 2001 total status quo revenue of $6.25 million. There would have been $240,000 in revenue at risk in the EG or 31.8 percent of the $760,000 2001 status quo revenue.

In the GOA, EFH fishing impact minimization measures under Alternative 5A would have affected a number of NPT fisheries, but primarily fisheries targeting rockfish and Pacific cod. The total revenue at risk in the NPT rockfish fishery would have been $2.82 million, or 30.1 percent of the status quo revenue of $9.36 million in 2001. The total revenue at risk in the GOA NPT Pacific cod fishery (mainly from the catcher-vessel fleet component) would have been $0.38 million, or 4.9 percent of the 2001 status quo revenue of $7.66 million.

In the GOA, the catcher-processor fleet would have had the greatest amount of revenue at risk, equaling $2.70 million, or 17.6 percent of the 2001 status quo total revenue. The catcher-vessel fleet would have had $900,000 of ex-vessel revenue at risk, or 7.3 percent of the total ex-vessel revenue of $12.31 million. Under Alternative 5A, the catcher-vessel fleet would have had revenue at risk in the EG of $60,000 or 20.8 percent of the 2001 status quo; in the CG, $470,000, or 4.9 percent of the 2001 status quo; and in the WG, $360,000, or 16.0 percent of the 2001 status quo. The GOA catcher-processor fleet would have revenue at risk mainly in the CG ($2.07 million, or 18.9 percent of the 2001 status quo), but also in the WG ($450,000, or 11.3 percent of the $4 million 2001 status quo gross revenue), and the EG ($180,000, or 39.3 percent of the $450,000 2001 status quo revenue).

The ten designated EFH fishing impact minimization measure areas described under Alternative 5A in the GOA are discreet and are widely spaced along the outer shelf and slope edge. Within the entire GOA, there is substantial NPT fishing area adjacent to the ten areas designated for EFH fishing impact minimization measures where some, or possibly all, of the revenue at risk might have been mitigated by a redeployment of fishing effort. However, Alternative 5A would have placed 31.8 percent of the status quo revenue at risk in the EG, an amount that would likely have been difficult to make up elsewhere. Amendment 58 to the GOA FMP, which took effect in 1998, prohibits trawling in the EG east of long. 140° W. This leaves a very limited area within the EG where the revenue at risk for the NPT fisheries could have been mitigated. There would likely have been some portion of the EG revenue at risk that would not be recovered under Alternative 5A.

Although some slope rockfish are caught with NPT gear at depths shallower than 200 m in the GOA, a majority of the NPT commercial catch of the slope rockfish complex occurs at depths in excess of 150 m (NMFS 2002d). There is limited fishing area for slope rockfish in the 150 to 200 m slope edge adjacent to the 200 to 1,000 m area designated for EFH fishing impact minimization measures where revenue at risk might be mitigated, in whole or in part by a redeployment of NPT fishing effort under Alternative 5A. Approximately 20 percent of the catch of the primary slope rockfish species, Pacific ocean perch, is historically taken by PTR gear fished by larger catcher-vessel and the catcher-processor fleet components. Between 30 and 50 percent of the shortraker/rougheye rockfish in the slope rockfish complex is traditionally taken incidental catch by HAL gear in the sablefish and halibut fisheries.

Under Alternative 5A, most, if not all, of the revenue at risk in the GOA might have been recovered by redeployment of fishing effort to adjacent areas or switching to PTR gear by most of the fleet components involved in the fishery. The smaller catcher-vessel fleet targeting slope rockfish almost exclusively uses NPT gear and has neither sufficient horsepower to fish PTR, nor the revenue from participation in this fishery to warrant the investment necessary to utilize PTR gear. The larger catcher vessels (vessels that also target pollock) and the catcher-processors either already have PTR gear available or have sufficient horsepower to convert to PTR to target slope rockfish. Under Alternative 5A, while the revenue at risk may have been recovered by vessels fishing adjacent areas of the GOA not affected by EFH fishing impact minimization measures or by switching to PTR gear within the EFH fishing impact minimization measure area, there would likely have been a transfer of catch share, and thus a transfer of revenue in the fishery from the smaller catcher-vessel fleet component to the larger catcher-vessel and catcher-processor fleet components. The magnitude of this transfer is impossible to estimate without specific knowledge of the redeployment fishing effort strategies that would actually have been followed by the different fleet components.

Larger catcher vessels and catcher-processors in the GOA have the option of changing to PTR gear for targeting slope rockfish. However, the smaller catcher vessels, particularly the 18.3 m (60 feet) and smaller vessels, do not have sufficient horsepower to switch to effective PTR fisheries, and the equipment costs would likely be prohibitive, given the annual revenue of these vessels. Operational costs for the catcher-processor fleet component may increase due to the redeployment of fishing effort necessary to mitigate the 17.6 percent of the status quo revenue at risk for this fleet component.

Revenue impacts from changes in product quality would be possible under Alternative 5A, particularly for the smaller catcher-vessel fleet component operating with NPT gear in the GOA. These vessels may be required to expend additional fishing effort in an attempt to recover the revenue at risk, which could lengthen fishing trips and result in diminished product quality. Product quality may not be affected in the catcher-processor fleet component, since these vessels process the catch on board the vessel, unless, for example, the average size fish in the catch changed substantially.

AI Region

In the AI, Alternative 5A would close designated areas to all species with NPT gear and would have resulted in placing $1.69 million of revenue, or 3.0 percent of the $56.70 million 2001 status quo revenue at risk in the affected fisheries. The AI revenue at risk impacts under Alternative 5A would occur mainly in the catcher-processor NPT fleet, which would have accounted for substantially all of the $1.69 million revenue at risk, or 3.1 percent of the total 2001 status quo revenue of $55.38 million. The AI revenue at risk in the catcher-processor fleet component could potentially have been mitigated, in whole or in part, by redeploying NPT fishing effort to adjacent areas not affected by the EFH fishing impact minimization measures.

In the AI, Alternative 5A would have placed revenue at risk in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The largest revenue at risk in the AI would have been in the NPT rockfish fishery, where $1.09 million, or 20.2 percent of the total status quo revenue value of $5.4 million, would be placed at risk. The impact on the Atka mackerel fishery would put $200,000 at risk, or 0.5 percent of the $41.16 million 2001 status quo value in this fishery.

Operating Costs (E-)

Operating cost impacts under Alternative 5A may likely be greater overall for both the GOA catcher vessel component and catcher-processor fleet components in all areas. CPUE of slope rockfish caught with PTR gear and with NPT gear at depths shallower than 200 m along the GOA slope edge may be

lower than the CPUE of NPT gear in the depth range of 200 m and greater where these species are normally fished. This may result in increased fishing effort and associated increased operational costs to mitigate the catch and revenue at risk.

Larger catcher vessels and catcher-processors in the GOA have the option of changing to PTR gear for targeting slope rockfish. However, the smaller catcher vessels, particularly the 18.3 m (60 feet) and smaller vessels, do not have sufficient horsepower to switch to effective PTR fisheries, and the equipment costs would likely be prohibitive, given the annual revenue of these vessels. Operational costs for the catcher-processor fleet component may increase due to the redeployment of fishing effort necessary to mitigate the 17.6 percent of the status quo revenue at risk for this fleet component.

Catcher-processors operating in the EBS NPT flathead sole fishery could have increased operational costs under Alternative 5A due to increased running time to reach northern fishing areas when the more southerly areas are closed, and possibly due to increased fishing effort to make up the revenue at risk in these fisheries. It is impossible to estimate the increase in operational costs without fully understanding the fishing effort redeployment strategy that the operators would actually follow. Undoubtedly, had Alternative 5A been in place in 2001, there would have been efforts to mitigate 11.8 to 29.3 percent of the status quo revenue placed at risk in the NPT fishery for flathead sole in that year. Alternative 5A would require the use of bobbins and disks on NPT footropes and trawl sweeps used in open areas. The use of bobbins and disks may reduce the CPUE of some bottom-dwelling species such as flatfish, resulting in increased fishing time and associated increased operational costs to attain the status quo catch and revenue in these fisheries. This operational impact would occur primarily in the catcher-processor fleet component in the EBS.

In the AI, Alternative 5A would have placed a relatively small amount, 3.0 percent, of the status quo revenue at risk and may not have resulted in any significant increases in operating costs for either the catcher-vessel or catcher-processor fleet components.

Costs to U.S. Consumers (E-)

Some impact on consumers from Alternative 5A may occur because, although some or all of the revenue at risk may be recovered by redeployment of fishing efforts, there would likely be some operational cost increases for the fleet components. This operational cost increase due to Alternative 5A EFH fishing impact minimization measures may result in a measurable increase in the price to consumers of species caught in fisheries directly or indirectly affected by the redeployment of fishing effort. There may also be attributable costs imposed on consumers from changes in availability of supply, product mix, and/or quality.

Safety (Ø)

Alternative 5A may not significantly affect the safety of any of the fleet components in the GOA because fishing effort would likely be redeployed to adjacent fishing areas.

In the EBS, catcher-processors targeting flathead sole, other flatfish, and Pacific cod would be restricted from fishing some areas closer to their home ports during some time periods, depending upon the EFH fishing impact minimization measure area affected by the rotational closures to NPT gear. When more southerly areas are closed, vessels fishing NPT gear would have to travel farther north and farther from ports of call, possibly increasing safety impacts.

Alternative 5A may not significantly affect the safety of any of the fleet components in the AI because fishing effort would likely be redeployed to adjacent fishing areas within similar distance of their home port.

Impacts to Related Fisheries (E-)
There may be an impact on related fisheries in the GOA from Alternative 5A because a substantial amount of NPT fishing effort for slope rockfish would likely be redeployed into adjacent areas shallower than 200 m that would not be affected by EFH fishing impact minimization measures. Other fisheries occur in these areas, including halibut longline, Pacific cod longline (if open), and other NPT fisheries such as shallow water flatfish. Increased NPT fishing effort at depths less than 200 m along the GOA shelf edge could have negative indirect economic impacts on these fisheries.

There may be impacts on related fisheries from Alternative 5A in the EBS and AI as vessels using NPT gear are displaced into adjacent areas where other gear groups such as hook and line and pot vessels may be operating.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs may increase under Alternative 5A, although it is not possible to estimate by what amount. Additional on-water enforcement could be required to assure compliance with the EFH fishing impact minimization measures applied in the GOA, EBS, and AI. VMS equipment or 100 percent observers coverage could be required of all vessels using NPT gear in the GOA, EBS, and AI to assure compliance with the EFH fishing impact minimization measures under Alternative 5A. Section 3.1.2.7 contains some additional discussion of the NMFS Enforcement and Coast Guard responses to resource demands connected with monitoring and enforcing provisions of Alternative 5A.

4.3.6.3.3 Effects on Communities and Shoreside Industries (Ø)

Overview
Unlike the previous alternatives, impacts to dependent communities and shoreside industries may have been significant at the community level, at least for a couple of communities (King Cove and Sand Point), had Alternative 5A been in place in 2001. Adverse impacts to individual operations may have occurred in other communities (especially Kodiak), but these impacts are unlikely to have been significant at the community level, due to the low magnitude of the impacts relative to the overall operations of the affected fleet and processing entities (as well as the overall community fishing sectors).

The only fisheries directly affected by Alternative 5A would have been groundfish fisheries. Similar to Alternative 4 (but unlike Alternatives 2 and 3), groundfish species in addition to rockfish would have been affected by this alternative. Like Alternative 4, this alternative would have had impacts on GOA, EBS, and AI fisheries. Like Alternatives 2, 3, and 4, the only gear group directly affected for both catcher vessels and catcher-processors would have been non-pelagic trawl. Using 2001 fleet data, 82 to 89 vessels (catcher vessels and catcher-processors combined) would have been affected by this alternative: 25 to 32 in Alaska, 12 to 13 from Oregon, 38 to 40 from Washington, and 6 from other states. Using 2001 processor data, between 16 and 21 shoreside processors in Alaska would potentially have been affected by this alternative, depending on specific closure configurations.

Catcher Vessels
Based on 2001 data, within Alaska, ownership of catcher vessels harvesting relevant groundfish species with revenue at risk would have been concentrated in the Aleutians East Borough with 17 vessels (King Cove with 8 vessels and Sand Point with 9), and Kodiak with 6 to 13 vessels. Anchorage and Girdwood ownership accounted for an additional vessel each. Unlike other alternatives, which featured only large (over 60 feet) vessels with revenue at risk, this alternative would have had both large and small vessels with revenue at risk. All but two of the Aleutians East Borough, resident-owned vessels with revenues that would have been at risk are under 60 feet, while none of the Kodiak vessels was a small vessel. The two other Alaska-owned vessels include one large and one small vessel. Ownership in the Pacific Northwest is largely confined to large vessels, with 17 to 30 vessels from Washington (including 2 small vessels) and 12 to 13 vessels from Oregon (with no small vessels).

Under Alternatives 2, 3, and 4, GOA impacts to catcher vessels would have been confined to the CG area. Under Alternative 5A, catcher vessels would have had at-risk catch in the EG, the CG, and the WG. At-risk harvest would not have been evenly distributed among the GOA areas, ranging from 20.85 percent in the EG, to 4.86 percent in the CG, to 16.04 percent in the WG, based upon 2001 fishery performance. However, since the CG accounts for 79 percent of the harvest among relevant catcher vessels in the entire GOA under status quo conditions, the at-risk percentage of total catch for the entire GOA would have been only 7.30 percent for all affected catcher vessels. Total status quo harvest in the EG would have been $310,000, and the WG would have been $2.24 million, compared to $9.76 million in the CG. At-risk revenue would have been about $900,000. Fisheries with greater than negligible (0.1 percent in this case) at-risk amounts in the GOA would have included deep water flatfish (3.4 percent), Pacific cod (5.1 percent), pollock-bottom trawl (9.1 percent), and rockfish (18.8 percent). For the affected catcher fleet as a whole, the revenue at risk would have represented about 2 percent of the ex-vessel value of the total harvest from all fisheries in which vessels participated (and about 3 percent of total groundfish ex-vessel value in particular). As noted elsewhere, figures given for catcher vessels represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities if examined alone. Values for first wholesale revenues at risk by shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. There would, however, have been variations within the fleet in terms of the community distribution of effort among fisheries. Almost twice as many catcher vessels participated in the pollock and cod fisheries as participated in the rockfish fisheries, and the smaller catcher vessels that are concentrated in King Cove and Sand Point did not participate in the rockfish fisheries. King Cove vessels that would have been affected by this alternative would have had 5.4 percent of the value of their total harvest at risk, almost all of it pollock. Sand Point vessels affected by this alternative would have had 3.3 percent of their revenue at risk, about three-fourths of which would have been Pacific cod and one-fourth pollock. Affected Kodiak boats would have had only 2 percent of their revenue at risk under this alternative, primarily from Pacific cod.

The amount of revenue at risk that would have likely been lost under actual conditions would, however, vary considerably by community. The smaller catcher boats of King Cove and Sand Point would have been placed more at risk by any restrictions on their fishing activity than larger catcher vessels of other communities. Larger vessels from Kodiak and the Pacific Northwest communities can generally fish the Bering Sea and the Aleutian Islands waters more easily than boats from King Cove and Sand Point. As discussed in the sector and regional groundfish profiles for King Cove and Sand Point (http://www.fakr.noaa.gov/npfmc/), many fishing operations are organized around a fleet of 58-foot salmon boats with multi-gear capability. This fleet has historically made a living through diversification, participating in a combination of groundfish (Pacific cod, pollock, and other), halibut,

crab, and salmon fisheries – with each traditionally comprising no more than 30 or 40 percent of total earnings. With the recent decline in the crab and salmon fisheries, groundfish have assumed great importance for these vessels – up to 75 percent of a vessel's ex-vessel income in recent years. Whereas salmon used to account for a third of a vessel's income, it now produces perhaps a tenth of the boat's ex-vessel returns. Crab returns have declined from up to 14 percent of a boat's earnings to 4 or 5 percent – if the boat continues to crab at all. Halibut is an important but variable component of a vessel's suite of fisheries. Since halibut is now an IFQ fishery, it is relatively expensive to buy into participation, especially for fishermen experiencing declining crab and salmon fisheries. The King Cove and Sand Point vessels fishing halibut are essentially those that qualified for the initial allocation of IFQs.

Boats from the two communities differ in their groundfish emphasis. King Cove boats catch a lot of Pacific cod and very little pollock. Sand Point boats have (through 2001, the most recent statistical year for which complete data are available) harvested more pollock than Pacific cod. Both fleets are dependent on closer and more protected fishing waters. They are less able, compared to larger vessels, to travel longer distances to find alternative fishing areas. These vessels face an inherent competitive disadvantage, compared to larger vessels, because they must stay tied up during heavy weather, when larger boats can fish. Closures of relatively close fishing grounds would impose additional costs on these vessels compared to vessels from Kodiak and the Pacific Northwest. In conjunction with the decline of other fisheries, the effects on vessels from these communities could have been significant. Each community has essentially only one processor, and this limitation of local markets also places constraints on the local fleet. As a result of all of these factors, the communities of King Cove and Sand Point may experience significant impacts under this alternative, depending on the success of strategies to replace at-risk revenues.

Affected catcher vessels from Washington and Oregon closely resemble those from Kodiak, but with an even higher dependence on Pacific cod and pollock, together accounting for over 80 percent of ex-vessel payments to the boats, with Pacific cod again predominating. Based on 2001 data, Oregon-based boats operating in the EEZ off Alaska harvest proportionally more of their total FMP catch from the areas that would have been closed by this alternative than is the case for vessels from other regions, but little more can be gleaned from the available information. The revenue at risk represents about 3 percent of the total ex-vessel payments paid to boats from Oregon, and less than 1 percent of those paid to Washington boats. Assuming that at least some at-risk revenue would have been made up with minimal costs by altering fishing areas or approaches, it is not likely that these operations would have experienced significant impacts under this alternative.

For catcher vessels operating in the EBS and AI, the only species that would have been affected is Pacific cod. For both the EBS and AI, revenue at risk under this alternative would have been 0.1 percent or less of the total status quo revenues of the affected vessels for each area (less than $2,000 out of $5.82 million and $1.32 million, respectively). As a result of the negligible at-risk portion of the catcher-vessel harvest of any groundfish fishery in either the EBS or AI, no significant impacts to dependent communities related to catcher vessels in these areas would have been likely to occur.

Catcher-Processors

Based on 2001 data, ownership of catcher-processors with revenue that would have been at risk was concentrated in Washington (with 15 to 19 vessels). Alaska ownership is exclusive to Kodiak (two to three vessels). Four vessels are owned in other states.

For catcher-processors, revenue at risk in the GOA would have been 17.6 percent under this alternative, and this is not evenly distributed among the various areas within the GOA. Revenue at risk in the EG would have been relatively modest in terms of total value ($180,000 out of a 2001 status quo revenue for affected vessels of $450,000), but this is relatively large in percentage terms (39.3 percent). For the CG, revenue at risk would have been 18.9 percent of the total ($2.07 million out of $10.93 million), while the analogous figure for the WG would have been 11.3 percent ($450,000 out of $4 million). The GOA total revenue associated with a number of species would potentially have been at risk, but only a few species would experience greater than negligible (0.3 percent in this case) amounts. These are deep water flatfish (2.2 percent), flathead sole (1.1 percent), rex sole (7.3 percent), and rockfish (33.8 percent). Except for rockfish, it is assumed that all at-risk revenues for all species could easily have been recovered with minimal efforts in other areas, due to the very low at-risk percentages involved. The catcher-processors involved in the at-risk rockfish harvest are head and gut vessels.

For the EBS, catcher-processors under Alternative 5A would have experienced revenue at risk associated with a number of different groundfish species (risk would vary by the specific rotational closure in place at any given time). The fisheries that would have had a revenue at risk greater than 1 percent would have included arrowtooth flounder (0.5 to 2.8 percent of a status quo value of $3.38 million), flathead sole (11.8 to 29.3 percent of $14.46 million), Greenland turbot (0.5 to 11.2 percent of $500,000 to $1.12 million), Pacific cod (2.2 to 11.5 percent of $8.50 million), rockfish (7.2 to 27.2 percent of $160,000 and other (11.6 to 27.9 percent of $170,000 to $180,000). A number of these species, however, would have had a relatively low overall value to the catcher-processor sector, and as a result relatively large percentage declines may have had minimal impacts on the sector (and associated communities). Of all of the species that would have had at-risk revenues greater than 1 percent of total value, the only species would have had at-risk revenues greater than $100,000 would be flathead sole ($1.70 million to $4.23 million), Pacific cod ($190,000 to $980,000), and Greenland turbot ($120,000 to $130,000). The catcher-processors harvesting and processing these species include head and gut vessels, as well as some pollock vessels that fill in with these fisheries.

For the AI, catcher-processors under Alternative 5A would have experienced revenue at risk associated with a number of different groundfish species. While a number of these species would have had a relatively high percentage of revenue at risk, the overall value at risk would have been comparatively low. Revenue of $10,000 or greater would have been at risk for only five species: Atka mackerel ($200,000 at risk, which is 0.5 percent of status quo revenue of affected vessels), Greenland turbot ($190,000, 51.0 percent of status quo revenue), Pacific cod ($130,000, 1.6 percent of status quo revenue), rock sole ($60,000, 42.8 percent of the status quo revenue) and rockfish ($1.09 million, 20.2 percent of status quo revenue). It is assumed that, given the small percentage of total catch at risk, catcher-processors could make up for revenue at risk for the Atka mackerel and Pacific cod fisheries. Further, the absolute value of the rock sole revenue at risk ($60,000) is low enough that community-level impacts are unlikely. This leaves the Greenland turbot and rockfish revenue shortfalls as being somewhat more problematic. Similar to the pattern seen in the EBS, the AI catcher-processors harvesting and processing the at-risk harvest for these species are head and gut boats along with some pollock-oriented vessels filling in during non-pollock periods.

The information available indicates that most of the revenue at risk would have been borne by affected Washington area catcher-processors (80 percent) and that this would have represented about 3 percent of the combined total catch valuation from all fisheries in which they participated in 2001. Affected catcher-processors from non-Washington locations would have had to bear about 20 percent of the revenue at risk, which would be about 6 percent of their 2001 total catch valuation (double the proportion of the Washington vessels), and this may be a low estimate. Catcher-processors owned by

residents of Washington and affected by this alternative harvested pollock extensively (about 75 percent of total catch valuation), while catcher-processors from other regions focused more on cod (66 percent of total catch valuation).

Due to confidentiality restrictions based on a small number of participating entities, revenue information for Alaska-based, catcher-processors with revenue at risk cannot be disclosed for this alternative. It is known, however, that impacts accruing in Alaska would have been concentrated in Kodiak. Given the small number of entities involved, the relative size of the local fishery-based economy, and what is known about the relative order of magnitude of overall impacts to the fleet, it is assumed that community level impacts associated with catcher-processors would have been significant. In the case of Washington communities, while individual Washington-owned entities may have experienced adverse impacts under this alternative, it is assumed that community-level impacts would have been significant under this alternative due to the scale of the local economy in those communities.

Shoreside Processors

For shoreside processors, no substantial impacts would have been likely under this alternative for EBS and AI fisheries because catcher-vessel harvest levels would likely have remained constant, and no substantial change in the fishery would have occurred. In the GOA, with processor dependence on a wider variety of fisheries, potential interactive impacts are more complex. In 2001, processors involved in the at-risk harvest were concentrated in Kodiak (with six to eight entities, depending on closure configurations), although a number of other communities had processed at least some groundfish from vessels with revenues that would have been put at-risk under this alternative (including some communities in Southeast Alaska, unlike Alternatives 2, 3, and 4). These were Unalaska/Dutch Harbor (two to four processors) and King Cove (one to two processors), along with seven others with one processor each (Akutan, Sand Point, Moser Bay [Kodiak Island Borough], Chignik, Sitka, Cordova, and Petersburg). The total first wholesale value at risk of catch delivered inshore for processing would have represented approximately 8 percent of the total status quo value ($3.28 million out of $42.25 million) of the relevant fisheries of the GOA area, well below 1 percent for the AI and EBS areas, and about 6 percent for all areas combined (about $3.28 million out of $58.59 million), but no breakdown by port of landing is available. Caution must be exercised in the interpretation of these wholesale value data as (1) they are not additive with ex-vessel values presented above and (2) they cannot be used as a proxy for potential levels of impacts to specific communities without considering the basic caveats laid out in the introductory paragraphs of the shoreside processor section of the Alternative 2, Effects on Communities, discussion presented above. Processor-associated impacts to dependent communities could have been significant in some of the smaller communities in the WG area, due primarily to potential impacts to local catcher-vessel fleets. However, as discussed earlier, the magnitude of these impacts would depend on the success of local fleet mitigation strategies that are not known at this time. Further, data to quantify the potential magnitude of these impacts on shore processors in the individual communities are confidential. No significant community impacts would have been likely for any other dependent communities.

Multi-Sector Impacts

Multi-sector impacts may have been significant at the community level under Alternative 5A. Among Alaska communities, Kodiak, King Cove, and Sand Point participated in more than one sector with at-risk revenues. In 2001, Kodiak was home to 6 to 13 locally owned catcher vessels, 2 to 3 locally owned catcher-processors, and 6 to 8 locally operating shoreside processing entities that would have had at least some revenue at risk, depending on closure configurations. Neither King Cove nor Sand Point was home to locally owned catcher-processors. In 2001, however, both had multiple locally owned catcher vessels (eight and nine vessels, respectively) and had at least one dominant local processor with at least

some revenue at risk under this alternative. Revenue at risk for King Cove and Sand Point catcher vessels would have been a higher percentage of total overall ex-vessel revenues (at 5.4 and 3.3 percent, respectively) than would have been the case in Kodiak (about 2 percent), and these vessels would have represented a much larger proportion of the total community fleet in King Cove and Sand Point than would the affected vessels in Kodiak. Given the smaller vessels in King Cove and Sand Point (with less flexibility of response), the higher proportion of revenue at risk, the higher proportion of the fleet with revenue at risk, and the known challenges that these fleets (and communities) are facing with other fisheries, the WG communities of King Cove and Sand Point may have experienced social impacts from this alternative that would have been significant at the community level. Individual Kodiak entities may have experienced adverse impacts under this alternative, but impacts at the community level would have been unlikely to rise to the level of significance given the small proportion of revenue at risk for the affected catcher vessels, the low volumes at risk, and the assumption that overall delivery patterns are unlikely to change for Kodiak based shoreside processors under this alternative. Some additional Alaska resident crew positions on vessels owned elsewhere, but that spend at least part of the year in Alaska ports, may have had some compensation at risk. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which in this case would have been concentrated in Kodiak (and, perhaps, Dutch Harbor). Given the assumption that overall delivery patterns for the community would have been unlikely to change, any vessel-expenditure-associated impacts would likely have been minor.

4.3.6.3.4 Effects on Regulatory and Enforcement Programs

The management implications of Alternative 5A are the same as for Alternative 4 in regard to additional reporting requirements, increased needs for monitoring vessel activity in terms of the type of gear being fished, and the potential effect on incidental species catch management.

The GOA component of this alternative is the same as for Alternatives 2, 3, and 4, and problems noted in the previous review of effects are summarized here.

Alternative 5A results in increasing the complexity of management of the fisheries for rockfish in the GOA. To manage the ten areas within which bottom trawling for rockfish would be closed, additional reporting requirements and enforcement activity would be needed. The effectiveness of the reporting requirements and enforcement of the closure would depend on the manner in which the alternative was put into effect. Our current process of accounting for catch would have to be changed to track the amount of catch taken inside and outside the closed area, and to verify which type of trawl gear was used.

Because current regulations do not require complete observer coverage on all vessels using trawl gear, catch from inside and outside the restricted area cannot be strictly verified. For vessels that do carry observers, haul retrieval locations for observed vessels defines catch location. The requirement to record haul retrieval locations might be supplemented to include deployment locations or tracking information, and vessel monitoring systems could be used to verify vessel activity data, as we currently do for Atka mackerel in the harvest limitation area fisheries in the AI.

Once an appropriate method was developed to determine catch location, a finding would have to be made as to what constitutes being in the area. If a trawl path touches the closed area but 95 percent of the tow is outside, would it be considered an inside catch? Conservative accounting rules might require conditions for the protected area to apply to the entire haul, if a vessel fishes inside the restricted area at

any time during the tow. These restrictions could have the effect of a de facto expansion of the closed area.

The use of bottom gear for targets other than rockfish and approval of pelagic trawl gear for rockfish fishing would complicate management of the restricted area. Since a vessel can carry multiple nets on board, it would not be possible to determine which fish on board were taken with which net.

Under Alternative 5A, similar to Alternatives 2, 3, and 4, bottom trawls could be used to take rockfish as incidental catch. Pelagic trawls can also fish in contact with the bottom; if the intention were for them to be fished off bottom at all times, a new monitoring program or system would need to be in effect as well.

This alternative, like the others, is somewhat ambiguous regarding whether rockfish taken in a bottom trawl net in incidental amounts in the course of fishing for other species could be retained, or whether the intention is that none of the rockfish taken in bottom trawls could be retained.

If, as we assume here, the condition envisioned is the former, then rockfish caught in a bottom trawl net could be retained up to the maximum retainable amount (MRA) defined in Table 10 of 50 CFR 679 Tables, either incidental to the target species, or deliberately up to that MRA.

Furthermore, the fishing fleet using bottom trawl nets could theoretically find a flatfish species of low value and easy to catch, to function as a basis for targeting higher-valued rockfish and sablefish within the closed area. Such behavior would undermine the intent of the regulations to decrease the impact of fishing on the benthos, and would require the development of regulations to deal with that activity, much in the same manner as the arrowtooth flounder target was constrained when the practice of catching arrowtooth flounder strictly as a basis for sablefish was prohibited by regulation.

The rotating closure areas would require establishment of reporting requirements to monitor activities in the areas. This would be complicated by the fact that because pelagic gear would still be allowed in the closed areas, the presence of a vessel fishing trawl gear would not necessarily be an indication of illegal activity.

Because VMS, which provides an independent observation of vessel location, is already required for vessels in the groundfish fishery that target three common species (i.e., pollock, Pacific cod, and Atka mackerel), addition of VMS as a requirement to monitor areas designated through the EFH process would not add a large additional burden to participants in the fishery as a whole. The VMS system would provide definitive information on vessel activity relative to closed and open areas, show where activity is occurring relative to any particular habitat defined or to be defined, and assist enforcement personnel in their activities.

The introduction of closed areas might have the effect of crowding vessels using bottom-trawl gear, and such crowding would have the potential of increasing the incidental catch of undesired species. Unintended catch could include groundfish species at risk of being overfished, and closures to other fisheries could be generated if such a risk materialized, or if a prohibited species limit defined by gear and target was reached.

The addition of gear requirements to have disks/bobbins on trawl sweeps and footropes would require additional monitoring on the part of enforcement agents.

4.3.6.4 Effects of Alternative 5A on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – The effects of Alternative 5A on EFH in the GOA would be the same as a combination of the effects of Alternatives 2 and 3, so please refer to Section 4.3.4.4 for the potential impacts to state-managed groundfish fisheries. State-managed groundfish fisheries do not occur in the EBS or in the specific areas closed in the AI in this alternative. Alternative 5A would have no additional effect on state-managed groundfish fisheries, besides what is discussed in Section 4.3.4.4.

State-managed Crab and Invertebrate Fisheries (Ø/E+) – The effects of Alternative 5A would be the same as a combination of the effects of Alternatives 2 and 3, so please refer to Sections 4.3.3.4 and 4.3.4.4 for the potential impacts to state-managed crab and invertebrate fisheries. Discussion about the potential impacts in the EBS is presented in Section 4.3.5.4, and is applicable for this alternative as well. There would be no apparent impacts to state-managed fisheries from the AI closures in this alternative.

Herring Fisheries (Ø) – Effects on herring fisheries for Alternative 5A would be very similar to those discussed in Alternative 4 above.

Halibut Fisheries (Ø) – Alternative 5A would have no measurable effect on halibut fisheries. If effort in the GOA rockfish trawl fishery, or GOA or BSAI groundfish trawl fisheries is displaced, it is possible that halibut bycatch rates and spatial distribution could change.

4.3.6.5 Effects of Alternative 5A on Protected Species

The discussion on protected species provided in this section relative to Alternative 5A is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (Ø) – Alternative 5A could increase bottom trawling in Steller sea lion critical habitat, but the level of increased fishing would likely be small to moderate and not likely have adverse effects on the sea lion population since the current sea lion protection measures would remain in place under Alternative 5A. There likely would be no adverse effect on species of great whales, although there is some concern over potentially increased fishing activity in areas of the EBS where right whales have been observed. Overall, however, Alternative 5A would likely not shift large amounts of fishing effort into right whale habitat.

Other Marine Mammals (Ø) – As was discussed above, Alternative 5A would likely result in a moderate amount of displaced fishing effort in the GOA and BSAI bottom trawl fisheries, which presumably would then be prosecuted in adjacent areas that remain open to bottom trawling or in other trawl fisheries. This would be accompanied by reduced levels of trawl fishing in the EFH closed area. The net changes would be small, however, and likely would have minimal impact on other marine mammals. These fishing activities would not likely occur in sea otter and harbor seal habitat because these fisheries occur in offshore locations distant from sea otter and harbor seal habitat. Fur seals would have little chance of encountering these fisheries in the GOA except for brief periods in transit to seasonal habitats that are not located in the GOA, as would the ice seals and walrus because they only inhabit the EBS. In the BSAI area, however, there is a potential for increased overlap between bottom trawl fishing activities and fur seal foraging areas but at a small level. Ice seals, walrus, and northern elephant seals would not likely be adversely affected under Alternative 5A because of their patterns of distribution. Other cetaceans are not currently adversely affected by GOA or BSAI fisheries, either through injury or other take or because of fishery removal of prey; thus it is reasonable to assume that the small changes

in the overall pattern of groundfish fishing in the GOA or BSAI would not change this. Overall, Alternative 5A would likely have no adverse effect on other marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Under Alternative 5A, the pattern of incidental take of ESA-listed salmon and steelhead in the groundfish fisheries of the GOA would likely continue to be the same as the status quo, and would not have an adverse impact on these species. In the EBS and AI areas, given the large size of areas of the EBS that would remain open, coupled with a relatively small amount of increased bottom trawling in these areas, it is unlikely that there would be an increase in mortality to salmonid ESUs under this alternative. Also, under the salmon PSC limit in the BSAI, salmon must be discarded; thus groundfish fisheries in the BSAI likely would continue to be prosecuted in a manner that minimizes salmon bycatch, which in turn would continue to minimize the chance of incidental take of ESA-listed species that co-mingle with other salmon stocks on the high seas. Also, it is not likely that the small amounts of displaced bottom trawl fishing under Alternative 5A would affect the prey field for ESA-listed salmonids.

ESA-listed Seabirds (Ø) – Under Alternative 5A, the net changes in fishing patterns would likely be small and localized, with some potential increase in fishing effort in time and space. But this minor change in trawling activities is likely to result in very small changes in the specific locations and how frequently vessels with trawl third-wire gear may encounter short-tailed albatross. Since no short-tailed albatross mortalities have been documented for the trawl fisheries, it is unlikely that the fishing patterns under Alternative 5A would change that situation. Trawl gear may take seabirds as bycatch, primarily seabird species that dive for their prey (shearwaters and alcids such as murres and puffins). Albatross also may strike vessel rigging or hulls. But to date no short-tailed albatross have been observed in trawl bycatch or involved in vessel strikes. The principal concern would be a potentially increased opportunity for short-tailed albatross encounters with trawl third-wire gear. But as noted above, the increased effort by bottom trawlers in the EBS or AI under Alternative 5A likely would be small, and lethal encounters with this gear would likely be rare. The proposed cooperative seabird bycatch reduction studies involving the USFWS, NMFS, and industry would continue to develop, and presumably the program would result in a mitigation strategy that would minimize trawl third-wire mortality to seabirds. As was discussed previously, depletion of albatross prey is not an issue under this alternative. Steller's and spectacled eiders overlap very little with the groundfish fisheries in the GOA and BSAI. Spectacled eiders are not present in the GOA and thus would not be affected by Alternative 5A. In the EBS, spectacled eiders occur primarily in northern areas during winter. In these areas, sea ice displaces fisheries preventing interaction with spectacled eider. Even under Alternative 5A, these fisheries will not appreciably overlap with spectacled eider habitat. Steller's eiders winter along the coast of the Alaska Peninsula and AI, but they remain in bays and nearshore areas, and presumably forage in nearshore habitats, and would not likely encounter any offshore fisheries. Thus, Steller's eiders also would not be affected by Alternative 5A in the GOA and BSAI.

Other Seabirds (Ø) – Alternative 5A may increase groundfish trawl fishing levels in some areas of the GOA and BSAI, with some potential concentration of fishing activities in the AI area, and could result in some slightly increased levels of fulmar mortality from take in bycatch or third wire or vessel strikes. Incidental mortality from trawl fishing operations would continue to take albatrosses and shearwaters because these seabirds are fairly susceptible to incidental take because of their feeding behavior; some slight increase in mortality under Alternative 5A could affect these species, particularly to Laysan albatross in the AI where this species may be more abundant. Some of these concerns would be alleviated with implementation of new seabird bycatch reduction programs in the longline fisheries. Alternative 5A would likely have minimal effect on red-legged kittiwakes and Kittlitz's murrelets; there could be additional overlap of trawl fishing activities and red-legged kittiwakes near their Pribilof and

Bogoslov Islands colonies, but the increased fishing in these areas would likely be small. Although there are few concerns over fishery-related depletion of seabird prey, some concerns would continue over the occasional intense fishing activity near seabird colonies that might interrupt or displace seabird foraging; Alternative 5A may slightly increase potential overlap of trawl fishing activities and other seabird foraging areas. Seabirds would continue to strike vessels and suffer mortality, particularly such species as storm-petrels, fulmars, some albatrosses, and crested auklets, perhaps at very slightly increased levels under Alternative 5A. Overall, however, the effects of Alternative 5A on seabirds would be minimal.

4.3.6.6 Effects of Alternative 5A on Ecosystems

Predator-Prey Relationships (Ø) – Alternative 5A is expected to have no effects on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, or increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem due to Alternative 5A, although catches of EBS other flatfish and AI and GOA slope rockfish may be somewhat reduced from status quo. Similarly, trophic level of the catch would not be much different from status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators is expected.

Energy Flow and Balance (Ø) – No changes in the amount and flow of energy flow in the ecosystem would be anticipated. The total level of catch biomass removals from groundfish fisheries would remain about the same, and no substantial changes in discarding would be expected under Alternative 5A.

Diversity (E+) – Alternative 5A would further reduce bottom trawling on some GOA slope areas, some AI areas, and some areas in the northwest BS. Although some of this effort would be redistributed to adjacent areas that remain open to trawling, the areas closed to bottom trawling provide protection against species extinction, particularly for sensitive, sessile animals. Thus, species level diversity would likely be somewhat higher than under Alternative 4. Closure of the larger areas to bottom trawling may help to maintain (or even enhance) productive fish habitat and thereby help sustain fish populations that rely on these areas. Genetic diversity could slightly increase with implementation of large bottom trawl closure areas in the BSAI, and bottom trawl closures distributed along the GOA slope area. Thus, Alternative 5A was judged to have positive effects on diversity.

4.3.7 Effects of Alternative 5B Options

4.3.7.1 Effects of Alternative 5B on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type would differ from status quo for Alternative 5B. LEIs for both status quo and Alternative 5B would be less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both the infauna and epifauna prey categories would make them relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent would be in the EBS near Unimak Island and in the center of the sand/mud habitat. These areas would not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Benthic Biodiversity (E+) – Alternative 5B would provide substantial increases in protection of coral in the GOA and very large increases in the AI. However, fishing effort is not uniform within the proposed open areas in Alternative 5B under any of the three management options and could shift to areas that are not fished regularly under current conditions, resulting in some new impacts to living substrates.

GOA – Alternative 5B would institute closures to all bottom trawling in ten areas of the GOA and to rockfish trawling in the GOA slope habitat. LEI values would be substantially reduced for coral (-47 percent). Besides being the trawl fishery with the most significant effect on this habitat type, the rockfish fishery is also the most likely of the major fisheries there (deepwater flatfish being the other) to fish on substrates conducive to coral growth. While the full slope closure would continue to allow some bottom trawling, elimination of the principal hard-bottom fishery from the slope would be likely to substantially reduce the areas exposed to even minimal levels of bottom trawling, thus improving protection of corals.

AI – Alternative 5B, Option 1, would close all Aleutian areas outside of recently productive fishing grounds and additional areas where higher bycatches of biostructure species have occurred due to bottom trawling. Total closures would account for 45 percent of the shallow habitat type and 68 percent of the deep. While moderate, substantial changes were estimated for coral LEIs (-11 percent for coral in the shallow habitat and -20 percent for coral in the deep habitat), the very large proportion of both habitat types closed to trawling affords very substantial protection to coral in the AI.

AI – Alternative 5B, Option 2, would close all Aleutian areas outside of recently productive fishing grounds, additional areas where higher bycatches of biostructure species have occurred due to bottom trawling, and areas where coral gardens have been delineated in the HAPC process. Total closures would account for 47 percent of the shallow habitat type and 69 percent of the deep. While moderate, substantial changes were estimated for coral LEIs (-1 percent for coral in the shallow habitat and -4 percent for coral in the deep habitat), the very large proportion of both habitat types closed to trawling would afford very substantial protection to coral in the AI.

AI – Alternative 5B, Option 3, would close all Aleutian areas outside of recently productive fishing grounds. Total closures would account for 34 percent of the shallow habitat type and 59 percent of the deep habitat. While moderate, substantial changes were estimated for coral LEIs (-8 percent for coral in the shallow habitat and -18 percent for coral in the deep habitat), the very large proportion of both habitat types closed to trawling would afford very substantial protection to coral in the AI.

Effects on Habitat Complexity (E+) – Alternative 5B would be expected to result in positive effects on epibenthic structure forming organisms, mainly through reduced effects on the GOA slope. Gear modifications and closures in the EBS may also provide improvements, but the effectiveness of gear modifications is speculative at this time.

GOA – Alternative 5B would institute closures to all bottom trawling in ten areas of the GOA and to rockfish trawling in the GOA slope habitat. Besides being the trawl fishery with the most effect on this habitat type, the rockfish fishery would also be the most likely of the major fisheries there (deepwater flatfish being the other) to fish on the more sensitive hard substrates. All of the 10 areas enclose slope habitat. LEI values would be substantially reduced for soft bottom bio- (-47 percent) and nonliving (-24 percent) structure, hard bottom bio- (-54 percent) and nonliving (-57 percent) structure. Estimated increased effects on the adjacent deep shelf habitats from fishing redistribution would be small proportional increases (less than 5 percent) to effects that would already be small (less than 5 percent).

AI – Alternative 5B, Option 1, would close all Aleutian areas outside of recently productive fishing grounds and additional areas where higher bycatches of biostructure species have occurred due to bottom trawling. Total closures would account for 45 percent of the shallow habitat type and 68 percent of the deep. Because the primary fishing grounds are not closed, changes in the LEI values would be relatively moderate (-3 and -5 percent, respectively, for nonliving and biostructure in the shallow habitat; -10 and -12 percent for nonliving and biostructure, respectively, in the deep habitat). However, these would be proportional reductions to original LEIs that would all be less than 10 percent, so the absolute improvements represent less than 0.5 percent of the structure available in an unfished state.

AI – Alternative 5B, Option 2, would close all Aleutian areas outside of recently productive fishing grounds, additional areas where higher bycatches of biostructure species have occurred due to bottom trawling, and areas where coral gardens have been delineated in the HAPC process. Total proposed closures account for 47 percent of the shallow habitat type and 69 percent of the deep habitat. Because the primary fishing grounds wold not be closed, changes in the LEI values would be relatively moderate (+3 and +2 percent, respectively, for nonliving and biostructure in the shallow habitat; +2 and +1 percent for nonliving and biostructure, respectively, in the deep habitat). However, these would be proportional reductions to original LEIs that were all less than 10 percent, so the absolute improvements would represent less than 0.5 percent of the structure available in an unfished state.

AI – Alternative 5B, Option 3, would close all Aleutian areas outside of recently productive fishing grounds. Total proposed closure would account for 34 percent of the shallow habitat type and 59 percent of the deep habitat. Because the primary fishing grounds would not be closed, changes in the LEI values would be relatively moderate (-1 and -2 percent, respectively, for nonliving and biostructure in the shallow habitat; -6 and -8 percent for nonliving and biostructure, respectively, in the deep habitat). However, these would be proportional reductions to original LEIs that were all less than 10 percent, so the absolute improvements would represent less than 0.5 percent of the structure available in an unfished state.

EBS – In the EBS, Alternative 5B would establish rotating bottom trawl closures over a large area of sand/mud and slope habitats and full bottom trawl closures of large areas of sand, sand/mud and mud habitats of the northeastern Bering Sea. The rotating closure area has been moderately fished recently, while the full closure area excludes very little recent effort. Rotations would close one third of the area at all times. The biostructure feature of the EBS sand/mud and slope habitats would have the highest LEI values of the analysis. This would only be reduced by 6 percent for both sand/mud and slope habitats due to the closures.

An additional feature of Alternative 5B is a required modification to the bottom-contact gear of all bottom trawls that would provide at least 3 inches of open spacing under 90 percent of the area swept by trawls. These modifications are already common for most, but not all, trawl footropes, but are not used for the bridles and sweeps, which provide 80 to 85 percent of the coverage of bottom trawls used in the EBS. Most bridles and sweeps in current use have constant diameter, providing no space for organisms to pass beneath except when raised by ridges and bumps on the seafloor. The reduction of damage to biological structure organisms by providing such a space is conceptual and speculative at this point and it would require testing before implementation. Many of the EBS structure-forming organisms are small enough to pass though a gap that size. A run of the analysis was done for Alternative 5B, Option 1, to see what effect a 50 percent reduction in mortality for organisms passing through the spaces would have on biostructure reductions. The result was a 16 percent reduction in slope LEI and a 19 percent reduction in sand/mud LEI (in combination with the closures). If that level of mortality reduction were confirmed, this would have a positive effect.

4.3.7.2 Effects of Alternative 5B on Target Species

4.3.7.2.1 Effects on Groundfish

4.3.7.2.1.1 Walleye Pollock (BSAI and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the BSAI, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the BSAI and GOA pollock stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, and 5B, Option 2, BSAI only) for some groundfish species, and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact walleye pollock fishing mortality in the GOA. In the BSAI, the additional closed areas would not be expected to impact walleye pollock fishing mortality because they are taken by pelagic trawl. While a TAC reduction in other groundfish fisheries would reduce the incidental take of walleye pollock, this source of mortality would be minor. Even if some decrease in fishing mortality were realized under Alternative 5A, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the EBS stock's ability to maintain itself above its MSST.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or WCGOA walleye pollock stocks that materially impact either stock's basic ability to maintain

itself at or above its MSST. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, and 5B, Option 2, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact the spatial concentration of walleye pollock catch in the GOA. The additional closures in the EBS would not be expected to impact the spatial concentration of walleye pollock catch in the BSAI. There is no evidence that Alternative 5B would alter the EBS stock's ability to maintain itself above its MSST.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, and 5B, Option 2, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall almost entirely outside of walleye pollock habitat, they would not be expected to impact the spawning and breeding success of walleye pollock in the GOA. In the EBS, the additional portions of walleye pollock habitat that would be closed under Alternative 5B appear to encompass only a small proportion of the known walleye pollock spawning grounds, and it is unclear whether the other elements of Alternative 5B would have a detectable impact on spawning and breeding success of walleye pollock in the EBS. Even if some increase in spawning and breeding success were realized under Alternative 5B, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Feeding (EBS U, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Because the additional closures in the GOA would fall nearly entirely outside of walleye pollock habitat, they would not be expected to impact the feeding success of adult walleye pollock in the GOA. In the EBS, the additional proportions of walleye pollock habitat that would be closed under Alternative 5B are small, and it is unclear whether the other elements of Alternative 5B would have a detectable impact on feeding success of walleye pollock in the EBS. The primary prey items in the diet of adult pollock are euphausiids and forage fish. The impact of the no trawl zones on these prey items would likely be minor. Even if some change in feeding success were realized under Alternative 5B, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Growth to maturity (EBS U, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Because the additional closures in the GOA would fall almost entirely outside of walleye pollock habitat, they would not be expected to impact the successful growth to maturity of walleye pollock in the GOA. In the EBS, the closed areas proposed under Alternative 5B would overlap regions occupied

by juvenile pollock. As was noted in Chapter 3, some juvenile walleye pollock assume a demersal existence at or near the end of the first year of life. Juvenile pollock maintain this existence for 1 year after which they assume a pelagic existence for 1 to 2 additional years. The impact of trawling on the feeding success and survival of juvenile walleye pollock is unknown. The impact of the no trawl zones on the feeding success of juvenile pollock is unknown.

4.3.7.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the BSAI and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall outside of Pacific cod EFH, they would not be expected to impact Pacific cod fishing mortality in the GOA. In the BSAI, it is possible that the additional closed areas might cause catches to be lower if the full TAC could not be taken by fishing in the remaining open areas. The TAC reduction in the BSAI would mean that fishing mortality on the BSAI stock would be approximately 10 percent lower under Alternative 5B, Option 1, than under Alternative 1, assuming that the full TAC would be taken under either alternative. The coral/bryozoan and sponge bycatch limits in the AI could also result in lower catches in the BSAI. However, there is no evidence that these decreases in fishing mortality would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its respective MSST.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the BSAI or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall outside of Pacific cod EFH, they would not be expected to impact the spatial concentration of Pacific cod catch in the GOA. How the additional closures in the BSAI would affect the spatial concentration of the catch in that region is unclear, because spatial concentration depends not just on the relative sizes of the open and closed areas, but on the magnitude and spatial distribution of catch within the open and closed areas as well. Likewise, the impacts of the other elements of Alternative 5B on the spatial concentration of Pacific cod catches in the BSAI are unclear. Even if some decrease in spatial concentration of the BSAI catch were realized under Alternative 5B, however, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only).

Because the additional closures in the GOA would fall outside of Pacific cod EFH, they would not be expected to impact the spawning and breeding success of Pacific cod in the GOA. In the BSAI, the additional portions of Pacific cod EFH that would be closed under Alternative 5B appear to encompass only a small proportion of the known Pacific cod spawning grounds, and it is unclear whether the other elements of Alternative 5B would have a detectable impact on spawning and breeding success of Pacific cod in the BSAI. Even if some increase in spawning and breeding success were realized under Alternative 5B, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall outside of Pacific cod EFH, they would not be expected to impact the feeding success of Pacific cod in the GOA. In the BSAI, the additional proportions of Pacific cod EFH that would be closed under Alternative 5B are small, and it is unclear whether the other elements of Alternative 5B would have a detectable impact on feeding success of Pacific cod in the BSAI. Even if some increase in feeding success were realized under Alternative 5B, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major changes under the Alternative 5B options would be the inclusion of additional areas closed to bottom trawling, the imposition of a TAC reduction (5B, Option 1, BSAI only) for some groundfish species and the imposition of coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2, AI only). Because the additional closures in the GOA would fall outside of Pacific cod EFH, they would not be expected to impact the successful growth to maturity of Pacific cod in the GOA. In the BSAI, the additional proportions of Pacific cod EFH that would be closed under Alternative 5B are small, and it is unclear whether the other elements of Alternative 5B would have a detectable impact on successful growth to maturity of Pacific cod in the BSAI. Even if some increase in successful growth to maturity were realized under Alternative 5B, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in the BSAI stock's ability to maintain itself above its MSST.

4.3.7.2.1.3 Sablefish (BSAI and GOA)

The effects of Alternative 5B for sablefish would be the same as the effects of Alternative 5A. The additional measures for the AI added by Alternative 5B would not affect any areas where sablefish are caught; the sablefish catch would not reduced by these additional measures.

4.3.7.2.1.4 Atka Mackerel (BSAI and GOA)

Stock Biomass (Ø) – The Alternative 5B options would inot expected to impact the stock biomass of Atka mackerel relative to status quo. Alternative 5B would prohibit the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island in the AI. These areas do not overlap with the major fishing grounds for Atka mackerel. In addition, 5B, Option 1, and 5B, Option 2, would contain a 6 percent TAC reduction for the Aleutian Atka mackerel trawl fishery, and there would be area-specific (541, 542, 543) coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2). The bycatch limits would be set at or near the upper end of the observed bycatch levels. Because the TAC reduction would be very low, the bycatch limits would not likely be limiting, at least initially, and the closed areas would not overlap with the major fishing grounds of the Atka mackerel fishery, Alternative 5B would not likely to impact the stock biomass relative to status quo. Alternative 5B would also close areas in the GOA bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for stock biomass would be no effect.

Spatial/Temporal Concentration of the Catch (Ø) – This alternative would not be expected to impact the spatial/temporal concentration of the catch of Atka mackerel relative to status quo. Alternative 5B would prohibit the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas would not overlap with the Atka mackerel fishery. In addition, 5B, Option 1, and 5B, Option 2, would contain a 6 percent TAC reduction for the Aleutian Atka mackerel trawl fishery, and there would be area-specific (541, 542, 543) coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2). The bycatch limits would be set at or near the upper end of the observed bycatch levels. Because the TAC reduction would be very low, the bycatch limits would not likely be limiting, at least initially, and the closed areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5B would not be likely to impact the spatial concentration of the catch relative to status quo. Alternative 5B would also close areas in the GOA to rockfish bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for spatial/temporal concentration of the catch would be no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Alternative 5B would not be expected to affect the spawning and breeding of Atka mackerel relative to status quo. Alternative 5B would prohibit the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. In addition, 5B, Option 1, and 5B, Option 2, would contain a 6 percent TAC reduction for the Aleutian Atka mackerel trawl fishery, and there would be area-specific (541, 542, 543) coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2). The bycatch limits would be set at or near the upper end of the observed bycatch levels. Because the TAC reduction would be very low, the bycatch limits would not likely be limiting, at least initially, and the closed areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5B would not be likely to impact the spawning and breeding of Atka mackerel relative to status quo. Alternative 5B would also close areas in the GOA to rockfish

bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for spawning and breeding would be no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods, which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. In addition, the closed areas in the GOA for Alternative 5B would be mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so in theory any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for Atka mackerel. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative were implemented, it is quite possible that fishermen might be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to status quo. Therefore, the rating for feeding would be no effect.

Growth to maturity (Ø) – Larvae are pelagic. Late juveniles/adults are semi-pelagic. Late juveniles/adults are demersal at times and are associated with rough, rocky habitat at depths of generally less than 200 m. They have exhibited strong diel behavior with movements away from the bottom up into the water column. The directed fishery in the AI overlaps with older juvenile/mature adult habitat at depths of generally less than 200 m.

Alternative 5B would not be expected to affect the growth to maturity of Atka mackerel relative to status quo. Alternative 5B would prohibit the use of bottom-trawl gear for all groundfish fisheries in areas of Stalemate Bank, Bowers Ridge, Seguam foraging area, Yunaska Island, and Semisopochnoi Island. These areas do not overlap with the major fishing grounds for Atka mackerel. In addition, 5B, Option 1, and 5B, Option 2, would contain a 6 percent TAC reduction for the Aleutian Atka mackerel trawl fishery, and there would be area-specific (541, 542, 543) coral/bryozoan and sponge bycatch limits (5B, Option 1, and 5B, Option 2). The bycatch limits would be set at or near the upper end of the observed bycatch levels. Because the TAC reduction would be very low, the bycatch limits would not likely be limiting, at least initially, and the closed areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5B would not be likely to impact the growth to maturity of Atka mackerel relative to status quo. Alternative 5B would also close areas in the GOA to rockfish bottom trawling (as in Alternatives 2 and 3), but there is no directed fishery for Atka mackerel in the GOA. Therefore, the rating for spawning and breeding would be no effect.

4.3.7.2.1.5 Yellowfin Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS yellowfin sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Nichol 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on EBS yellowfin sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS yellowfin sole harvest does not occur in the designated bottom trawl closure areas that are scheduled for rotating closures and also in those proposed for the AI, there would probably not be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS yellowfin sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B would not be expected to affect the availability of prey for yellowfin sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, bivalves, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for yellowfin sole. Within the first year of life, yellowfin sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.6 Greenland Turbot (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS Greenland turbot biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Ianelli et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on the spatial/temporal concentration of the EBS Greenland turbot catch in most years except when the portion of the closed areas include slope waters. In those years, only minor changes would likely occur in the spatial/temporal concentration of the catch. Since most of the EBS Greenland turbot harvest would not occur in the designated bottom trawl closure areas in 10 out of 15 years, and because their exploitation rate is so small, there would probably be neither a negative effect or future benefit to the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS Greenland turbot since there would be few changes in the current harvest practices. Fishing would probably not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B would probably not affect the availability of prey for Greenland turbot since the modeled benthic disturbance for infauna and epifauna prey are not relevant to their diet. Adult feeding on pollock, squid, and deep water fish species primarily occurs during summer throughout the deep slope waters and to a lesser extent, on the upper slope/shelf margins. Most of the Greenland turbot feeding behavior is observed to take place off bottom and is not related to the benthic food availability.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for Greenland turbot. Within the first year of life, Greenland turbot metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.7 Arrowtooth Flounder (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA arrowtooth flounder biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on GOA arrowtooth flounder since there would be only minor changes in the spatial/temporal concentration of the catch. Recent summer surveys indicate that 90 percent of the stock biomass resides less than 200 m deep. Harvesting under Alternative 5B would probably not cause a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA arrowtooth flounder since there would be few changes in the current harvest practices. Fishing probably would not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B would probably not affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.8 Rock Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS rock sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on EBS rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS rock sole harvest does not occur in the designated bottom trawl closure areas which are scheduled for rotating closures and also in the AI, there probably would not be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS rock sole, since there would be few changes in the current harvest practices. Fishing probably wold not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, small changes in future fishing probably would not have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.9 Flathead Sole (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on GOA and EBS flathead sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Bottom trawl surveys conducted during summer indicate that 95 percent of the flathead sole biomass is at depths less than 200 m. Therefore, future harvest under this scenario probably would not differ much from Alternative 1 and would not be expected to have a negative effect on the future genetic diversity of the stock. Since most of the recent EBS flathead sole harvest has not occurred in the designated bottom trawl closure areas that are scheduled for rotating

closures and also in those proposed for the AI, there would probably not be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA and EBS flathead sole, since there would be few changes in the current harvest practices. Fishing would probably not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, small changes in future fishing would probably not have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 5B on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – Relative to the status quo, Alternative 5B might have some effect on the GOA rex sole harvest due to the 200 m restriction. Trawl surveys indicate that more than half of the summertime biomass are at depths less than 200 m, so it is possible that the harvest could be taken entirely in the shallow areas. It is unknown what effect this would have on the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA rex sole, since there would be no change in the current harvest practices and fishing probably would not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to depend on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, fishing probably would not have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there probably would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.11 Alaska Plaice (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS Alaska plaice biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on EBS Alaska plaice, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the EBS Alaska plaice harvest does not occur in the designated bottom trawl closure areas that would be scheduled for rotating closures or in those areas proposed for the AI, there probably would not be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on EBS Alaska plaice, since there would be few changes in the current harvest practices. Fishing probably would not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for Alaska plaice, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, marine worms and, to a lesser extent, bivalves. Given the present condition of the resource resulting from current management practices, small changes in future fishing probably would not have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for Alaska plaice. Within the first year of life, Alaska plaice metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there probably would be no effect from fishing on survival and growth to maturity.

4.3.7.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for GOA shallow water flatfish, the effect of Alternative 5B on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5B would have little effect on GOA rock sole and other shallow water flatfish since they primarily inhabit water less than 200 m depth.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA rock sole, since there would be no change in the current harvest practices and since fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, small changes in future fishing probably would not have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, fishing would have no effect on survival and growth to maturity.

4.3.7.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for GOA deep water flatfish, the effect of Alternative 5B on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – Relative to the status quo, Alternative 5B might have some effect on the GOA Dover sole harvest due to the 200 to 1,000 m restriction. Trawl surveys indicate that nearly half of the summertime biomass are at depths less than 200 m, so the harvest could be taken entirely in the shallow areas. It is unknown what effect this would have on the genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5B would have no effect on GOA Dover sole, since there would be no change in the current harvest practices and fishing would probably not have a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5B probably would not affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey would be the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, fishing probably would not have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5B would have no effect on the growth to maturity for Dover sole. Within the first year of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 5B, there fishing would have no effect survival and growth to maturity.

4.3.7.2.1.14 Pacific Ocean Perch (BSAI)

Stock Biomass (Ø) – Under Alternative 1, total biomass (ages 3 through 21+) of BSAI Pacific ocean perch is above the MSST and is expected to remain above the MSST, resulting in a rating of no effect of fishing on stock biomass. Because Alternatives 5A and 5B have additional habitat protections (and TAC reductions under 5B, Option 1, and 5B, Option 2) in the BSAI area, the stock biomass would also be expected to remain above the MSST and the effect of fishing on stock biomass would also be rated as no effect.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for Pacific ocean perch harvest in EBS are on the slope to the southeast of the EBS closure areas, which have little effect on the fishery. Similarly, the closure areas in the AI are located where few Pacific ocean perch would be caught under Alternative 5B; thus this alternative would have little effect on the spatial/temporal concentration of the catch. The pattern of fishing for Pacific ocean perch under Alternative 5B would probably be similar to that in Alternative 1; thus, there would be no substantial effect on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo (Alternative 1) management, resulting in a rating of no effect of fishing on spawning habitat. As was mentioned above, the pattern of fishing for Pacific ocean perch in the BSAI area would probably be similar to Alternative 1, and Alternatives 5A and 5B would probably have no substantial effects on essential spawning habitat.

Feeding (Ø) – Pacific ocean perch are plankton feeders, with juvenile Pacific ocean perch eating calanoid copepods and adults eating largely euphausiids (Yang 1993, 1996). Fishing activity under Alternatives 5A and 5B would have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. The pattern of Pacific ocean perch fishing under Alternatives 5A and 5B would probably be similar to that under Alternative 1; thus fishing would probably have no substantial effect on the survival of fish to maturity.

4.3.7.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – The ten areas in the GOA that Alternative 5B would close to all groundfish bottom trawling cover a relatively small portion of the slope geographically. This portion does not appear to coincide with many areas of high Pacific ocean perch concentrations.

The closure of the slope to directed rockfish bottom trawling could have a substantial impact on the catch of Pacific ocean perch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope were closed to bottom trawling, the effort might move onto the shelf and into the gullies. Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope were closed to bottom trawling, the Pacific ocean perch fishery on the slope might convert to pelagic trawl gear. In either case, the stock biomass would likely remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – Because the ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and are generally not in areas with high Pacific ocean perch concentrations, Alternative 5B would have a negligible effect on the spatial/temporal concentration of catch.

The closure of the slope to directed rockfish bottom trawling could have a substantial impact on the spatial/temporal concentration of Pacific ocean perch catch compared to the status quo, but it would depend upon how the fishery responded to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope were closed to bottom trawling, Pacific ocean perch fishing effort might move onto the shelf and into the gullies. This could result in increased fishing pressure in these areas and under a short duration open access fishery could increase the risk of localized depletion in these areas.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope were closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear and current levels of fishing pressure on the slope could continue.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. The fishing closures would probably not increase total fishing mortality. Consequently, Alternative 5B would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 5B on Pacific ocean perch spawning would be insignificant. Little is known, however, about the habitat requirements for spawning and possible fishing effects on that habitat.

The ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally are not in areas with high Pacific ocean perch concentrations, but they would create no-take zones or refugiua for Pacific ocean perch in these areas, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited fish populations (Yoklavich 1988). In particular, the closed areas might allow increased survival of larger and older fish that produce significantly more offspring. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit Pacific ocean perch.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 5B.

Growth to Maturity (Ø) – The ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally are not in areas with high Pacific ocean perch concentrations. This portion of the alternative would likely have little impact on the growth to maturity of Pacific ocean perch compared to the status quo.

Closing the slope to directed rockfish bottom trawling could have a positive impact on the growth to maturity of Pacific ocean perch compared to the status quo. The fishing closures would be geographically large, but they probably would not coincide with juvenile Pacific ocean perch habitat. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. If the bottom trawl closures coincide with juvenile habitat, damage to this epifauna by bottom trawls would be reduced in closed areas.

Areas of the slope closed only to bottom trawling would not likely serve as refugia for Pacific ocean perch because trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002).

4.3.7.2.1.16 Shortraker and Rougheye Rockfish (BSAI)

Stock Biomass (U) – BSAI shortraker and rougheye rockfish are not currently assessed with an age-structured population model, and the MSSTs have not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for shortraker and rougheye rockfish harvest in EBS are on the slope to the southeast of the closure areas, which have little effect on the fishery. Large catches of rougheye rockfish are occasionally taken just outside of Seguam Pass and would fall outside of the proposed Seguam Pass area closure. Small amounts of rougheye and shortraker rockfish are harvested within the other proposed closure areas. The spatial/temporal concentration of the catch under Alternatives 5A and 5B probably would not have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas of the AI would probably have little effect on the spawning and breeding habitat of shortraker/rougheye rockfish because relatively few shortraker and rougheye are caught within the proposed closed areas. Thus, the effect of fishing on spawning habitat would probably be similar to that in Alternative 1. However, because the

MSSTs for shortraker and rougheye rockfish are unknown, the effect of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Pandalid and hippolytid shrimp are the largest components of the rougheye rockfish diet (Yang 1993, 1996). The diet of shortraker rockfish is largely unknown, but a limited number of samples suggest that squid is a major component. The reduction of epifaunal prey could affect the diet of rougheye rockfish, but the percent reductions are so small (0 to 3 percent) that fishing probably would have no effect on the diet of shortraker/rougheye rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile rougheye/shortraker rockfish. Because the MSSTs for rougheye and shortraker rockfish are unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.7.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – Alternative 5B would likely have little or no impact on the stock biomass of shortraker/rougheye rockfish compared to the status quo. This appears to be true even though the alternative would combine the measures in Alternatives 2 and 3 and, in addition, would prohibit bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope. Fishery data indicate that catches of shortraker and rougheye rockfish are rather evenly spread along the continental slope of the GOA, especially in the central GOA and west Yakutat areas, where most of the catch is taken. This lack of geographic catch concentration may be due to Council regulations that allow these species to be taken only as bycatch in other fisheries. About 40 percent of the shortraker/rougheye catch in recent years has come from longline fisheries that target on sablefish and halibut (Heifetz et al. 2002). Since shortraker and rougheye are only taken as bycatch, are taken by both trawl and longline fisheries, and because distribution is evenly spread over a wide geographical area, the closures proposed under Alternative 5B would probably not have an effect on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – Because fishery data indicate that shortraker/rougheye catches are spread out evenly along the continental slope of the GOA and because shortraker/rougheye are taken only as bycatch in several major fisheries including longline fisheries, the closures proposed under Alternative 5B probably would not change the spatial/temporal concentration of the catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur from February through August for shortraker rockfish, and from December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish are unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small, they generally are not taken in bottom-tending fishing gear. This alternative would combine the measures in Alternatives 2 and 3 and, in addition, would prohibit bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope and would likely not affect the prey availability to adult

shortraker and rougheye rockfish. Therefore, it is unlikely that the effects of Alternative 5B would lead to a change in food availability to shortraker and rougheye rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to conclude firmly that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, most of the proposed areas in this alternative would only be closed to directed rockfish bottom trawling and would still be open to other directed fisheries, which may continue to damage sensitive benthic fauna. The ten areas that would be closed to all bottom trawling are small and cover a relatively small portion of the slope. Since it is unknown if a reduction in bottom trawl effort in such small areas would improve benthic habitat and since habitat requirements are mostly unknown for shortraker/rougheye, it is unknown what effects Alternative 5B would have on these species.

4.3.7.2.1.18 Northern Rockfish (BSAI)

Stock Biomass (U) – BSAI northern rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stocks' ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for northern rockfish harvest in EBS are on the slope to the southeast of the closure areas, which have little effect on the fishery. The Semisopochnoi Island and Seguam Pass area closures might reduce effort from the Atka mackerel fishery in these areas, as well as bycatch of northern rockfish. The spatial/temporal concentration of the catch under Alternative 5B probably would not have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition on bottom trawling in some areas where northern rockfish have been taken as bycatch, such as Semisopochnoi Island and Seguam Pass, may reduce effect of fishing on spawning habitat relative to the status quo. However, the magnitude of this effect, as reflected by changes in the stock size relative to the MSST, is unknown.

Feeding (Ø) – Northern rockfish are largely plankton feeders, eating mainly euphausiids but also copepods, hermit crabs, and shrimp (Yang 1993). Fishing activity under Alternatives 5A and 5B would probably have no effect on the largely pelagic diet of northern rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile northern rockfish. Because the MSST for northern rockfish is unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) are also unknown.

4.3.7.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. This alternative would likely have little impact on the stock biomass of northern rockfish compared to the status quo.

The ten areas in the GOA that the alternative would close to all groundfish bottom trawling cover a relatively small portion of the slope geographically and do not appear to coincide with areas of high northern rockfish concentrations.

The closed slope areas in the GOA are all 200 to 1,000 m deep. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, the areas that Alternative 5B would close to rockfish bottom trawling do not appear to coincide with areas of high northern rockfish concentrations.

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST, and Alternative 5B would likely not affect this. Because the ten areas in the GOA that the alternative would close to all groundfish bottom trawling are geographically small and generally not in areas with high northern rockfish concentrations, this portion of Alternative 5B would have a negligible effect on the spatial/temporal concentration of catch.

Closing the slope to directed rockfish bottom trawling could have an impact on the spatial/temporal concentration of northern rockfish catch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Pacific ocean perch are caught in the commercial fishery on the shelf break and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). If the slope were closed to bottom trawling, Pacific ocean perch fishing effort might move onto the shelf and into the gullies. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Consequently, movement of the Pacific ocean perch bottom trawl fishery could result in increased fishing pressure in areas of high northern rockfish concentrations. Under a short duration open access fishery, the risk of overfishing and or localized depletion in these areas could increase.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope were closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, which would have little effect on northern rockfish.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, this alternative would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 5 on northern rockfish spawning would be insignificant. However, caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 5B.

Growth to Maturity (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. The ten areas in the GOA that Alternative 5B would close to all groundfish bottom trawling are geographically small and are generally not in areas with high northern rockfish concentrations. This portion of the alternative would likely have little impact on the growth to maturity of northern rockfish compared to the status quo.

Closing the slope to all bottom trawling could have a negative impact on the growth to maturity of northern rockfish compared to the status quo. The fishing closures are geographically large, but probably do not coincide with adult or juvenile northern rockfish habitat. Studies using submersibles have indicated that several species of rockfish appear to use rocky, shallower habitats during their juvenile stage (Carlson and Straty 1981, Kreiger 1993). Although these studies did not specifically observe northern rockfish, juvenile northern rockfish may also use these shallower habitats as refuge areas. Trawl surveys and commercial fishing data indicate that the preferred habitat of adult northern rockfish in the GOA is on relatively shallow rises or banks on the outer continental shelf at depths of approximately 75 to 150 m (Clausen and Heifetz 2003). Northern rockfish appear to be associated with relatively rough bottoms on these banks, and they are primarily demersal in their distribution (Pers. comm. Dave Clausen). Observations from a submersible in the AI have also identified adult northern rockfish associated with boulders and sponges in mixed sand/gravel on the shallow (less than 200 m) slope. Consequently, there is some anecdotal evidence to suggest that adult and juvenile northern rockfish may be associated with living and nonliving structure on the bottom that could be negatively impacted by the effects of bottom trawling. Pacific ocean perch are caught in the commercial fishery on the shelf break, and inside major gullies and trenches running perpendicular to the shelf break as well as along the continental slope (Lunsford 1999, Lunsford et al. 2001, Major and Shippen 1970). Consequently, if the slope were closed to bottom trawling, Pacific ocean perch fishing effort might move onto the shelf and into the gullies where concentrations of northern rockfish are found.

Alternatively, trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). Consequently, if the slope were closed to bottom trawling, the Pacific ocean perch fishery on the slope could convert to pelagic trawl gear, which would have little effect on northern rockfish.

4.3.7.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA comprises three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on this species as a proxy for the pelagic shelf rockfish management group.

Stock Biomass (Ø) – Alternative 5B would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo. This appears to be true even though the alternative would combine the measures in Alternatives 2 and 3 and, in addition, would prohibit bottom trawling for all species (not just slope rockfish) in the closed areas of Alternative 2. The ten areas in the GOA that the alternative would close to all bottom trawling cover a relatively small portion of the slope, and all would be more than 200 m deep. In contrast, the fishing grounds that account for most of the catch of light dusky rockfish are all on the outer shelf less than 200 m deep. The large closure area for all slope waters 200 to 1,000 m would only affect bottom trawling for species in the slope rockfish management group, and the directed bottom trawl fishery for light dusky rockfish would continue similar to its present state. This large closure might somewhat reduce the bycatch of light dusky rockfish in the slope rockfish fisheries, but the closure would only apply to waters of the continental slope at depths of 200 to 1,000 m, where few light dusky rockfish are found.

Spatial/Temporal Concentration of the Catch (Ø) – Because the areas closed to fishing generally do not correspond with locations where light dusky rockfish are abundantly caught (the closed areas are all too deep), Alternative 5B would probably have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring, based on observations of ripe females sampled on a research cruise in April in the central GOA. Because of this lack of knowledge, the effects Alternative 5B would have on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution, and they are so small that they are not retained by any fishing gear, Alternative 5B probably would have little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closed areas in Alternative 5B are mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch, so that in theory, any reduction in the catch of Pacific ocean perch as a result of this alternative might free up some food for light dusky rockfish. However, it is debatable whether this alternative would actually reduce the catch of Pacific ocean perch because, although bottom trawling would be prohibited in all the closed areas, pelagic trawling for this species would still be allowed. Trawl fishermen have already demonstrated the ability to catch significant quantities of Pacific ocean perch using pelagic trawls (Heifetz et al. 2002). If this alternative went into effect, it is quite possible that fishermen may be able to use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to light dusky rockfish would be unchanged compared with the status quo.

Growth to maturity (Ø) – Alternative 5B would have little or no effect on growth to maturity of light dusky rockfish. Closing certain areas to bottom trawling could potentially have a benefit to light dusky rockfish because evidence suggests the fish may be associated with epifauna and rocky substrates. These features can be negatively altered or damaged by bottom trawling, and closed areas would allow some degree of recovery for these features. However, the closure areas in this alternative are all located in deeper waters (more than 200 m) that are inhabited by relatively few light dusky rockfish, so they provide little benefit to these fish.

4.3.7.2.1.21 Other Rockfish Species (BSAI)

Stock Biomass (Ø) – The closure areas in the AI, except for the Seguam Pass area, are areas where little to no light dusky rockfish have been observed. In the EBS, the closure areas are in the northern parts of the shelf and slope region, which are areas of little to no observations of light dusky rockfish. Therefore, Alternative 5B would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Similar rationale as for stock biomass, Alternative 5B would likely have little or no impact on the spatial/temporal concentration of light dusky rockfish catch compared to the status quo.

Spawning/Breeding (U) – There is no information on reproductive behavior for light dusky rockfish, therefore due to this lack of knowledge, the effects of Alternative 5B on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). Although any direct or indirect effects of fishing on euphausiid abundance is not presently known, these closure areas probably have no effect on their abundance.

Growth to maturity (Ø) – The closure areas are not in locations of known concentrations of light dusky rockfish. Therefore, Alternative 5B would have little or no effect on growth to maturity of light dusky rockfish.

4.3.7.2.1.22 Shortspine Thornyheads (BSAI)

Stock Biomass (Ø) – The peak abundance for shortspine thornyheads is along the slope from 300 to 1,000 m. Although the suggested 33.3 percent rotational closure areas in the BSAI do extend over the slope, only a small fraction of it is actual shortspine thornyhead habitat area. Additionally, the displaced fishery catch of shortspine thornyhead, in these areas, would be minimal (Reuter and Spencer 2001). Therefore, under Alternative 5B there would be little to no effect on their stock biomass as compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – No stock structure has been found for shortspine thornyheads in the BSAI. Their spatial distribution is uniform along the slope of the BSAI. Therefore, Alternative 5B would likely have little to no effect on their catch as compared to the status quo.

Spawning/Breeding (Ø) – Larval and juveniles of this species are pelagic for up to 15 months after spawning. Therefore, the effect of the Alternative 5B closures on the habitat of this life stage is probably minimal to none.

Feeding (U) – The major prey of adult shortspine thornyheads appears to be pandalid shrimp (based on the limited food information available for this species) (Yang 1993). Any direct or indirect effects of fishing on pandalid shrimp abundance is not presently known.

Growth to maturity (Ø)
The peak spawning biomass for shortspine thornyheads on the west coast is at depths from 800 to 1,000 m (Wakefield 1990). Although the suggested 33.3 percent rotational closure areas in the BSAI do extend over the slope, only a small fraction of it is the habitat of reproductively mature shortspine thornyheads. Additionally, the displaced fishery catch of shortspine thornyhead, in these areas, would be minimal in both the EBS and AI (Reuter and Spencer 2001). Therefore, Alternative 5B would have little to no effect on their growth potential as compared to the status quo.

4.3.7.2.1.23 Forage Species (BSAI and GOA)

Stock Biomass (Ø) – The impact of Alternative 5B on forage species is likely to be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 5B would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 5B are not in areas of significant forage species bycatch. Alternative 5B would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 5B are not thought to be important to the spawning and breeding of forage species. Alternative 5B would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 5B are not thought to be important to the feeding ecology of forage species. Alternative 5B would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 5B are not thought to be important to the feeding ecology of forage species. Alternative 5B would have minimal effect on the growth to maturity of forage species.

4.3.7.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.7.2.2.1 Salmon

Stock Biomass (Ø) – The salmon fishery is not impacted by measures proposed under Alternative 5B. In addition, the bycatch of salmon would not change, as the closures do not affect the pollock fishery, which takes a majority of the salmon bycatch. Thus, no changes in the catch of salmon would be expected, so no effects on biomass would be expected.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of salmon fishing effort is expected under Alternative 5B.

Spawning/Breeding (Ø) – No changes in the distribution of fisheries in salmon spawning and breeding areas would occur under this alternative, and thus no effects would be expected under Alternative 5B.

Feeding (Ø) – No substantial changes in the catch of these prey species is expected under Alternative 5B, so this alternative was judged to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alternative 5B, so no effects would be anticipated. Bycatch of juvenile salmon has been relatively small in the fisheries primarily affected by this alternative (BSAI flatfish trawl fishery and GOA slope rockfish), and no substantial changes in bycatch amounts would be anticipated due to fleet redistribution.

4.3.7.2.2.2 Crabs

Stock Biomass (Ø) – Alternative 5B would not affect the catch of crabs in the directed fisheries. This alternative would be expected to have slight reductions in the bycatch amounts taken in groundfish trawl fisheries (due to the minimum bobbin/roller gear requirements of this alternative). Nevertheless, bycatch of crabs is very, very small relative to total population size (Witherell and Pautzke 1997) and would not result in any change stock biomass. Thus, stock biomass would not be substantially affected by Alternative 5B.

Spatial/Temporal Concentration (Ø) – Alternative 5B would not modify the distribution and intensity of fishing effort in the crab fisheries, so no effects would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of crabs would be expected under Alternative 5B. The closure areas designated by this alternative only overlap substantially with the opilio crab stock (although there is a small portion of the St. Matthew and Pribilof Islands blue king

crab stocks, Tanner crab stock, and golden king crab stock). Bottom trawl effort from the closed areas of the northwest area of the EBS would likely redistribute to adjacent areas that likely have similar abundance of female opilio crab in any given year (the distribution of these crab has shown significant changes over time). For that reason, Alternative 5B was judged to have no effect on spawning and breeding of crab stocks.

Feeding (Ø) – Fisheries are considered not to have any substantial effects on the prey of crab species. Alternative 5B is considered to have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas in the EBS overlap with opilio crab EFH areas of concentration. The trawl closure areas may improve habitat and reduce bycatch mortality for opilio crab within the closure area by eliminating potential impacts due to bottom trawling. However, it is likely that trawl fishing effort would redistribute to nearby adjacent areas also used by these crab, and this redistribution would likely dampen potential habitat benefits or reductions in bycatch resulting from these closures. The requirement for large bobbins and rollers on trawl gear footropes and sweeps is expected to reduce crab bycatch and unobserved mortality by reducing the amount of gear hitting the bottom. The nets and sweeps should simply pass over the crabs without touching them, and resulting higher survival rate. Overall, positive changes in habitat effects and survival would be expected under Alternative 5B.

4.3.7.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 5B is anticipated to have no substantial effects on scallop stock biomass, as catches would not be affected by these measures.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of scallop fishing effort is expected under Alternative 5B.

Spawning/Breeding (Ø) – None of the closure areas designated under this alternative overlap with scallop populations. Therefore, Alternative 5B is anticipated to have no substantial effects on spawning and breeding of weathervane scallops.

Feeding (Ø) – None of the closure areas designated under this alternative overlap with scallop populations, and fishing effort is not projected to increase in areas with scallops. Thus Alternative 5B was judged to have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in scallop dredge effort is expected under Alternative 5B, and no changes in effort redistribution to scallop grounds would be expected, so Alternative 5B was judged to have no effect on growth to maturity.

4.3.7.3 Effects of Alternative 5B on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 5B, were it in place in 2001, on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.7 of the RIR/IRFA (Appendix C).

4.3.7.3.1 Effects on Passive Use Values (E+)

Under Alternative 5B, NPT fishing activities for all species in ten designated areas and for slope rockfish along the entire slope (200 to 1,000 m) in the GOA would be eliminated. Use of NPT gear would be closed over 33 1/3 percent of five areas in the EBS on a 5-year rotational basis, with bobbins required on NPT gear fished in other areas. The use of NPT gear would be prohibited for all species in designated areas of the AI. While it is not possible at this time to provide an empirical estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 5B would yield some incremental increase in passive-use benefits over no action Alternative 1.

Alternative 5B would reduce the impact of NPT fishing over a large area of habitat in the GOA, EBS, and AI. However, the current distribution of fishing effort does not extend to the edge of the EEZ. Thus, fishing impacts on EFH would actually be minimized over 31,904 sq. km of GOA shelf and slope edge habitat (11.4 percent of the current 279,874 sq. km of habitat) and an average 63,975 sq. km of EBS habitat (8.0 percent of the current 798,870 sq. km of habitat), as in Alternative 5A. Alternative 5B would further reduce NPT fishing impacts in the EBS by requiring disks and bobbins on trawl sweeps and footropes used in open areas. In the AI, Alternative 5B would reduce the impact of NPT fishing over 82,023 sq. km of AI habitat, or 77.9 percent of the current fishable area of 105,243 sq. km in the AI. Overall, Alternative 5B would affect 177,903 sq. km, or 15.0 percent of the combined fishable area of 1,183,987 sq. km in the GOA, EBS, and AI.

Alternative 5B is designed to reduce the effects on EFH of NPT fishing in the GOA, EBS, and AI. These fishing impact measures would extend beyond measures currently in place or planned as part of other fishery management actions. Current scientific knowledge does not permit either a quantitative or qualitative assessment of the use benefits that would be derived from minimizing the effects of fishing on EFH. However, the assumption implicit in the Magnuson-Stevens Act requirement to minimize effects of fishing on EFH is that doing so would result in the sustained or enhanced production from FMP species and contribute to a healthy ecosystem. As such, Alternative 5B would contribute additional management measures that would further reduce the impacts of fishing on EFH. Whether these fishing impact minimization measures would provide increased future use and productivity benefits over status quo Alternative 1 or other action Alternatives 2, 3, 4, 5A, or 6 is unknown at this time.

4.3.7.3.2 Effects on the Fishing Fleet

<u>Passive Use and Productivity Benefits (E+)</u>
Under Alternative 5B, NPT fishing activities for all species, in ten designated areas, and for slope rockfish along the entire slope (200 to 1,000 m) in the GOA would be eliminated. Use of NPT gear would be closed over 33 1/3 percent of five areas in the EBS, on a 5-year rotational basis, with bobbins required on NPT gear fished in other areas. The use of NPT gear would be prohibited for all species in designated areas of the AI. While it is not possible at this time to provide an empirical point estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 5B would yield some incremental increase in the passive-use benefit of EFH, over the no action Alternative 1.

Alternative 5B would reduce the impact of NPT fishing over a large area of habitat in the GOA, EBS, and AI. However, the current distribution of fishing effort does not extend to the edge of the EEZ. Thus, fishing impacts on EFH would actually be minimized over 31,904 sq. km of GOA shelf and slope edge habitat (11.4 percent of the current 279,874 sq. km of habitat) and an average 63,975 sq. km of EBS habitat (8.0 percent of the current 798,870 sq. km of habitat), as in Alternative 5A. Alternative 5B

would further reduce NPT fishing impacts in the EBS by requiring disks and bobbins on trawl sweeps and footropes used in open areas. In the AI, Alternative 5B would reduce the impact of NPT fishing over 64,986 to 76,689 sq. km of AI habitat, or from 59.9 percent to 70.7 percent of the current fishable area of 108,543 sq. km in the AI. Overall, Alternative 5B would affect 160,865 to 172,568 sq. km, or 13.5 to 14.5 percent of the combined fishable area of 1,187,287 sq. km in the GOA, EBS, and AI.

Alternative 5B is designed to reduce the effects on EFH of NPT fishing in the GOA, EBS, and AI. These fishing impact measures would extend beyond measures currently in place or planned as part of other fishery management actions. Current scientific knowledge does not permit either a quantitative or qualitative assessment of the use benefits that would be derived from minimizing the effects of fishing on EFH. However, the assumption implicit in the Magnuson-Stevens Act requirement to minimize effects of fishing on EFH is that doing so would result in the sustained or enhanced production from FMP species and contribute to a healthy ecosystem. As such, Alternative 5B would contribute additional measures that would further reduce the impacts of fishing on EFH. Whether these fishing impact minimization measures would provide increased future use and productivity benefits over status quo Alternative 1 or other action Alternatives 2, 3, 4, 5A, or 6 is unknown at this time.

Gross Revenue Effects (E-)

Alternative 5B, had it been in place for the 2001 fishing year, would have placed $7.46 million to $15.93 million of gross revenue at risk in NPT fisheries in the GOA, EBS, and AI, or 4.1 to 8.8 percent of the status quo total revenue of $179.77 million to $180.41 million, depending upon which rotational areas are affected in the EBS and which AI option is chosen.

EBS Region

In the EBS, Alternative 5B would have placed between $2.63 million and $5.61 million of revenue at risk, or 2.7 to 5.8 percent of the $96.27 million to $96.91 million of 2001 status quo revenue in the fisheries affected, had it been in place in 2001. However, the reduction in the combined BSAI trawl TAC for Pacific cod, required by Alternative 5B, would have reduced the revenue from NPT fisheries for Pacific cod in the EBS by $8.5 million, or more than the total of the combined species revenue at risk for EBS EFH fishing impact minimization measures. These represent pure losses for the sector, because the foregone catch may not be made up by redeployment.

Alternative 5B would have placed revenues at risk in a number of NPT target fisheries in the EBS including flathead sole, yellowfin sole, rock sole, other flatfish, and Pacific cod, among others. However, the largest revenue at risk would occur in the flathead sole fishery, where, had this rule been in place in 2001, $1.70 million to $4.23 million of revenue would have been at risk, equaling 11.8 to 29.3 percent of the $14.46 million status quo revenue, depending upon the rotational area affected. The total revenue at risk in the EBS NPT Pacific cod fishery would have ranged from $190,000 to $980,000, or 1.3 to 6.8 percent of the 2001 status quo revenue of $14.33 million. However, the reduction in the combined BSAI trawl TAC for Pacific cod, required by Alternative 5B, Option 1, would reduce the revenue from NPT fisheries for Pacific cod in the EBS by $8.5 million, or more than $7.0 million more than the Pacific cod revenue at risk and more than the total of the combined species revenue at risk from EBS EFH fishing impact minimization measures.

In the EBS, substantially all of the revenue at risk would have occurred in the catcher-processor fleet component. A total of $2.63 million to $5.61 million of revenue is at risk, or 2.9 to 6.2 percent of $90.45 million to $91.08 million of status quo revenue, depending upon the rotational area closures, had Alternative 5B been in place that year. However, the reduction in the combined BSAI trawl TAC for Pacific cod, required by Alternative 5B, Option 1, would have reduced the catcher-processor revenue

from NPT fisheries for Pacific cod in the EBS by $8.5 million. This is $7.0 million more than the Pacific cod revenue at risk and more than the total of the catcher-processor combined species revenue at risk from EBS EFH fishing impact minimization measures, based on 2001 fisheries.

Some portion or all of the revenue at risk in the EBS might be mitigated by fishing with NPT gear in adjacent areas not affected by EFH fishing impact minimization measures. However, there could be additional revenue placed at risk in the EBS, under Alternative 5B, by the requirement to use bobbins and disks on trawl sweeps for all NPT gear used in open areas. The amount of increased revenue that could be placed at risk is unknown.

GOA Region

Alternative 5B, had it been in place in 2001, would have imposed EFH fishing impact minimization measures in the GOA, EBS, and AI. Within the GOA, the largest amount of revenue at risk would have been in the CG, with $2.55 million at risk, or 12.3 percent of the $20.69 million 2001 status quo revenue in the CG. The revenue at risk in the WG would have been $810,000, or 13.0 percent of the total 2001 status quo revenue of $6.25 million. There would be $240,000 of revenue at risk in the EG, or 31.8 percent of the $760,000 status quo revenue that year.

In the GOA, EFH fishing impact minimization measures under Alternative 5B would have affected a number of NPT fisheries, but primarily fisheries targeting rockfish and Pacific cod. The total revenue at risk under these rules in the NPT rockfish fishery would have equaled $2.82 million, or 30.1 percent of the status quo revenue of $9.36 million, in 2001. The total revenue at risk in the GOA NPT Pacific cod fishery (mainly from the catcher-vessel fleet component) would have been $380,000, or 4.9 percent of the status quo revenue of $7.66 million.

In the GOA, had this rule prevailed in 2001, the catcher-processor fleet would have had the greatest amount of revenue at risk, $2.70 million, or 17.6 percent of the status quo total revenue. The catcher-vessel fleet would have had $900,000 of ex-vessel revenue at risk, or 7.3 percent of the total ex-vessel revenue of $12.31 million. Under Alternative 5A, the catcher-vessel fleet would have had revenue at risk in the EG of $60,000, or 20.8 percent of the status quo; in the CG, $470,000, or 4.9 percent of the status quo; and in the WG, $360,000, or 16.0 percent of the status quo. The GOA catcher-processor fleet would have had revenue at risk mainly in the CG, $2.07 million, or 18.9 percent of status quo, but also in the WG, $450,000, or 11.3 percent of the $4 million status quo gross revenue, and in the EG, $180,000, or 39.3 percent of the $450,000 status quo.

The ten designated EFH fishing impact minimization measure areas described under Alternative 5B in the GOA are discreet and are widely spaced along the outer shelf and slope edge. Within the entire GOA, there is substantial NPT fishing area adjacent to the ten areas designated for EFH fishing impact minimization measures where the revenue at risk might be mitigated by a redeployment of fishing effort. Had Alternative 5B been in effect in 2001, however, it would have placed 31.8 percent of the status quo revenue at risk in the EG. That large a revenue at risk would have been difficult to fully make up. Amendment 58 to the GOA FMP, which took effect in 1998, prohibits trawling in the EG east of long. 140° W. This leaves a very limited area within the EG where the revenue at risk for the NPT fisheries could be mitigated. It is likely that some portion of the EG revenue at risk that would not be recovered under Alternative 5B.

Although some slope rockfish are caught with NPT gear at depths shallower than 200 m in the GOA, a majority of the NPT commercial catch of the slope rockfish complex occurs at depths in excess of 150 m (NMFS 2002d). There is limited fishing area for slope rockfish in the 150 to 200 m slope edge

adjacent to the 200 to 1,000 m area designated for EFH fishing impact minimization measures where the revenue at risk might be mitigated by a redeployment of NPT fishing effort under Alternative 5B. Approximately 20 percent of the catch of the primary slope rockfish species, Pacific Ocean perch, is taken by PTR, fished by larger catcher-vessel and the catcher-processor fleet components. Between 30 and 50 percent of the shortraker/rougheye rockfish in the slope rockfish complex is taken incidentally by hook and line gear in the sablefish and halibut fisheries.

Under Alternative 5B, most, if not all, of the revenue at risk in the GOA might be recovered by redeployment of fishing effort to adjacent areas or switching to PTR gear by most of the fleet components involved in the fishery. The smaller catcher-vessel fleet targeting slope rockfish almost exclusively uses NPT gear and has neither sufficient horsepower to fish PTR, nor the revenue from participation in this fishery to warrant the investment necessary to utilize PTR gear. The larger catcher vessels (vessels that also target pollock) and the catcher-processors either already have PTR gear available or have sufficient horsepower to convert to PTR to target slope rockfish. Under Alternative 5B, while the revenue at risk might be recovered by vessels fishing adjacent areas in the GOA or by switching to PTR gear within the EFH fishing impact minimization measure area, there could be a transference of catch share and, thus, a transfer of revenue in the fishery from the smaller catcher-vessel fleet component to the larger catcher-vessel and catcher-processor fleet components. The magnitude of this transfer is impossible to estimate without specific knowledge of the redeployment fishing effort strategies that would actually be followed by the different fleet components.

Revenue impacts from changes in product quality may be possible under Alternative 5B, particularly for the smaller catcher-vessel fleet component operating with NPT gear in the GOA. These vessels may be required to expend additional fishing effort in their attempt to recover a portion of the revenue at risk, which may lengthen fishing trips and result in diminished product quality. Product quality may not be affected in the catcher-processor fleet component, unless, for example, the average size or condition of the fish changes significantly, since these vessels process the catch onboard the vessel.

AI Region
Option 1

Under Alternative 5B, Option 1, $6.71 million of revenue would have been placed at risk, or 12.0 percent of the $55.81 million of 2001 status quo revenue in the AI fisheries affected by this rule. In the AI, were Alternative 5B, Option 1 in place in 2001, there would have been reductions in TACs for NPT target species that would reduce gross revenue in the catcher-vessel and catcher-processor fleet components. Based on recent harvests from within the EFH fishing impact minimization measure areas in the AI, the 2003 Atka mackerel trawl TAC of 45,649 mt would have been reduced, under this rule, by 6 percent or 2,739 mt, resulting in a complete loss of $2.73 million in first wholesale gross revenue. The 2003 trawl-caught rockfish TAC in the AI of 18,254 mt would be reduced by 12 percent, or 2,190 mt, resulting in a complete loss of $1.10 million in first wholesale gross revenue. Since the Pacific cod TAC is allocated for both the AI and EBS combined, it is assumed that the combined area TAC for trawl- caught Pacific cod would be reduced by 10 percent, or 9,021 mt from the 90,210 mt 2003 TAC. Using the recent historical Pacific cod catch rates of 25 percent in the AI and 75 percent in the EBS, this would have resulted in a total loss of $8.50 million in first wholesale revenue in the EBS and $2.83 million in the AI for a total of $11.34 million in the 2001 fishery. The reduction in revenue from the EBS and AI from TAC reductions under Alternative 5B, Option 1, would have totaled $15.16 million, with an $8.5 million reduction in revenue in the EBS and a $6.66 million reduction in the AI or nearly all of the revenue at risk in the AI in 2001, under the Alternative 5B, Option 1, EFH fishing impact minimization measures.

In the AI, Alternative 5B, Option 1, would have placed revenue at risk in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The largest revenue at risk in the AI would be in the NPT Atka mackerel fishery, where, had Alternative 5B, Option 1, been in place in 2001, $3.61 million, or 8.8 percent of the status quo revenue of $41.01 million would have been placed at risk. The TAC reduction requirement under Alternative 5B, Option 1, would have reduced the trawl-caught Atka mackerel revenue in the AI by $2.73 million, or 75.6 percent of the revenue at risk in this 2001 fishery, leaving $880,000 of revenue at risk that could potentially have been recovered, in whole or in part, with redeployment of fishing effort. In addition to the impacts on the Atka mackerel fishery, Alternative 5B, Option 1, would have placed $1.64 million of Pacific cod at risk, or 17.1 percent of the status quo revenue of $9.61 million. However, the TAC reduction in AI trawl-caught Pacific cod would have reduced the revenue in this fishery by $2.83 million, or more than the revenue at risk from 2001 harvest data. Under Alternative 5B, Option 1, $1.45 million of revenue would have been placed at risk in the NPT rockfish fishery, or 28.5 percent of the status quo revenue value of $5.08 million. Of this amount, $1.10 million would not have been recovered, due to the TAC reduction. Some or all of the remaining $350,000 revenue at risk in the rockfish NPT fishery could potentially have been recovered by redeploying fishing effort to adjacent open areas or switching to PTR gear.

In the AI, the catcher-processor NPT fleet would have accounted for $6.40 million, or more than 95 percent of the 2001 total revenue at risk of $6.71 million under Alternative 5B, Option 1. The catcher-processor revenue at risk of $6.40 million is 11.7 percent of the total status quo revenue of $54.49 million. The catcher-vessel fleet would have had $310,000 of revenue at risk, or 23.6 percent of the total status quo revenue of $1.32 million. All of the catcher-vessel fleet impact on revenue at risk in the AI is in the NPT fishery for Pacific cod, whereas the catcher-processor fleet impacts on revenue at risk are mainly in the Atka mackerel, rockfish, and Pacific cod fisheries. The TAC reductions, required by Alternative 5B, Option 1, would have reduced the revenue in the catcher-processor fleet for Atka mackerel and rockfish and for the catcher-processor and catcher-vessel fleet for Pacific cod by$6.66 million, or nearly all of the revenue at risk in the AI under the Alternative 5B, Option 1 EFH fishing impact minimization measures.

In the AI under Alternative 5B, Option 1, NPT gear would have been prohibited for all species in designated areas, and additional closures would occur in areas of high coral and sponge bycatch. TACs in NPT fisheries would have been reduced by the 1998 to 2002 average historical amounts of target species caught in the designated closure areas and in coral and sponge closure areas. Under Alternative 5B, Option 1, revenue would have been placed at risk in both the catcher-vessel and catcher-processor fleet components for NPT fisheries.

Option 2

Under Alternative 5B, Option 2, $2.99 million of revenue in the 2001 AI fisheries would have been placed at risk, or 5.4 percent of the $55.81 million of status quo revenue in the fisheries affected under this rule. In the AI, were Alternative 5B, Option 2, in place in 2001, there would have been reductions in TACs for NPT target species for Atka mackerel and rockfish that would reduce gross revenue in the catcher-vessel and catcher-processor fleet components. Based on recent harvests from within the EFH fishing impact minimization measure areas in the AI, the 2003 Atka mackerel trawl TAC of 45,649 mt would have been reduced, under this rule, by 6 percent, or 2,739 mt, resulting in a complete loss of $2.73 million in first wholesale gross revenue. The 2003 trawl-caught rockfish TAC in the AI of 18,254 mt would be reduced by 12 percent, or 2,190 mt, resulting in a complete loss of $1.10 million in first wholesale gross revenue. The combined Atka mackerel and rockfish TAC reductions, had Alternative 5B, Option 2, been in place, would have totaled $3.83 million in the 2003 fishing season, or more than the total revenue at risk under the Alternative 5B, Option 2, EFH fishing impact minimization measures.

In the AI, Alternative 5B, Option 2, would have placed revenue at risk in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The largest revenue at risk in the AI would be in the NPT Atka mackerel fishery, where, had Alternative 5B, Option 2, been in place in 2001, $1.59 million, or 3.9 percent of the status quo revenue of $41.01 million would have been placed at risk. The TAC reduction requirement under Alternative 5B, Option 2, would reduce the trawl-caught Atka mackerel revenue in the AI by $2.73 million, or more than the revenue at risk in this 2001 fishery, leaving no opportunity for recovery, in whole or in part, by redeployment of fishing effort. In addition to the impacts on the Atka mackerel fishery, Alternative 5B, Option 2, would have placed $0.58 million of Pacific cod at risk, or 5.0 percent of the status quo revenue of $9.61 million. Under Alternative 5B, Option 2, $1.19 million of revenue would have been placed at risk in the NPT rockfish fishery, or 23.5 percent of the status quo revenue value of $5.08 million. Of this amount, $1.10 million would not have been recovered, due to the TAC reduction. Some or all of the remaining $90,000 revenue at risk in the rockfish NPT fishery could potentially have been recovered by redeploying fishing effort to adjacent open areas or switching to PTR gear.

In the AI, the catcher-processor NPT fleet would have accounted for $2.94 million, or more than 98 percent of the 2001 total revenue at risk of $2.99 million under Alternative 5B, Option 2. The catcher-processor revenue at risk of $2.94 million is 5.4 percent of the total status quo revenue of $54.49 million. The catcher-vessel fleet would have had $50,000 of revenue at risk, or 3.9 percent of the total status quo revenue of $1.32 million. All of the catcher-vessel fleet impact on revenue at risk in the AI is in the NPT fishery for Pacific cod, whereas the catcher-processor fleet impacts on revenue at risk are mainly in the Atka mackerel, rockfish, and Pacific cod fisheries. The TAC reductions required by Alternative 5B, Option 2, would reduce the revenue in the catcher-processor fleet for Atka mackerel and rockfish by a total of $3.83 million, or more than the revenue at risk in the AI under the Alternative 5B, Option 2, EFH fishing impact minimization measures.

In the AI under Alternative 5B, Option 2, NPT gear would be prohibited for all species in designated areas and additional closures would occur in areas of high coral and sponge bycatch. TACs in NPT fisheries for Atka mackerel and rockfish would be reduced by the 1998 to 2002 average historical amounts of target species caught in the designated closure areas and in coral and sponge closure areas. Under Alternative 5B, Option 2, revenue would be placed at risk in both the catcher-vessel and catcher-processor fleet components for NPT fisheries.

Option 3

Under Alternative 5B, Option 3, $1.23 million of revenue in the 2001 AI fisheries would have been placed at risk, or 2.2 percent of the $55.81 million of status quo revenue in the fisheries affected under this rule. There are no TAC reductions associated with Alternative 5B, Option 3.

In the AI, Alternative 5B, Option 3, would have placed revenue at risk in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The largest revenue at risk in the AI would be in the NPT Atka mackerel fishery, where, had Alternative 5B, Option 3, been in place in 2001, $0.62 million, or 1.5 percent of the status quo revenue of $41.01 million, would have been placed at risk. In addition to the impacts on the Atka mackerel fishery, Alternative 5B, Option 3, would have placed $0.35 million of Pacific cod at risk, or 3.6 percent of the status quo revenue of $9.61 million. Under Alternative 5B, Option 3, $0.26 million of revenue would have been placed at risk in the NPT rockfish fishery, or 5.1 percent of the status quo revenue value of $5.08 million.

In the AI, the catcher-processor NPT fleet would have accounted for $1.20 million, or more than 97 percent of the 2001 total revenue at risk of $1.23 million under Alternative 5B, Option 3. The

catcher-processor revenue at risk of $1.20 million is 2.2 percent of the total status quo revenue of $54.49 million. The catcher-vessel fleet would have had $30,000 of revenue at risk, or 2.2 percent of the total status quo revenue of $1.32 million. All of the catcher-vessel fleet impact on revenue at risk in the AI would be in the NPT fishery for Pacific cod, whereas the catcher-processor fleet impacts on revenue at risk would be mainly in the Atka mackerel, rockfish, and Pacific cod fisheries.

In the AI under Alternative 5B, Option 3, NPT gear would be prohibited for all species in designated areas, but no additional closures would occur due to coral and sponge bycatch. Under Alternative 5B, Option 3, there would be no TAC reductions.

Operating Costs (E-)

Operating cost impacts under Alternative 5B may be greater overall for both the GOA catcher vessel component and catcher-processor fleet components in all areas. CPUE of slope rockfish caught with PTR gear and with NPT gear at depths shallower than 200 m along the GOA slope edge could be lower than the CPUE of NPT gear in the depth range of 200 m and greater where these species are normally fished. This would likely result in increased fishing effort and associated operational costs to mitigate the catch and revenue at risk.

Larger catcher vessels and catcher-processors in the GOA have the option of changing to PTR gear for targeting slope rockfish. However, the smaller catcher vessels, particularly the 18.3 m (60 feet) and smaller vessels, do not have sufficient horsepower to switch to PTR fisheries and the equipment costs would likely be prohibitive, given the annual revenue of these vessels. Had Alternative 5B been implemented in 2001, operational costs for the catcher-processor fleet component might increased due to the redeployment of fishing effort made necessary to mitigate a portion or all of the 17.6 percent of the status quo revenue at risk for this fleet component.

Catcher-processors operating in the EBS NPT flathead sole fishery would likely have increased operational costs under Alternative 5B due to increased running time to reach northern fishing areas when the more southerly areas are closed, and possibly due to increased fishing effort to mitigate the revenue at risk in these fisheries. It is impossible to estimate the increase in operational costs without fully understanding the fishing effort redeployment strategy that the operators would follow in their attempt to mitigate these Alternative 5B attributable losses. Assuming Alternative 5B had been the rule in 2001, this would have meant that 11.8 to 29.3 percent of status quo revenue would have been placed at risk in the NPT fishery for flathead sole that year. Alternative 5B would require the use of bobbins and disks on NPT footropes and trawl sweeps used in open areas. The use of bobbins and disks may reduce the CPUE of some bottom-dwelling species such as flatfish, resulting in increased fishing time and associated operational costs to attain the status quo catch and revenue in these fisheries. This operational impact would occur primarily in the catcher-processor fleet component in the EBS.

In the AI, all options of Alternative 5B would likely result in increased operational costs for both the catcher-vessel and catcher-processor fleets. Alternative 5B would require any vessel using NPT gear to have a VMS system. Although probably all of the vessels fishing the area currently have such a system, due to SSL regulations, Alternative 5B may require additional VMS operation time on these vessels. Alternative 5B would also require 100 percent observer coverage for vessels targeting groundfish, which would increase observer costs on the 30 percent coverage catcher vessels very substantially . Alternative 5B, Options 1 and 2, would each produce a complicated patchwork of open and closed areas, depending upon coral/sponge bycatch rates that may change from year to year. This may require fishermen to alter their normal fishing areas and possibly explore for new fishing grounds on an annual

basis. All of these fishing strategies would likely result in increased operational costs in the AI catcher-vessel and catcher-processor NPT groundfish fleets.

Costs to U.S. Consumers (E-)
There may likely be an increase in costs to consumers from Alternative 5B, Options 1 and 2, because the total revenue at risk would not be recovered in the AI due to the reduction in TACs. Under all three options of Alternative 5B, there may be some increases in operational costs for certain fleet components that may be passed on to consumers from harvesters and processors (depending on market conditions such as available close substitutes in supply, demand elasticities, vertical integration, etc). There may also be attributable costs imposed on consumers from changes in availability of supply, product mix, and/or quality.

Safety (E-)
Alternative 5B may not significantly affect the safety of any of the fleet components in the GOA because fishing effort would likely be redeployed to immediately adjacent fishing areas.

In the EBS, catcher-processors targeting flathead sole, other flatfish, and Pacific cod would be restricted from fishing some areas closer to their home ports during some time periods, depending upon the EFH fishing impact minimization measure area affected by the rotational closures to NPT gear. When more southerly areas are closed, vessels fishing NPT gear would be required to travel farther north and farther from safe harbors and ports of call. This may reasonably be assumed to increase the risks to vessel and crew.

All three options of Alternative 5B would likely affect the safety of the catcher-vessel and catcher-processor fleet components in the AI because fishing effort would likely be redeployed to new fishing areas, possibly farther from the vessels' home ports.

Impacts on Related Fisheries (E-)
There would likely be an impact on related fisheries in the GOA from Alternative 5B because a substantial amount of NPT fishing effort for slope rockfish would likely be redeployed into adjacent areas shallower than 200 m that would not be affected by EFH fishing impact minimization measures. Other fisheries occur in these areas, including halibut longline, Pacific cod longline (if open), and NPT fisheries such as shallow water flatfish. Increased NPT fishing effort at depths of less than 200 m along the GOA shelf edge may have negative (and potentially substantial) indirect economic impacts on these fisheries.

There may be impacts on related fisheries from Alternative 5B in the EBS and AI as vessels using NPT gear would be displaced into adjacent areas where other gear groups such as hook and line and pot vessels may be operating.

Impacts on Management and Enforcement Costs (E-)
Management and enforcement costs may increase under Alternative 5B, although it is not possible to estimate by what amount. Additional on-water enforcement may be required to assure compliance with the EFH fishing impact minimization measures applied in the GOA, EBS, and AI. Section 3.1.2.7 of Appendix C contains some additional discussion of the NMFS Enforcement and Coast Guard responses to resource demands connected with monitoring and enforcement provisions of Alternative 5B. VMS equipment or 100 percent observer coverage may be required of all vessels using NPT gear in the GOA and EBS, and both VMS and 100 percent observer coverage would be required in the AI to assure

compliance with the EFH fishing impact minimization measures under all three options of Alternative 5B.

4.3.7.3.3 Effects on Communities and Shoreside Industries (Ø/E-)

Overview

Like Alternative 5A, impacts to dependent communities and shoreside industries may have been significant at the community level, at least for a few communities (King Cove and Sand Point) under each of the Alternative 5B options. Adverse impacts to individual operations may have occurred in other communities (especially Kodiak), but these impacts are unlikely to have been significant at the community level, due to the magnitude of the impacts relative to the overall operations of the affected fleet and processing entities (as well as the overall community fishing sectors).

The only fisheries that would have been directly affected by any of the Alternative 5B options would have been groundfish fisheries. Similar to Alternative 4 (but unlike Alternatives 2 and 3), groundfish fisheries in addition to rockfish would have been affected by this alternative. Like Alternative 4, this alternative would have had impacts on GOA, EBS, and AI fisheries. Like Alternatives 2, 3, and 4, the only gear group directly affected for both catcher vessels and catcher-processors would have been non-pelagic trawl. Using 2001 fleet data, 93 vessels (catcher vessels plus catcher-processors) would have been affected by this alternative: 28 in Alaska, 12 from Oregon, 47 from Washington, and 6 from other states. Washington and Oregon communities, though significantly engaged in the fishery, are not considered dependent communities, based on the overall economic structure of those communities and the relatively small role that the Alaska groundfish fishery plays in the local economy. Using 2001 processor data, 19 shoreside processors in Alaska would, potentially, have been affected by this alternative.

Catcher Vessels

Based on 2001 data, within Alaska, ownership of catcher vessels harvesting relevant groundfish species with at-risk revenue under any of the Alternative 5B options would have been concentrated in the Aleutians East Borough with 19 vessels (King Cove has 8 and Sand Point 11) and Kodiak with 7 vessels. All but two of the Aleutians East Borough vessels are classified as small (less than 60 feet) vessels, while none of the Kodiak vessels is so classified. Anchorage and Girdwood account for the remaining two Alaska-owned vessels; one of these is a small vessel and one is a large vessel. Ownership in the Pacific Northwest accounts for 44 vessels with at-risk revenues under this alternative (32 from Washington, all but 2 of them large vessels, and 12 vessels, all large, from Oregon). Four vessels (three large and one small) are owned in other states.

Catcher-vessel-associated community impacts in the GOA under any of the Alternative 5B options would have been the same as those seen under Alternative 5A. As noted under that alternative, significant impacts associated with local catcher fleets could have accrued to the communities of King Cove and Sand Point. Catcher-vessel-associated community impacts in the EBS under any of the Alternative 5B options would have been the same as those seen under Alternative 5A (not significant).

For catcher vessels operating in the AI, the only affected fishery would have been Pacific cod under any of the options, but the amount of revenue at risk would have varied by option. Under Alternative 5B, Option 1, the revenue at risk under this alternative ($310,000) was 23.6 percent of the 2001 status quo total ($1.32 million) of affected vessels for the area. As noted elsewhere, figures given for catcher vessels represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities if examined separately.

Values for first wholesale revenues at risk by shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. Based on known characteristics of the different fleet segments, the ownership of these vessels with at-risk AI revenues would have been primarily concentrated in Pacific Northwest communities, and any impacts seen in Alaska would have been concentrated in Kodiak. No significant community level impacts associated with this catcher fleet would have been likely, due to the amount of revenue at risk and the relative size and diversity the economies of these communities (although some vessels would likely experience increased costs and/or decreased harvests).

Under 5B, Option 2, the revenue at risk under this alternative ($50,000) would have been 3.9 percent of the status quo total ($1.32 million) of affected vessels for the AI area. The vessels with revenues at risk under 5B, Option 2, would have been the same vessels as those with revenue at risk under 5B, Option 1; therefore, effects on communities would have been similar to those seen under 5B, Option 1 (but of a lower intensity, due to less revenue at risk). Impacts would have been concentrated primarily in Pacific Northwest communities and Kodiak, and no significant community level impacts associated with this catcher fleet would have been likely, due to the size and diversity the economies of these communities and the relatively minor level of revenue at risk (although some vessels would likely have experienced increased costs and/or decreased harvests).

Under 5B, Option 3, the revenue at risk under this alternative ($30,000) would have been 2.3 percent of the status quo total ($1.32 million) of affected vessels for the AI area. The vessels with revenues at risk under 5B, Option 3, would have been the same vessels as those with revenue at risk under 5B, Option 1; therefore, effects on communities would have been similar to those seen under Option 1 (but of a lower intensity due to less revenue at risk). Impacts would have been primarily concentrated in Pacific Northwest communities and Kodiak, and no significant community level impacts associated with this catcher fleet would have been likely, due to the size and diversity of the economies of these communities and the relatively minor level of revenue at risk (although some vessels would likely have experienced increased costs and/or decreased harvests).

Catcher-Processors

In 2001, Alaska ownership of catcher-processors with revenue at risk was exclusive to Kodiak (three vessels). Ownership in the Pacific Northwest was exclusive to Washington (15 vessels). Because of the small number of entities, information on harvest value cannot be disclosed for Alaska catcher-processors at risk under this alternative. For catcher-processors, impacts under any of the Alternative 5B options would have been the same for the GOA as those seen under Alternative 5A. Catcher-processor-related impacts under any of the Alternative 5B options in the EBS would also have been the same as those seen under Alternative 5A.

For the AI, affected catcher-processors under Alternative 5B, Option 1, would have experienced revenue at risk of $6.40 million, or approximately 11.7 percent of the status quo revenue total ($54.49 million). This is approximately 3.8 times the analogous revenue at risk under Alternative 5A. Catcher-processors would have experienced revenue at risk associated with a number of different groundfish species. While fisheries for some of these species would have had a relatively high percentage of revenue at risk, the overall value at risk is comparatively low for a number of fisheries for these species. Only fisheries for three species would have had revenue of greater than $10,000 at risk. These are Atka mackerel ($3.61 million at risk, which is 8.8 percent of the status quo value), Pacific cod ($1.33 million, 16.1 percent of the status quo value), and rockfish ($1.45 million, 28.5 percent of the status quo value). The catcher-processors harvesting and processing these species were primarily head and gut vessels.

Due to confidentiality restrictions based on a small number of participating entities, value information for Alaska-based catcher-processors with revenue at risk cannot be disclosed for this alternative. It is known, however, that impacts experienced in Alaska would have been concentrated in Kodiak. Given the small number of entities involved, and the relative size of the local fishery-based economy, it is assumed that community level impacts associated with catcher-processors would not have been significant, although some individual entities may have experienced adverse impacts due to increased costs and/or decreased harvests. While individual Washington-owned entities may have experienced adverse impacts under Alternative 5B, Option 1, it is assumed that community level impacts would not have been significant due to the scale of the local economy in those communities.

Under Alternative 5B, Option 2, affected catcher-processors in the AI would have experienced revenue at risk of $2.94 million, or approximately 5.4 percent of the status quo revenue total ($54.49 million). Revenues at risk would have been associated with the same groundfish species as under Option 1, but the amount of revenue at risk would have been different for Atka mackerel, Greenland turbot, Pacific cod, and rockfish. Greenland turbot revenues at risk, however, as under 5B, Option 1, would be less than $10,000. For the other three species, revenue at risk would have been less than seen under 5B, Option 1: Atka mackerel ($1.59 million at risk, which is 3.9 percent of the status quo value), Pacific cod ($430,000 at risk, 5.2 percent of the status quo value), and rockfish ($1.19 million at risk, 23.5 percent of the status quo value). The vessels with revenues at risk under 5B, Option 2, would have been the same vessels as those with revenue at risk under 5B, Option 1; therefore, effects on communities would have been similar to those seen under 5B, Option 1 (but of a lower intensity due to less revenue at risk). Specific information on Alaska-based catcher processors cannot be disclosed, but impacts experienced in Alaska would have been concentrated in Kodiak. Given the small number of entities involved, the small amount of revenue at risk, and the relative size of the local fishery-based economy, it is assumed that community level impacts associated with catcher-processors would not have been significant, although some vessels may have experienced increased costs and/or decreased harvests. While individual Washington-owned entities may have experienced adverse impacts under Alternative 5B, Option 2, it is assumed that community level impacts would not have been significant due to the amount of revenue at risk and the scale of the local economy in those communities.

Under Alternative 5B, Option 3, affected catcher-processors in the AI would have experienced revenue at risk of $1.20 million, or approximately 2.2 percent of the status quo revenue total ($54.49 million). Revenues at risk would have been associated the same groundfish species as under 5B, Option 1, but the amount of revenue at risk would be different for Atka mackerel, Greenland turbot, Pacific cod, and rockfish. Greenland turbot revenues at risk, however, as under 5B, Option 1, would be less than $10,000. For the other three species, revenue at risk would have been less than that seen under 5B, Option 1: Atka mackerel ($620,000 at risk, which is 1.5 percent of the status quo value), Pacific cod ($320,000 at risk, 3.9 percent of the status quo value), and rockfish ($260,000 at risk, 5.1 percent of the status quo value). The vessels with revenues at risk under 5B, Option 2, would have been the same vessels as those with revenue at risk under 5B, Option 1; therefore, effects on communities would have been similar to those seen under 5B, Option 1 (but of a lower intensity due to less revenue at risk). Specific information on Alaska-based catcher processors cannot be disclosed, but impacts experienced in Alaska would have been concentrated in Kodiak. Given the small number of entities involved, the small amount of revenue at risk, and the relative size of the local fishery-based economy, it is assumed that community level impacts associated with catcher-processors would not have been significant, although some vessels may have experienced increased costs and/or decreased harvests. While individual Washington-owned entities may have experienced adverse impacts under Alternative 5B, Option 3, it is assumed that community level impacts would not have been significant, due to the amount of revenue at risk and the scale of the local economy in those communities.

Shoreside Processors

Shoreside plants involved in the processing of at-risk harvest (using 2001 data) under any of the Alternative 5B options were concentrated in Kodiak (with nine entities). Akutan had two entities, and a number of other communities each had a single processor that processed at least some groundfish from vessels with at-risk revenues under this alternative (King Cove, Sand Point, Unalaska/Dutch Harbor, Ketchikan, Moser Bay [Kodiak Island Borough], Chignik, Sitka, and Cordova).

Under Alternative 5B, Option 1, the total first wholesale value at risk of catch delivered inshore for processing would have represented approximately 8 percent of the total 2001 status quo value (about $3.28 million out of $42.45 million) of the relevant fisheries of the GOA area, about 24 percent of the AI status quo value (about $726,000 out of $3.08 million), well below 1 percent for the EBS area, and about 7 percent for all areas combined (about $4.01 million out of $58.84 million), but no breakdown by port of landing is available. Caution must be exercised in the interpretation of these wholesale value data as (1) they are not additive with ex-vessel values presented above and (2) they cannot be used as a proxy for potential levels of impacts to specific communities without considering the basic caveats laid out in the introductory paragraphs of the shoreside processor section of the Alternative 2 effects on communities discussion presented above. Similar to Alternative 5A, processor-associated impacts to dependent communities may have been significant in some of the smaller communities in the WG area (for the reasons discussed under Alternative 5A), but data that would be needed to quantify these impacts are confidential. Based on 2001 processor location data, it is assumed that most of the additional AI Pacific cod catch at-risk under this alternative (compared to Alternative 5A) would have been processed in Unalaska/Dutch Harbor. The $310,000 at risk is approximately 2 percent of the total Pacific cod value ($15 million) processed in the community in 2000 (the most recent year for which complete community-level data for Unalaska/Dutch Harbor are available), or about 0.2 percent of the total processing value ($144 million) for the community in 2000. Given that at least some of this catch would likely have been made up by redeployment of catcher vessel effort in other areas, along with the low overall proportion of the at-risk totals compared to overall local processing, no significant community impacts associated with processing would have been likely for Unalaska/Dutch Harbor, although some individual entities may have experienced a loss of processing volume and/or revenues. No significant community impacts would have been likely for any other dependent communities.

Under Alternative 5B, Option 2, revenue at risk for the relevant fisheries of the GOA area and the EBS area would have been the same as under 5B, Option 1. For the AI fisheries, revenue at risk for all fished species would remain the same for relevant fisheries with one exception: Pacific cod deliveries to shoreline processors would have less revenue at risk under 5B, Option 2, than under 5B, Option 1. It is assumed that most of AI Pacific cod catch at-risk under this option would have been processed in Unalaska/Dutch Harbor. The $50,000 at risk is approximately 0.3 percent of the total Pacific cod value ($15 million) processed in the community in 2000 (the most recent year for which complete community-level data for Unalaska/Dutch Harbor are available), or about 0.03 percent of the total processing value ($144 million) for the community in 2000. Given the low overall proportion of the at-risk totals, compared to overall local processing, no significant community impacts associated with processing would have been likely for Unalaska/Dutch Harbor, although some individual entities may have experienced a loss of processing volume and/or revenues. No significant community impacts would have been likely for any other dependent communities.

Under Alternative 5B, Option 3, revenue at risk for the relevant fisheries of the GOA area and the EBS area would have been the same as under 5B, Option 1. For the AI fisheries, revenue at risk for all fished species would remain the same for relevant fisheries with one exception: Pacific cod deliveries to shoreline processors would have less revenue at risk under 5B, Option 2, than under 5B, Option 1. It is

assumed that most of AI Pacific cod catch at-risk under this option would have been processed in Unalaska/Dutch Harbor. The $30,000 at risk is approximately 0.2 percent of the total Pacific cod value ($15 million) processed in the community in 2000 (the most recent year for which complete community-level data for Unalaska/Dutch Harbor are available), or about 0.02 percent of the total processing value ($144 million) for the community in 2000. Given the low overall proportion of the at-risk totals compared to overall local processing, no significant community impacts associated with processing would have been likely for Unalaska/Dutch Harbor, although some individual entities may have experienced a loss of processing volume and/or revenues. No significant community impacts would have been likely for any other dependent communities.

Multi-Sector Impacts

Multiple sector impacts may have been significant at the community level under Alternative 5B, Option 1. Among Alaska communities, Kodiak, King Cove, and Sand Point participated in more than one sector with at-risk revenues in 2001. Kodiak was home to seven locally owned catcher vessels, three locally owned catcher-processors, and nine locally operating shoreside processing entities with at least some revenue that would have been at risk, depending on closure configurations. Neither King Cove nor Sand Point was home to locally owned catcher-processors, but both had multiple locally owned catcher vessels (8 and 11 vessels, respectively) and had at least one dominant local processor with at least some revenue that would have been at risk under this alternative. Alaska fleet related community impacts would have been similar to those seen under Alternative 5A, with revenue at risk for King Cove and Sand Point catcher vessels comprising a higher percentage of total overall ex-vessel revenues than was the case in Kodiak. These vessels represent a much larger proportion of the total community fleet in King Cove and Sand Point than do the affected vessels in Kodiak. Given the smaller vessels in King Cove and Sand Point (with less flexibility of response), the higher proportion of revenue at risk, the higher proportion of the fleet with revenue at risk, and the known challenges that these fleets (and communities) are facing with other fisheries, the WG communities of King Cove and Sand Point may have experienced social impacts from this alternative that would have been significant at the community level. Individual Kodiak entities may have experienced adverse impacts under this alternative, but impacts at the community level are unlikely to have risen to the level of significance given the small proportion of revenue at risk for the affected catcher vessels, the low volumes at risk, and the assumption that overall delivery patterns would have been unlikely to change for Kodiak-based shoreside processors under this alternative. Kodiak may have experienced additional catcher-processor related impacts over and above those seen in Alternative 5A, but the information that would permit such an analysis is confidential. Some additional Alaska resident crew positions on vessels owned elsewhere, but that spend at least part of the year in Alaska ports, may have had some compensation at risk. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which, in this case, would have been concentrated in Kodiak. Given the assumption that overall delivery patterns for the community are unlikely to change, however, any vessel expenditure associated impacts would likely have been minor.

Multiple sector community impacts under Alternative 5B, Option 2, would have been the same as those identified under Alternative 5B, Option 1, because the same fleets and processors would have been affected, and most multiple sector impacts to communities would have been driven largely by GOA impacts that would not differ between the options under this alternative. As under Alternative 5B, Option 1, these impacts may have been significant at the community level in King Cove and/or Sand Point, for the reasons identified in the Alternative 5B, Option 1, discussion. Additional impacts would have been concentrated in Kodiak, but it is not likely that they would have been significant at the community level for the reasons outlined in the Alternative 5B, Option 1, discussion.

Multiple sector community impacts under Alternative 5B, Option 3, would also have been the same as those identified under Alternative 5B, Option 1, because the same fleets and processors would have been affected, and most multiple sector impacts to communities would have been driven largely by GOA impacts that would not differ between the options under this alternative. As under Alternative 5B, Option 1, these impacts may have been significant at the community level in King Cove and/or Sand Point, for the reasons identified in the Alternative 5B, Option 1, discussion. Additional impacts would have been concentrated in Kodiak, but it is not likely that they would have been significant at the community level for the reasons outlined in the Alternative 5B, Option 1, discussion.

4.3.7.3.4 Effects on Regulatory and Enforcement Programs

The management implications of Alternative 5B would be the same as for Alternative 5A for the GOA and EBS in regards to additional reporting requirements, increased needs for monitoring vessel activity in terms of the type of gear being fished, and the potential effect on incidental species catch management.

For the AI, Alternative 5B would involve a program for coral and sponge management that would include three approaches. First, under Options 1 and 2, area closures would be imposed, and the groundfish TAC would be reduced based on catch rates of trawl-caught groundfish versus catch rates of corals and sponges. Second, bottom trawling would be prohibited outside of current areas. Third, a coral and sponge bycatch management program would be implemented to address incidental catch in the bottom trawl fishery.

Portions of the AI subarea are identified under all three options of this alternative on the basis of coral and sponge catch relative to groundfish catch. Where rates of groundfish catch are low relative to high coral and sponge catch rates, bottom trawl fisheries would be closed. In effect, under this alternative, broad areas of the AI would be closed, while trawling would be allowed to continue in particular areas where groundfish catch rates have been strong.

The area where trawling would be allowed to occur is central to several management and enforcement issues in the groundfish fishery.

If the size of the area where bottom trawling could occur were relatively small, monitoring catch locations would be a problem. Some extant areas where regulatory restrictions occur in the EBS are small enough that vessels can trawl across them so that both retrieval and deployment locations are outside of the area. The areas would have to be large enough so that law enforcement agencies could monitor them.

The areas that would remain open to bottom trawling are those where groundfish catch rates have been traditionally high. On occasion, there is a significant catch rate decline in the traditional fishing areas, but options for alternate areas where groundfish bottom trawling might be more successful are limited under this alternative. Limited choices for the bottom trawl fleet can also affect the fleet's ability to avoid prohibited species such as Pacific halibut, or groundfish species that may be approaching overfishing.

The area open to bottom trawling also would determine the proportion by which the groundfish TACs would be reduced under Alternative 5B, Options 1 and 2. Depending on the size of the proportional reduction and the level of the TAC, the remaining amount would either be taken in a more rapid fishery, or, if the TAC reduction were great enough, stop the directed fishery all together. Reduced fishing

times on smaller apportionments of the TAC would increase the likelihood that the apportionments would be exceeded.

Options 1 and 2 of Alternative 5B do not address which groundfish TACs would be reduced. If the reduction were to extend beyond the three major fisheries in the AI (Atka mackerel, Pacific cod, and Pacific ocean perch) to species that are limited in abundance relative to the target TACs, retention of the incidental catch could be affected.

Because different gear types take Pacific cod, an appropriate approach under Option 1 might be to assign the proportional catch to be deducted from the trawl fishery to alternate gear types, rather than simply reducing the absolute amount available for catch.

Options 1 and 2 of Alternative 5B involve active inseason management and advocate "area-specific coral/sponge bycatch limits that close specific areas if exceeded."

This option appears to be modeled on current prohibited species management regulations in place for Pacific halibut, two species of salmon, three species of crab and, to a lesser extent, Pacific herring. The proposal would establishe absolute amounts of coral and sponge as limits that would trigger a closure of a currently undefined area. The proposal does not specify the dimension of the limit amount, or whether this is to be determined by counts, by weight, or simply by the presence or absence of the coral and sponges; it also does not specify particular species or groups of coral, but leaves the classification of the animals to be managed as "corals and sponges."

Programs that manage the incidental catch of prohibited fish species work, in part, because the activity being monitored is fishing, and the gear is, in general, designed to catch fish. Fishing gear is not designed to catch corals and sponges. Because of the structure of corals, they do not behave in the same manner as a fish in a trawl. Implicit in the structure of the extant prohibited species catch monitoring programs is the assumption that the prohibited species are caught in enough volume and in a consistent manner, so that extrapolations of catch from observer data make sense. Multiple events of coral discovery in sampling a single haul may represent a single specimen broken into several pieces or multiple specimens. The retrieval of corals and sponges may be such that, over a short time such as a fishery or season, catch would be a patchy event and not indicative of overall impact on the habitat for which protection is sought. One problem is that corals may be broken or crushed by fishing gear without necessarily appearing in the net. If the intent of the action is to limit trawling activity in habitat-sensitive areas, the simple presence of corals in the bottom-trawl gear may be a better indicator of the impact on corals than trying to quantify the bycatch. The penalty for attaining the limit is not described under Options 1 or 2 of Alternative 5B. Depending on what those consequences were, they could have different ramifications, as effort dispersed into other areas or fisheries.

Currently the three major bottom trawl fisheries in the AI are Atka mackerel, Pacific cod, and Pacific ocean perch. Typically, fishing for Atka mackerel lasts about a month for each season, 2 months of the year; the three Pacific ocean perch fisheries in areas 541, 542, and 543 last about a week each, for a total of 3 weeks in July; and the Pacific cod fishery lasts for about 6 weeks, from mid-February until the end of March. These rather abbreviated fisheries do not lend themselves well to detecting the attainment of a coral/sponge limit and imposing a penalty during the fishery, so that if a penalty were decided upon that was to be imposed during a fishing year, the effects on the fishery, and perhaps the protected habitat, could be very limited.

All three of the options of Alternative 5B propose expanding observer coverage to 100 percent. Coverage at that level has high cost and adjustment implications for two classes of vessels, those less than 125 feet and greater than 59 feet, and vessels less than 60 feet. In the former case, these vessels currently carry observers only part of the time while fishing. The under 60-foot class carries none at all. Including a new class of vessels that have not carried observers in the past would probably generate a new set of logistical problems and protocols.

4.3.7.4 Effects of Alternative 5B on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – EFH mitigation for the GOA in Alternative 5B is a combination of the effects of Alternatives 2 and 3, so please refer to Section 4.3.4.4 for the potential impacts to state-managed groundfish fisheries. State-managed groundfish fisheries do not occur in the EBS or in the specific areas closed in the AI in any of the three management options for this alternative. Alternative 5B would have no additional effect on state-managed groundfish fisheries, besides what is discussed in Section 4.3.4.4.

State-managed Crab and Invertebrate Fisheries (Ø/E+) – EFH mitigation for the GOA in Alternative 5B is a combination of the effects of Alternatives 2 and 3, so please refer to Sections 4.3.4.4 and 4.3.5.4 for the potential impacts to state-managed crab and invertebrate fisheries. Discussion about the potential impacts in the EBS is presented in Section 4.3.6.4, and is applicable for this alternative as well. There are no apparent impacts to state-managed fisheries from the AI closures in this alternative.

Herring Fisheries (Ø) – Effects on herring fisheries for Alternative 5B are very similar to those previously discussed for Alternative 4.

Halibut Fisheries (Ø) – Alternative 5B would have no effect or very limited effects on halibut fisheries. If effort in the GOA rockfish trawl fishery, or GOA or BSAI groundfish trawl fisheries is displaced, it is possible that halibut bycatch rates and spatial distribution could change.

4.3.7.5 Effects of Alternative 5B on Protected Species

The discussion on protected species provided in this section relative to Alternative 5B is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (E-) – Under any of the three management options, Alternative 5B may result in increased fishery interactions with Steller sea lions because of the moderate level of increased fishing in sea lion habitat. While not likely to be adverse at the population level, any reduction in the western population segment of Steller sea lions would be considered adverse. Any take of an endangered Steller sea lion, either from behavioral impacts from prey removal or from direct injury or mortality in fishing gear, would be an adverse effect with potential impacts on the population. With new genetic stock identification data suggesting more genetic differentiation within this group, and possibly the definition of smaller and more distinct stocks in the AI area, injury or mortality to the western Steller sea lion would heighten the concern over potential adverse effects on what is possibly a small and declining population unit. The Alternative 5B management options also could increase the potential for take of ESA-listed whales. The concerns for ESA-listed whales may be less apparent than for sea lions, but up to a third more fishing activity, if it occurred in a localized area where whales migrate or feed, could result in a vessel strike or gear entanglement. This potential take of an animal in the northern right whale group recently observed to seasonally inhabit the EBS, would constitute a serious impact on this population unit. Thus, if concentrated fishing were to occur in areas frequented

by whales or in Steller sea lion foraging habitat, Alternative 5B could result in adverse effects for both whales and sea lions. The adverse effects for sea lions and whales are not likely to be substantial because the redistribution of fishing effort under Alternative 5B would be small under any of the three management options. Alternative 5B was designed to allow fishing to continue in areas with the highest historical catch rates and to preclude fishing in new areas.

Other Marine Mammals (Ø) – Alternative 5B would likely result in a moderate amount of displaced fishing effort in the GOA and BSAI bottom trawl fisheries, which presumably would then be prosecuted in adjacent areas that remain open to bottom trawling or in other trawl fisheries. In the GOA and EBS, impacts on other marine mammals would be the same as described for Alternative 5A. In the AI, given the relatively smaller areas that would remain open to bottom trawl fishing, the displaced bottom trawl fisheries would then be concentrated in relatively smaller areas. The result could be increased levels of fishery encounters with these marine mammals. These fishing activities would not likely affect sea otters or harbor seals because these fisheries occur in offshore locations distant from sea otter and harbor seal habitat. Fur seals would have some chance of encountering these fisheries in summer foraging habitat, but displaced fishing concentrations would not likely impact ice seals and walrus because they only inhabit the EBS. Northern elephant seals would not likely be adversely affected under Alternative 5B because they generally are not present in this area. Other cetaceans are not currently adversely affected by GOA or BSAI fisheries, either through injury or other take or because of fishery removal of prey, and the modest redistribution of groundfish fishing in the AI would not cause adverse effects to those species. Overall, Alternative 5B would likely have no adverse effect on other marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Impacts of Alternative 5B on ESA-listed salmon and steelhead in the GOA and EBS would be identical to impacts described previously for Alternative 5A. Alternative 5B would displace bottom trawl fisheries from closed areas and concentrate this fishing effort in the remaining open areas. Although the effort would likely be similar to status quo, just in different areas, the concentration of fishing effort could increase bycatch of salmon in the region. ESA-listed species of salmon and steelhead would be co-mingled with non-ESA-listed stocks, and thus would be susceptible to take in these fisheries. Under the salmon PSC limits in the AI, salmon must be discarded when taken in groundfish fisheries, and the fisheries are allowed to occur only up to that limit; thus there is an incentive to avoid fishing in areas of high rates of salmon bycatch. Under Alternative 5B, the groundfish fisheries in the AI likely would continue to be prosecuted in a manner that would minimize salmon bycatch, which in turn would continue to minimize the chance of incidental take of an ESA-listed species. Furthermore, CWT data indicate that ESA-listed salmonids are primarily taken in GOA midwater trawl fisheries, with very few taken in the AI. It is not likely that the displaced bottom trawl fishing under Alternative 5B would affect the prey field for ESA-listed salmonids.

ESA-listed Seabirds (Ø) – ESA-listed seabirds would likely encounter some increased fishing activities in the GOA, BSAI, and AI under Alternative 5B. Alternative 5B would have the same effects in the GOA and EBS as previously described for these species under Alternative 5A. In the AI, displaced fishing activity would likely concentrate in some remaining open areas, but would not likely affect the eider species because spectacled eiders do not use these areas as habitat. Steller's eiders, although present in winter, are coastally oriented and would not likely overlap concentrated fishing activities that would occur further offshore. Short-tailed albatross would likely encounter groundfish fishing activities in this region, but since no documented take of this species has been reported for these fisheries, fishing activities under Alternative 5B likely would not result in take of this species. Nonetheless, the fishing industry would continue to cooperate with agencies to develop methods to minimize potentially lethal

encounters of short-tailed albatross with trawl vessel fishing activities. Thus, the Alternative 5B management options would not likely have adverse effects on ESA-listed seabirds.

Other Seabirds (Ø) – Alternative 5B may increase groundfish trawl fishing levels in some areas of the GOA and BSAI, with some potential concentration of fishing activities in the AI area, and could result in some increased levels of fulmar mortality from take in bycatch or third wire or vessel strikes. Incidental mortality from trawl fishing operations would continue to take albatrosses and shearwaters because these seabirds are fairly susceptible to incidental take because of their feeding behavior; some increase in mortality under Alternative 5B could affect these species, particularly Laysan albatross in the AI where this species may be more abundant. Some of these concerns would be alleviated with implementation of new seabird bycatch reduction programs in the longline fisheries. Alternative 5B would likely have minimal effect on red-legged kittiwakes and Kittlitz's murrelets; there could be additional overlap of trawl fishing activities and red-legged kittiwakes near their Pribilof and Bogoslov Islands colonies. Although there are few concerns over fishery-related depletion of seabird prey, some concerns would continue over the occasional intense fishing activity near seabird colonies that might interrupt or displace seabird foraging; Alternative 5B may slightly increase potential overlap of trawl fishing activities and other seabird foraging areas. Seabirds would continue to strike vessels and suffer mortality, particularly such species as storm-petrels, fulmars, some albatrosses, and crested auklets, perhaps at moderately increased levels under Alternative 5B. Overall, however, the effects of Alternative 5B on seabird populations are expected to be negligible.

4.3.7.6 Effects of Alternative 5B on Ecosystems

Predator-Prey Relationships (Ø) – No effect on predator prey relationships is expected for Alternative 5B. No substantial changes would be anticipated in biomass or numbers in prey populations, nor would there be an increase the catch of higher trophic levels, or the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem, although TAC reductions would result in reduced catches of AI rockfish, Atka mackerel, and Pacific cod under Option 1 and reduced catches of rockfish and Atka mackerel under Option 2. The trophic level of the catch would not be much different from status quo, and little change is expected in the species composition of the groundfish community, or in the removal of top predators.

Energy Flow and Balance (Ø) – The amount and flow of energy in the ecosystem would be the same as the status quo with regards to the total level of catch biomass removals from groundfish fisheries. No substantial changes in groundfish catch or discarding (except perhaps some reduction in the catch of EBS other flatfish species) would be expected.

Diversity (E+) – Bottom trawling would be much reduced on some GOA slope areas, some areas in the northwest EBS, and in a substantial portion of the AI shelf and slope. Although much of this effort would be redistributed to adjacent open areas, the closed areas under all three management options provide protection for sensitive, sessile organisms. Thus, species level diversity would be provided higher protection relative to the status quo. Closure of the areas to bottom trawling might help to maintain or enhance productive fish habitat and would, thereby, aid in sustaining fish populations that rely on these areas. Structural habitat diversity supported by living substrates would be provided greater protection in this alternative relative to Alternative 1. Genetic diversity could slightly increase if older, more heterozygous individuals were left in the populations – AI rockfish in particular. However, the exact spawning locations of these species is unknown, so the effects of the three Alternative 5B management options on this aspect of diversity remain unknown. Overall, Alternative 5B would have positive effects on diversity.

4.3.8 Effects of Alternative 6

4.3.8.1 Effects of Alternative 6 on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type differed from status quo for this alternative. LEIs for both status quo and Alterative 6 were less than 3 percent for all habitat types. The relatively low sensitivity and high recovery rates of both infauna and epifauna prey categories make then relatively resilient to fishing effort. The only areas of LEIs greater than 25 percent were in the EBS near Unimak Island and in center of the sand/mud habitat. These areas did not comprise a substantial portion of the EFH (either by general distribution or known concentration) for any managed species.

Effects on Benthic Biodiversity (E+) – Alternative 6 breaks Alaska waters into 10 regions and establishes closures to all bottom-contact fishing that comprise approximately 20 percent of each region. When added to existing bottom trawl closures these close 33 percent of the shallow AI, 26 percent of the deep AI, and 32 percent of GOA slope habitat. These are substantial areas closed to future fishing and yield improvements in protection of coral.

Effects on Habitat Complexity (E+) – Alternative 6 breaks Alaska waters into 10 regions and establishes closures to all bottom-contact fishing that comprise approximately 20 percent of each region. LEI values were decreased in all habitat types with existing effects greater than 5 percent, including biostructure for the hard substrate portions of the GOA slope and deep shelf, the Aleutian shallow and the EBS sand/mud and slope. All such reductions were moderate, lowering the original values by 7 to 16 percent. The combination of these reductions account for a substantial positive effect.

4.3.8.2 Effects of Alternative 6 on Target Species

4.3.8.2.1 Effects on Groundfish

4.3.8.2.1.1 Walleye Pollock (BSAI and GOA)

Walleye pollock are managed as five separate management units. Several studies have been conducted to determine the stock structure of pollock in Alaskan waters. These studies show considerable mixing between populations occupying the continental shelf off Alaska. Thus the management units represent relatively distinct populations of fish that may mix over temporal scales of 100 to 1,000 years. In the GOA, two stocks are recognized, the western-central population and the southeast Alaska population. In the BSAI, distinct stocks are recognized for the AI, the EBS, and the central BS. In the western central GOA, the ABC is partitioned by INPFC area in an attempt to distribute fishing mortality in a manner consistent with the underlying biomass. The following analysis focuses on the impacts of alternatives on the EBS, AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the EBS and WCGOA pollock stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. In either the EBS or GOA, it is possible that the additional closed areas might cause catches to be lower if the full TAC could not be taken by fishing in the remaining open areas. Walleye pollock are fished using pelagic trawls so the direct impact of this alternative on walleye pollock fishing mortality and stock biomass is minor.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the EBS or WCGOA walleye pollock stocks that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. Shifts in fishing effort resulting from the no trawl zones in the GOA and EBS is unclear, because spatial concentration depends not just on the relative sizes of the open and closed areas, but on the magnitude and spatial distribution of catch within the open and closed areas as well. For example, in the GOA Chiniak and Barnabas troughs remain open. These troughs are prime fishing grounds for pollock and cod. If the Pacific cod fleet increased fishing effort in the troughs, the incidental catch of pollock would increase. Even if some change in spatial concentration of the catch were realized under Alternative 6, however, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. However, the additional portions of walleye pollock habitat that would be closed under Alternative 6 appear to encompass only a minor proportion of the known walleye pollock spawning grounds. One notable exception includes the closed region around the Shumagin Islands. Even if some increase in spawning and breeding success were realized under Alternative 6, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Feeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of adult feeding. Adult walleye pollock primarily consume euphausiids and forage fish. The impacts of Alternative 6 on the availability of these pelagic prey would probably be minor. There is no evidence that minor changes in prey availability would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Growth to maturity (EBS U, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the EBS or WCGOA walleye pollock stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. In the EBS and the GOA, the proposed closed areas proposed under Alternative 6 overlap regions occupied by juvenile pollock. As was noted in Chapter 3, some juvenile walleye pollock assume a demersal existence at or near the end of the first year of life. Juvenile pollock maintain this existence for 1 year after which they assume a pelagic existence for 1 to 2 additional years. The impact of trawling on the feeding success of juvenile walleye pollock is unknown. The impact of the no trawl zones on the feeding success of juvenile pollock is unknown.

4.3.8.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the BSAI and GOA Pacific cod stocks are projected to remain above their respective MSSTs under the current fishery management regime. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. In either the BSAI or GOA, it is possible that the additional closed areas might cause catches to be lower if the full TAC could not be taken by fishing in the remaining open areas. However, the additional proportions of Pacific cod EFH that would be closed in the BSAI under Alternative 6 are small (on the order of 20 percent). Even if some decrease in fishing mortality were realized under Alternative 6, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Spatial/Temporal Concentration of the Catch (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the BSAI or GOA Pacific cod populations that materially impact either stock's basic ability to maintain itself at or above its MSST. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. How the additional closures would affect the spatial concentration of the catch in the BSAI or GOA is unclear, because spatial concentration depends not just on the relative sizes of the open and closed areas, but on the magnitude and spatial distribution of catch within the open and closed areas as well. Even if some decrease in spatial concentration of the catch were realized under Alternative 6, however, there is no evidence that this decrease would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Spawning/Breeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of spawning and breeding. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. However, the additional portions of Pacific cod EFH that would be closed under Alternative 6 appear to encompass only a minor proportion of the known Pacific cod spawning grounds. Even if some increase in spawning and breeding success were realized under Alternative 6, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Feeding (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts mediated through the process of feeding. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. The additional proportions of Pacific cod EFH that would be closed under Alternative 6 are small, but not necessarily insignificant. Even if some increase in feeding success were realized under Alternative 6, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

Growth to maturity (Ø) – As was determined in the revised draft programmatic groundfish SEIS (NMFS 2003a), nothing in the current fishery management regime jeopardizes the abilities of the BSAI or GOA Pacific cod stocks to maintain themselves at or above their respective MSSTs, including impacts

mediated through the process of growth to maturity. Relative to the status quo, the major change under Alternative 6 is the inclusion of additional areas closed to all bottom-tending gear. The additional proportions of Pacific cod EFH that would be closed under Alternative 6 are small, but not necessarily insignificant. Even if some increase in successful growth to maturity were realized under Alternative 6, however, there is no evidence that this increase would be of sufficient magnitude to result in a significant increase in either stock's ability to maintain itself above its respective MSST.

4.3.8.2.1.3 Sablefish (BSAI and GOA)

Stock Biomass (Ø) – Alternative 6 closes 20 percent of fishable waters shallower than 1,000 m to all bottom-tending gear. The sablefish fishery likely would move to adjacent open areas of the slope, keeping total sablefish catch the same. Thus Alternative 6 likely would have an insignificant impact on sablefish biomass compared to the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 6 would increase the spatial/temporal concentration of fishing mortality compared to the status quo. Effort in the remaining open areas would increase by 25 percent on average.

Spawning/Breeding (Ø) – Alternative 6 would increase fishing effort by 25 percent in the remaining open areas. Higher effort levels than current have occurred in the past both when sablefish were more abundant for trawl and longline fishing and during the open-access longline fishery for longline fishing (Sigler and Lunsford 2001). Thus the increased effort is unlikely to affect sablefish habitat required for spawning. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat. Habitat-mediated effects on sablefish spawning due to physical structure are projected to decrease somewhat compared to the status quo.

Feeding (Ø) – Benthic prey (epifauna and infauna) are substantial prey items for sablefish. Alternative 6 likely would increase availability of benthic prey to sablefish in the closure areas as the habitat recovers from effects of fishing. Fishing effort would shift to adjacent open areas, increasing fishing effort there by 25 percent on average. Benthic prey availability likely would decrease in the open areas due to the increased fishing, though relatively less than the eventual increases for the closed areas because the open areas have already been fished. Thus habitat-mediated effects on feeding overall would decrease for Alternative 6 (only minor improvements are projected). Habitat-mediated effects on sablefish feeding due to physical structure are projected to decrease somewhat compared to the status quo.

Growth to maturity (Ø) – The closure areas for Alternative 6 likely would decrease habitat-mediated effects on growth to maturity of sablefish. Alternative 6 likely would decrease habitat-mediated effects on growth in the closure areas as the habitat recovers from effects of fishing. Fishing effort would shift to adjacent open areas, increasing fishing effort there by 25 percent on average. Habitat-mediated effects on growth likely would decrease in the open areas due to the increased fishing, though relatively less than the eventual increases for the closed areas because the open areas have already been fished. Thus habitat-mediated effects on growth to maturity overall would decrease for Alternative 6. Habitat-mediated effects on sablefish growth to maturity due to physical structure are projected to decrease somewhat compared to the status quo.

Total fishing effort would not change for Alternative 6 as sablefish fishing would shift to open areas. Thus other fishing effects on growth to maturity not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) would not change under Alternative 6, so that the potential

remains to decrease juvenile survivorship especially for areas of the EBS and GOA where juvenile sablefish are concentrated and bottom trawl fishing intensity currently is high.

The closure areas for Alternative 6 likely would decrease habitat-mediated effects on sablefish feeding and growth to maturity as closed areas recover from the effects of fishing. Other effects of fishing not mediated by habitat (fishing on the continental shelf, catching juvenile sablefish as bycatch) would remain the same because total fishing effort would remain the same. Total fishing effort would not change for Alternative 6 as slope rockfish fishing would shift to open areas. Fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any habitat-mediated effects of fishing would continue in the slope rockfish trawl fishery closure areas, although at a lower level. Habitat-mediated effects on sablefish due to physical structure are projected to decrease somewhat compared to the status quo.

4.3.8.2.1.4 Atka Mackerel (BSAI and GOA)

Stock Biomass (Ø) – Alternative 6 would likely have little impact on the stock biomass of Atka mackerel relative to status quo. The closed areas, although they cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances do not correspond to the major fishing grounds for Atka mackerel. The exception possibly being the east end of Amchitka Island, however, it is likely the fishing effort that previously existed in this area would merely be shifted to other areas (e.g., the west end of Amchitka Island), and Aleutian catches and stock biomass would remain unchanged. There is no directed fishery in the GOA, thus the closures in the GOA are not likely to have any impact relative to status quo for GOA Atka mackerel. Therefore, the rating for stock biomass is no effect.

Spatial/Temporal Concentration of the Catch (Ø) – This alternative would likely have little impact on the spatial concentration of the catch relative to status quo. The closed areas, although they cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances do not correspond to the major fishing grounds for Atka mackerel. The exception possibly being the east end of Amchitka Island. It is likely the fishing effort that previously existed in this area would be shifted to other areas, the most likely being the west end of Amchitka Island where it would increase the spatial concentration of the catch. However, at this time there is no evidence of genetic stock structure within the AI (Lowe et al. 1998), and it is assumed that any potential increase in the spatial concentration of the catch would not affect genetic diversity. There is no directed fishery in the GOA, thus the closures in the GOA are not likely to have any impact relative to status quo for GOA Atka mackerel. Therefore, the rating for spatial/temporal concentration of the catch is no effect.

Spawning/Breeding (Ø) – AI spawning Atka mackerel females deposit adhesive eggs in benthic nests in rocky crevices and hollows and among stones at depths less than 100 m. The nests are guarded by males until hatching occurs. The reproductive ecology of GOA Atka mackerel is assumed to be similar based on observations in the AI. The directed fishery in the AI generally occurs at depths greater than 100 m and there is assumed to be little or no overlap with AI Atka mackerel nesting grounds.

Alternative 6 would likely have little impact on the spawning and breeding of Atka mackerel relative to status quo. The closed areas, although they cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances do not correspond to the major fishing grounds for Atka mackerel. The exception possibly being the east end of Amchitka Island, however, it is likely the fishing effort that previously existed in this area would merely be shifted to other areas (e.g., the west end of Amchitka Island) where catches already occur under status quo. If the east end of Amchitka

Island is a spawning ground for Atka mackerel, there is the potential that the closure would provide protection to this habitat and possibly enhance the spawning and breeding in the closed area. However, it is presumed that there is little overlap between the directed fishery and the shallow spawning grounds. Also, any potential enhancement of spawning and breeding in a local area is not likely to have population level effects. There is no directed fishery in the GOA, thus the closures in the GOA are not likely to have any impact relative to status quo for GOA Atka mackerel. Therefore, the rating for spawning and breeding is no effect.

Feeding (Ø) – Adult Atka mackerel feed mainly on pelagic euphasiids followed by calanoid copepods, which are not one of the affected habitat features. Euphausiids and copepods are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear. Euphausiids are also the major food for Pacific ocean perch and northern rockfish, so in theory any reduction in the catch of these species as a result of this alternative might free up some food for Atka mackerel. However, it is doubtful that Alternative 6 would reduce the catch of these two species to any great extent because the closed areas generally do not correspond to major fishing grounds for these fish. Therefore, if this alternative were enacted, food availability to Atka mackerel would likely be unchanged relative to status quo, and the rating for feeding is no effect.

Growth to maturity (Ø) – Of all the alternatives, Alternative 6 has the greatest potential to benefit Atka mackerel in terms of growth to maturity. This alternative prohibits the use of all bottom tending gear inside a number of closed areas that encompass 20 percent of the benthic habitat in the GOA and AI less than1,000 m depth. Late juvenile and adult Atka mackerel are found over hard, rocky substrates. The closed areas in this alternative would protect the benthic habitat from any damage by fishing gear. Theoretically, this improved habitat could result in increased survival of Atka mackerel to adulthood. However, although the closed areas protect 20 percent of the GOA and Aleutian habitat, it is unknown to what extent this directly protects habitat that is important to Atka mackerel. Also, the closed areas in most instances do not correspond to the major fishing grounds for Atka mackerel. The exception possibly being the east end of Amchitka Island, however, it is likely the fishing effort that previously existed in this area would merely be shifted to other areas (e.g., the west end of Amchitka Island) where catches already occur under status quo. There is no directed fishery in the GOA, thus the closures in the GOA are not likely to have any impact relative to status quo for GOA Atka mackerel. Relative to status quo, any potential benefits are not likely to be substantial. Therefore the rating for growth to maturity is no effect.

4.3.8.2.1.5 Yellowfin Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS yellowfin sole biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Nichol 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle EBS shelf where yellowfin sole are harvested. These closures would most likely result in increased harvest in the remaining open areas. It is unknown what effect this redistribution of harvest would have on EBS yellowfin sole, since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there is not expected to be a negative effect on the future genetic diversity of the stock. The closed areas could be beneficial as documented for other marine protective areas (Shipp 2002, Carr et al. 2002, Woodby et al. 2002).

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS yellowfin sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for yellowfin sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for yellowfin sole. Within the first year of life, yellowfin sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.6 Greenland Turbot (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS Greenland turbot biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Ianelli et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close areas throughout the EBS slope where Greenland turbot are harvested at low levels. These closures would most likely result in increased harvest in the remaining open areas. It is unknown what effect this redistribution of harvest would have on EBS Greenland turbot since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there is not expected to be a negative effect on the future genetic diversity of the stock. The closed areas could be beneficial as documented for other marine protective areas (Shipp 2002, Carr et al. 2002, Woodby et al. 2002).

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS Greenland turbot since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for Greenland turbot since the modeled benthic disturbance for infauna and epifauna prey are not relevant to their diet. Adult feeding primarily occurs during summer throughout the deep slope waters and to a lesser extent on the upper slope/shelf margins, on pollock, squid, and deep water fish species. Most of the Greenland turbot feeding behavior is observed to take place off bottom and is not related to the benthic food availability.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for Greenland turbot. Within the first year of life, Greenland turbot metamorphose from free-

swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.7 Arrowtooth Flounder (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA arrowtooth flounder biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close areas throughout the middle GOA shelf where arrowtooth flounder are harvested at low levels. These closures would most likely result in increased harvest in the remaining open areas. It is unknown what effect this redistribution of harvest would have on GOA arrowtooth flounder since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there is not expected to be a negative effect on the future genetic diversity of the stock. The closed areas could be beneficial as documented for other marine protective areas (Shipp 2002, Carr et al. 2002, Woodby et al. 2002).

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA arrowtooth flounder since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on fish, squid, pandalid and cragonid shrimp, and euphausiids primarily occurs during summer throughout the outer continental shelf and upper slope areas. Therefore the benthic epifauna is of some importance in their diet (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for arrowtooth flounder. Within the first year of life, arrowtooth flounder metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.8 Rock Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS rock sole biomass since there would be no change in fishing mortality. The current management practices are

projected to maintain the stock's ability to sustain itself above the MSST level in the future (Wilderbuer and Walters 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle EBS shelf where rock sole are usually taken in pursuit of other species. The area where the roe rock sole fishery operates would remain open. These closures would most likely result in increased harvest in the remaining open areas. This redistribution of harvest is expected to have little effect on EBS rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore there is not expected to be a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS rock sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. It is unknown what the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.9 Flathead Sole (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA and EBS flathead sole biomass since there would be no changes in fishing mortality or fishing practices. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Turnock et al. 2002, Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle and outer GOA shelf where flathead sole are harvested. This Alternative would also close some areas on the middle EBS shelf where this species is harvested. These closures would most likely result in increased harvest in the remaining open areas. It is unknown what effect this redistribution of harvest would have on GOA and EBS flathead sole, since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there is not expected to be a negative effect on the future genetic diversity of the stock. The closed areas could be beneficial as documented for other marine protective areas (Shipp 2002, Carr et al. 2002, Woodby et al. 2002).

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA and EBS flathead sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna, epifauna, and certain fish species primarily occurs during summer on the middle and outer continental shelf areas. They are therefore dependent on the infaunal and epifaunal supply of polychaete worms, mysids, brittle stars, shrimp, and hermit crabs (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for flathead sole. Within the first year of life, flathead sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.10 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 6 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle and outer GOA shelf and slope where rex sole are usually taken. These closures would most likely result in increased harvest in the remaining open areas. This redistribution of harvest is expected to have little effect on GOA rex sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore there is not expected to be a negative effect on the future genetic diversity of the stock. Some future positive effect could result from the newly protected areas.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA rex sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Adult feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for rex sole. Within the first year of life, rex sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in

nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.11 Alaska Plaice (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS Alaska plaice biomass since there would be no change in fishing mortality. The current management practices are projected to maintain the stock's ability to sustain itself above the MSST level in the future (Spencer et al. 2002).

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle EBS shelf where Alaska plaice are harvested. These closures would most likely result in increased harvest in the remaining open areas. It is unknown what effect this redistribution of harvest would have on EBS Alaska plaice since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there is not expected to be a negative effect on the future genetic diversity of the stock. The closed areas could be beneficial as documented for other marine protective areas (Shipp 2002, Carr et al. 2002, Woodby et al. 2002).

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on EBS Alaska plaice since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for Alaska plaice since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, marine worms, and, to a lesser extent, bivalves. Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for Alaska plaice. Within the first year of life, Alaska plaice metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.12 Shallow Water Flatfish (GOA)

Eight species of flatfish comprise the shallow water management complex. For this discussion of impacts to EFH, southern rock sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA shallow water flatfish complex, the effect of Alternative 6 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle GOA shelf where rock sole are usually taken in pursuit of other species. These closures would most likely result in increased harvest in the remaining open areas. This redistribution of harvest is expected to have little effect on GOA rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore there is not expected to be a negative effect on the future genetic diversity of the stock. Some future positive effect could result from the newly protected areas.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA rock sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding on benthic infauna primarily occurs during summer throughout the continental shelf and is, therefore, dependent on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Given the present condition of the resource resulting from current management practices, it is not expected that small changes in future fishing would have a substantial effect on adult feeding.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for rock sole. Within the first year of life, rock sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depends on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there is no effect from fishing on survival and growth to maturity.

4.3.8.2.1.13 Deep Water Flatfish (GOA)

Three species of flatfish comprise the deep water management complex. For this discussion of impacts to EFH, Dover sole is used to characterize the group of species.

Stock Biomass (U) – Because the value of MSST is unknown for the GOA deep water flatfish complex, the effect of Alternative 6 on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 6 would close some areas on the middle GOA slope where Dover sole are usually taken. These closures would most likely result in increased harvest in the remaining open areas. This redistribution of harvest is expected to have little effect on GOA Dover sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore there is not expected to be a negative effect on the future genetic diversity of the stock. Some future positive effect could result from the newly protected areas.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 6 would have no effect on GOA Dover sole, since there would be few changes in the current harvest practices. Fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 is not expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey are the same as in Alternative 1. Adult feeding primarily occurs during summer on the continental slope and to a lesser extent on the outer shelf area. They are thought to be dependent on the infaunal supply of polychaete worms, amphipods, and other marine worms. Given the present condition of the resource resulting from current management practices, it is not expected that fishing has had a substantial effect on adult feeding.

Growth to maturity (Ø) – Relative to the status quo, Alternative 6 would have no effect on the growth to maturity for Dover sole. Within the first year of life, Dover sole metamorphose from free-swimming larvae to the familiar asymmetrical morphological life form characteristic of flatfish. When they settle in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and for burrowing for protection from predators (Moles and Norcross 1995). Growth from newly settled juveniles to mature adults depend on the infaunal supply of polychaete worms, amphipods, other marine worms, and sandlance (Lang et al. 2003). Since fishing would not occur at inshore nursery grounds under Alternative 6, there fishing would have no effect on survival and growth to maturity.

4.3.8.2.1.14 Pacific Ocean Perch (BSAI)

Stock Biomass (Ø) – Under Alternative 1, total biomass (ages 3 through 21+) of BSAI Pacific ocean perch is above the MSST and is expected to remain above the MSST, resulting in a rating of no effect of fishing on stock biomass. Alternative 6 has additional habitat protections in the BSAI area, but these closures would not likely result in substantial enhancement of the stock biomass of Pacific ocean perch. The stock would be expected to remain above the MSST, so the effect of fishing on stock biomass would also be rated as no effect.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for Pacific ocean perch harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. Similarly, the closure areas in the AI are located in areas where few Pacific ocean perch are caught and thus have little effect on the spatial/temporal concentration of the catch. The expected pattern of fishing for Pacific ocean perch is similar to that in Alternative 1 and thus would have no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo (Alternative 1) management. As was mentioned above, the pattern of fishing for Pacific ocean perch in the BSAI area is expected to similar to Alternative 1, and Alternative 6 is expected to have no substantial effects on essential spawning habitat.

Feeding (Ø) – Pacific ocean perch are plankton feeders, with juvenile Pacific ocean perch eating calanoid copepods and adults eating largely euphausiids (Yang 1993, 1996). Fishing activity under Alternative 6 would be expected to have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the PSEIS, based on estimated recruitments in recent years, indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above the MSST under status quo management. The pattern of fishing under Alternative 6 is expected to be similar to that under Alternative 1, and fishing is thus anticipated to have no substantial effect on the survival of fish to maturity.

4.3.8.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – Alternative 6 creates large scale closure areas that together effectively close 20 percent of the GOA to all bottom trawling at all depths. Several of the closed areas coincide with known Pacific ocean perch concentrations. The closure areas could have a substantial impact on the catch of Pacific ocean perch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Bottom trawl fishing effort for Pacific ocean perch could move to open areas or the Pacific ocean perch fishery could convert to pelagic trawl gear in areas closed to bottom trawling. In either case the stock biomass is likely to remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – The closure areas could have a substantial impact on the catch of Pacific ocean perch compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. Bottom trawl fishing effort for Pacific ocean perch could move to open areas. This could result in increased fishing pressure in these areas and under a short duration open access fishery could increase the risk of localized depletion in these areas. Alternatively, the Pacific ocean perch fishery could convert to pelagic trawl gear in areas closed to bottom trawling. In either case, the stock biomass is likely to remain above MSST. This could result in increased fishing pressure in these areas and under a short duration open access fishery could increase the risk of localized depletion in these areas.

Spawning/Breeding (Ø) – GOA Pacific ocean perch are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, this alternative would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 6 on Pacific ocean perch spawning are insignificant. However caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

The areas in the GOA that Alternative 6 would close to all groundfish bottom trawling create no-take zones or refugiua for Pacific ocean perch in these areas, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited fish populations (Yoklavich 1988). In particular, the closed areas may allow increased survival of larger and older fish that produce significantly more offspring. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit Pacific ocean perch.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 6.

Growth to Maturity (Ø) – The areas in the GOA that Alternative 6 would close to all groundfish bottom trawling could have a positive impact on the growth to maturity of Pacific ocean perch compared to the status quo. The fishing closures are geographically large, and may coincide with juvenile Pacific ocean perch habitat. As was discussed above, juvenile Pacific ocean perch tend to live inshore in shallower depths than adults and may also be associated with epifauna that provides structural relief on the bottom. Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of juvenile Pacific ocean perch. If the bottom trawl closures coincide with juvenile habitat then damage to this epifauna by bottom trawls would be reduced in closed areas

4.3.8.2.1.16 Shortraker and Rougheye Rockfish (BSAI)

Stock Biomass (U) – BSAI shortraker and rougheye rockfish are not currently assessed with an age-structured population model, and the MSSTs have not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for shortraker and rougheye rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. Large catches of rougheye rockfish are occasionally taken just outside of Seguam Pass, and would fall outside of the proposed Seguam Pass area closure. Small amounts of rougheye and shortraker rockfish are harvested within the other proposed closure areas. The spatial/temporal concentration of the catch under Alternative 6 is not expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of fishing in some areas of the AI is expected to have little effect on the spawning and breeding habitat of shortraker/rougheye rockfish because relatively few shortraker rougheye are caught within the proposed closed areas. Thus, under Alternative 6 the effect of fishing on spawning habitat is expected to be similar to that in Alternative 1. However, because the MSSTs for shortraker and rougheye rockfish are unknown, the effect of fishing on essential spawning habitat (as reflected by changes in the stock size relative to the MSST) is also unknown.

Feeding (Ø) – Pandalid and hippolytid shrimp are the largest components of the rougheye rockfish diet (Yang 1993, 1996). The diet of shortraker rockfish is largely unknown, but a limited number of samples suggest that squid is a major component. The reduction of epifaunal prey could affect the diet of rougheye rockfish, but the percent reductions in are so small (0 to 3 percent) that fishing is anticipated to have no effect on the diet of shortraker/rougheye rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile rougheye/shortraker rockfish. Because the MSSTs for rougheye and shortraker rockfish are unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.8.2.1.17 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – Alternative 6 would likely have little impact on the stock biomass of shortraker/rougheye rockfish compared to the status quo. Fishery data indicate catches of shortraker and rougheye rockfish are rather evenly spread along the continental slope of the GOA, especially in the central GOA and west Yakutat areas, where most of the catch is taken. The closed areas, although they cover 20 percent of the bottom habitat in the GOA over a wide range of depths, in most instances do not correspond to large areas of shortraker/rougheye habitat. It is likely fishing effort would merely shift from these closed areas to open areas since distribution of fishing effort is currently evenly spread out. Therefore, effort and the majority of catch would likely be shifted to more concentrated areas, but Gulfwide catches and stock biomass would remain unchanged.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 6 would result in a displacement of shortraker/rougheye catch from closed areas to remaining open areas. Shifting catch to other open areas would likely not affect the spatial/temporal concentration of catch since shortraker/rougheye are caught only as bycatch over a large period of time and the catches in general appear to be distributed across the entire continental slope of the GOA.

Spawning/breeding (U) – There is no information on reproductive behavior for either species, except that parturition (larval release) is believed to occur in February through August for shortraker rockfish and in December through April for rougheye rockfish (McDermott 1994). Because of this lack of knowledge, the effects of fishing on spawning and breeding of these fish is unknown.

Feeding (Ø) – Food habit studies conducted by Yang and Nelson (2000) indicate that the diet of rougheye rockfish is primarily shrimp, and that various fish species are also consumed. The diet of shortraker rockfish is not well known; however, based on a small number of samples, the diet appears to be mostly squid, shrimp, and deepwater fish such as myctophids. Because these prey items are all pelagic or semi-pelagic in their distribution and because they are also small in size, they are generally not taken in bottom-tending fishing gear. Alternative 6 closes more than 20 percent of the bottom habitat in the GOA but this is over a wide range of depths and in most instances does not protect large geographical areas of shortraker/rougheye habitat. Therefore, it is unlikely the effects of Alternative 6 would lead to a change in food availability to shortraker and rougheye rockfish.

Growth to Maturity (U) – As was previously discussed, habitat requirements for the various life stages of both species are mostly unknown. Bottom trawling may have a negative effect on the essential habitat for adults of both species where it is permitted in the west Yakutat area and central/western GOA. However, to firmly conclude that a negative impact of bottom trawling exists, additional information is needed on the association of shortraker and rougheye rockfish with sensitive benthic fauna such as corals. Under Alternative 6, the closed areas protect 20 percent of the GOA habitat. However, they do not protect 20 percent of the habitat that is important to shortraker/rougheye rockfish. Since catch is distributed across the entire continental slope it appears the distribution of shortraker/rougheye rockfish is relatively even across all areas including heavily trawled areas. Therefore, since habitat requirements are mostly unknown for shortraker/rougheye and the 20 percent closures do not represent 20 percent of shortraker/rougheye habitat, it is unknown what effects Alternative 6 would have on these species.

4.3.8.2.1.18 Northern Rockfish (BSAI)

Stock Biomass (U) – BSAI northern rockfish are not currently assessed with an age-structured population model, and the MSST has not been determined. The effect of fishing on the stocks ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary locations for northern rockfish harvest in EBS are located on the slope to the southeast of the closure areas, which thus have little effect on the fishery. The Semisopochnoi Island and Seguam Pass area closures may reduce effort from the Atka mackerel fishery in these areas, and also bycatch of northern rockfish. The spatial/temporal concentration of the catch under Alternative 6 are not be expected to have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas where northern rockfish have been taken as bycatch, such as Semisopochnoi Island and Seguam Pass, may have some positive effect on the effect of fishing on spawning habitat relative to the status quo. However, the magnitude of this effect, as reflected by changes in the stock size relative to the MSST, is unknown.

Feeding (Ø) – Northern rockfish are largely plankton feeders, eating mainly euphausiids but also copepods, hermit crabs, and shrimp (Yang 1993). Fishing activity under Alternative 6 would be expected to have no effect on the largely pelagic diet of northern rockfish.

Growth to Maturity (U) – Little information is available on the habitat of juvenile northern rockfish. Because the MSST for northern rockfish is unknown, the effects of fishing on survival to maturity (as reflected by changes in the stock size relative to the MSST) is also unknown.

4.3.8.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – Alternative 6 creates large scale closure areas that together effectively close 20 percent of the GOA to all bottom trawling at all depths. Several of the closed areas coincide with known northern rockfish concentrations. In particular one closed area includes an area known as the "Snakehead," which accounted for 46 percent of northern rockfish catch from 1990-1998 (Clausen and Heifetz 2003). Bottom trawl fishing effort for northern rockfish would likely move to open areas, and the stock biomass is likely to remain above MSST.

Spatial/Temporal Concentration of the Catch (Ø) – GOA northern rockfish are currently sustaining themselves above MSST, and Alternative 6 would likely result in GOA northern rockfish sustaining themselves above MSST. However, the closed areas could have an impact on the catch of northern rockfish compared to the status quo, but it would depend upon how the fishery responds to the bottom trawl closure. The alternative removes an area from bottom trawling known as the "Snakehead," which accounted for 46 percent of northern rockfish catch from 1990-1998 (Clausen and Heifetz 2003). It is not known whether northern rockfish can be captured with other gear, such as pelagic trawls. It is likely that the northern rockfish quota would be captured with bottom trawls in the remaining open areas. The GOA rockfish trawl fishery is managed under an open season that occurs in July and generally lasts a few weeks. The open fishery system compresses the fishery effort into a short time period and increases the risk of overfishing. Moving 46 percent of the catch from a high concentration area could also increase the risk of localized depletion in the remaining open areas.

Spawning/Breeding (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures are not likely to increase total fishing mortality. Consequently, Alternative 6 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criteria, the fishing effects of Alternative 6 on northern rockfish spawning are insignificant. However, caution is warranted. Little is known about the habitat requirements for spawning and possible fishing effects on that habitat.

The areas in the GOA that the alternative would close to all groundfish bottom trawling create no-take zones or refugiua for northern rockfish in these areas, as trawls are generally the only effective gear for capturing this species. Marine harvest refugia have been considered as a management tool for exploited fish populations (Yoklavich 1988). In particular, the closed areas may allow increased survival of larger and older fish that produce significantly more offspring. However, it is uncertain if high volumes of larvae equate to high levels of recruitment. If marine harvest refugia are beneficial for exploited fish populations, then this refugia would likely benefit northern rockfish.

Feeding (Ø) – There is insufficient information to conclude that existing trophic interactions would undergo significant change under Alternative 6.

Growth to Maturity (Ø) – The areas in the GOA that Alternative 6 would close to all groundfish bottom trawling could have a positive impact on the growth to maturity of northern rockfish compared to the status quo. The fishing closures are geographically large, and may coincide with juvenile and adult northern rockfish habitat. Bottom trawling or other fishing gear in contact with the ocean floor of the GOA continental shelf and upper slope could negatively impact the habitat of northern rockfish. If the

bottom trawl closures coincide with juvenile habitat then damage to this epifauna by bottom trawls would be reduced in closed areas.

4.3.8.2.1.20 Pelagic Shelf Rockfish (GOA)

The pelagic shelf rockfish management group in the GOA is comprised of three species: dusky rockfish (*Sebastes ciliatus*), yellowtail rockfish (*S. flavidus*), and widow rockfish (*S. entomelas*). As was discussed in Section 3.2.1.1.10.5, dusky rockfish is in the process of being taxonomically divided into two species, a light-colored form and a dark-colored form. Light dusky rockfish is much more abundant in Alaska than the other three species, and it supports a valuable trawl fishery in the GOA. Because of the abundance and commercial importance of light dusky rockfish in the GOA, this section will focus exclusively on this species as a proxy for the pelagic shelf rockfish management group.

Stock Biomass (Ø) – This alternative would likely have little impact on the stock biomass of light dusky rockfish compared to the status quo. The closed areas, although they cover 20 percent of the bottom habitat in the GOA over a wide range of depths, in most instances do not correspond to the major fishing grounds for light dusky rockfish. For example, especially important grounds for light dusky rockfish around Kodiak Island such as Portlock Bank, Barnabus Gully, and most of the "Snakehead" all lie outside of the closed areas. Two grounds of somewhat lesser importance, Shumagin Bank and the "W" Grounds west of Yakutat, are mostly included in closed areas. If Alternative 6 were adopted, however, it is likely the fishing effort that previously existed on these latter two grounds would merely be shifted to other grounds, and Gulfwide catches and stock biomass would remain unchanged.

Spatial/Temporal Concentration of the Catch (Ø) – Alternative 6 would result in a relatively modest displacement of catch from two fishing grounds for light dusky rockfish (Shumagin Bank and the "W" Grounds) that are located inside closed areas. This displacement would cause a shift in catch to other grounds. However, this change in spatial concentration would not be substantial because Shumagin Bank and the "W" Grounds account for a relatively small percentage of the Gulfwide catch for this species. Alternative 6 would have no effect on temporal concentration of catch.

Spawning/breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring, based on observations of ripe females sampled on a research cruise in April in the central GOA. Because of this lack of knowledge, the effects of Alternative 6 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution and they are so small they are not retained by any fishing gear, Alternative 6 probably has little or no direct effect on the availability of prey to adult light dusky rockfish. Euphausiids are also the major food for Pacific ocean perch and northern rockfish, so that in theory, any reduction in the catch of these species as a result of this alternative might free up some food for light dusky rockfish. However, it is doubtful that Alternative 6 would reduce the catch of these two species to any great extent because the closed areas generally do not correspond to major fishing grounds for these fish. Therefore, if this alternative were enacted, food availability to light dusky rockfish would likely be unchanged compared with the status quo.

Growth to maturity (Ø) – Of all the alternatives, Alternative 6 has the greatest potential to benefit light dusky rockfish in terms of growth to maturity. This alternative prohibits the use of all bottom tending gear inside a number of closed areas that encompass 20 percent of the benthic habitat in the GOA less

than1,000 m depth. The best evidence available at present suggests that late juvenile and adult light dusky rockfish are found over hard, rocky substrates and that they may associate with epifauna such as corals and sponges. The closed areas in this alternative would protect the benthic habitat from any damage by fishing gear and would allow corals and sponges to re-grow and recover from such damage. Theoretically, this improved habitat could result in increased survival of light dusky rockfish to adulthood. However, although the closed areas protect 20 percent of the GOA habitat, they do not protect 20 percent of the habitat that is important to light dusky rockfish. The major fishing grounds for light dusky rockfish around Kodiak Island, where they occur in their greatest abundance and where most of the GOA catch is taken, are not included in the closed areas. Because the closed areas do not generally correspond with the preferred habitat locations for light dusky rockfish, this alternative provides only a modest benefit for growth to maturity of these fish. Compared with the status quo, the benefits would not be substantial.

4.3.8.2.1.21 Other Rockfish Species (BSAI)

Stock Biomass (Ø) --This alternative would likely have little impact on the stock biomass of light dusky rockfish compared to the status quo. The closed areas, although they cover 20 percent of the bottom habitat in the BSAI over a wide range of depths, in most instances do not correspond to areas where light dusky rockfish have been observed in high abundance. Therefore, this alternative would have little to no change from status quo.

Spatial/Temporal Concentration of the Catch (Ø) – Similar to the above rationale, Alternative 6 would have no effect on temporal concentration of catch.

Spawning/breeding (U) – There is no information on reproductive behavior for light dusky rockfish, except that parturition (larval release) is believed to occur in the spring. Because of this lack of knowledge, the effects of Alternative 6 on the habitat required for reproduction of light dusky rockfish are unknown.

Feeding (Ø) – The major prey of adult light dusky rockfish appears to be euphausiids (based on the limited food information available for this species) (Yang 1993). As euphausiids are pelagic rather than benthic in their distribution, and they are so small they are not retained by any fishing gear, Alternative 6 probably has little or no direct effect on the availability of prey to adult light dusky rockfish. Euphausiids are also the major food for Pacific ocean perch and northern rockfish, so that in theory, any reduction in the catch of these species as a result of this alternative might free up some food for light dusky rockfish. However, it is doubtful that the alternative would reduce the catch of these two species to any great extent because the closed areas generally do not correspond to major fishing grounds for these fish. Therefore, if this alternative were enacted, food availability to light dusky rockfish would likely be unchanged compared with the status quo.

Growth to maturity (Ø) – Of all the alternatives, Alternative 6 has the greatest potential to benefit light dusky rockfish in terms of growth to maturity. This alternative prohibits the use of all bottom tending gear inside a number of closed areas that encompass 20 percent of the benthic habitat in the BSAI less than 1,000 m depth. The best evidence available at present suggests that late juvenile and adult light dusky rockfish are found over hard, rocky substrates and that they may associate with epifauna such as corals and sponges. The closed areas in this alternative would protect the benthic habitat from any damage by fishing gear and would allow corals and sponges to re-grow and recover from such damage. Theoretically, this improved habitat could result in increased survival of light dusky rockfish to adulthood. However, although the closed areas protect 20 percent of the BSAI habitat, they do not

protect 20 percent of the habitat that is important to light dusky rockfish. Regardless, the closure areas do include locations such as the Seguam Pass area and the Semisopochnoi-Amchitka Islands area where concentrations of light dusky rockfish have been found (Reuter and Spencer 2002). Compared with the status quo, the benefits would be slightly greater but probably not significant.

4.3.8.2.1.22 Shortspine Thornyheads (BSAI)

Stock Biomass (Ø) – Alternative 6 would likely have a trivial impact on the stock biomass of shortspine thornyheads compared to the status quo. The permanent closed areas, although they cover 20 percent of the bottom habitat in the BSAI, only cover a small portion (300 to 1,000 m) of shortspine thornyhead habitat. The area seems to be less than the area covered by Alternatives 4 and 5. Additionally, the displaced fishery catch of shortspine thornyhead in these areas would be minimal (Reuter and Spencer 2001). Therefore, if Alternative 6 were adopted, the effects would probably be undetectable from our trawl surveys.

Spatial/Temporal Concentration of the Catch (Ø) – No stock structure has been found for shortspine thornyheads in the BSAI. Their spatial distribution is uniform along the slope of the BSAI. Therefore, Alternative 6 would likely have little to no effect on their catch as compared to the status quo.

Spawning/breeding (Ø) – Larval and juveniles of this species are pelagic for up to 15 months after spawning. Therefore, the effect of the closures on the habitat of this life stage is probably minimal to none.

Feeding (U) – The major prey of adult shortspine thornyheads appears to be pandalid shrimp (based on the limited food information available for this species) (Yang 1993). Any direct or indirect effects of fishing on pandalid shrimp abundance is not presently known.

Growth to maturity (Ø) – The peak spawning biomass for shortspine thornyheads on the west coast is at depths from 800 to 1,000 m (Wakefield 1990). Although the suggested 20 percent permanent closure areas in the BSAI do extend over the slope, only a small fraction of it is the habitat of reproductively mature shortspine thornyheads. Additionally, the displaced fishery catch of shortspine thornyhead in these areas would be minimal in both the EBS and AI (Reuter and Spencer 2001). Therefore, there would be little to no effect on their growth potential under Alternative 6 as compared to the status quo.

4.3.8.2.1.23 Forage Species (BSAI and GOA)

Stock Biomass (Ø) – The impact of Alternative 6 on forage species is likely to be small. The areas closed by this alternative do not have a large incidence of forage species bycatch. It is unlikely that the changes in the fishing practices due to Alternative 6 would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As was stated above, the areas closed by Alternative 6 are not in areas of significant forage species bycatch. Alternative 6 would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/breeding (Ø) – The areas closed by Alternative 6 are not thought to be important to the spawning and breeding of forage species. Alternative 6 would have minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 6 are not thought to be important to the feeding ecology of forage species. Alternative 6 would have minimal effect on the feeding of forage species.

Growth to maturity (Ø) – The areas closed by Alternative 6 are not thought to be important to the feeding ecology of forage species. Alternative 6 would have minimal effect on the growth to maturity of forage species.

4.3.8.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.8.2.2.1 Salmon

Stock Biomass (Ø) – The salmon fishery is not impacted by measures proposed under Alternative 6. The bycatch of salmon may change, as the closures would change the distribution of the pollock fishery, which takes a majority of the salmon bycatch. However, the pollock fleet would likely redistribute to adjacent open areas, which likely have similar salmon bycatch rates. Thus, no changes in the catch or bycatch of salmon would be expected, so no effects on biomass would be expected.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of salmon fishing effort is expected under Alternative 6.

Spawning/Breeding (Ø) – No changes in the distribution of fisheries in salmon spawning and breeding areas would occur under this alternative, and thus no effects would be expected under Alternative 6.

Feeding (Ø) – No substantial changes in the catch of these prey species is expected under Alternative 6, so this alternative was judged to have no effects on feeding of salmon species.

Growth to Maturity (Ø) – The bycatch of salmon may change, as the closures would change the distribution of the pollock fishery, which takes a majority of the salmon bycatch. However, the pollock fleet would likely redistribute to adjacent open areas, which likely have similar salmon bycatch rates. Habitat for juvenile salmon would not be affected. Overall, this alternative was judged to have no effect on salmon growth or survival.

4.3.8.2.2.2 Crabs

Stock Biomass (E+) – The catch of crabs in the directed fisheries may be substantially reduced under Alternative 6, if the catch cannot be made up in the remaining open areas. Some of the closure areas encompass substantial portions of the stock and the areas fished in the fisheries (Figures 4.3-1 to 4.3-4) In particular, the closure encompass areas where the crab fleet has harvested substantial amounts of Pribilof Island and St. Matthew blue king crab, Pribilof Islands red king crab, AI red king crab (Petrel Bank area), Bristol Bay red king crab, and EBS Tanner crab. Additionally, this alternative would be expected to have slight reductions in the bycatch amounts taken in groundfish trawl fisheries (due to the minimum bobbin/roller gear requirements of this alternative). Overall, stock biomass was judged to be positively affected by Alternative 6.

Spatial/Temporal Concentration (E-) – Alternative 6 would substantially change the distribution and intensity of fishing effort in the crab fisheries to make the fisheries more concentrated in some areas. Thus this alternative was judged to have negative effects on spatial/temporal concentration.

Spawning/Breeding (Ø) – The closure areas designated by Alternative 6 overlap substantially with the distribution of females for some crab stocks, namely opilio and Tanner crab. Both crab fishing effort and bottom trawl effort from the closed areas would likely redistribute to adjacent areas that likely have similar abundance of female opilio and Tanner crab in any given year (the distribution of these crabs has shown significant changes over time). For that reason, this alternative was judged to have no effect on spawning and breeding of crab stocks.

Feeding (Ø) – Fisheries are considered not to have any substantial effects on the prey of crab species. Alternative 6 is considered to have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas of Alternative 6 overlap with crab EFH areas for several species including Pribilof Island and St. Matthew blue king crab, Pribilof Islands red king crab, AI red king crab, Bristol Bay red king crab, and EBS Tanner crab (Figures 4.3-1 through 4.3-4). The trawl closure areas may improve habitat and reduce bycatch mortality for crab within the closure area by eliminating potential impacts due to bottom trawling. However, it is likely that trawl fishing effort would redistribute to nearby adjacent areas also used by these crab, and this redistribution would likely dampen potential habitat benefits or reductions in bycatch resulting from these closures. The requirement for large bobbins and rollers on trawl gear footropes and sweeps is expected to reduce crab bycatch and unobserved mortality by reducing the amount of gear hitting the bottom. The nets and sweeps should simply pass over the crabs without touching them, and resulting higher survival rate. Overall, positive changes in habitat effects and survival would be expected under Alternative 6.

4.3.8.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 6 may have slightly positive effects on scallop stock biomass in the Yakutat and Kayak Island areas, as catches wold likely be reduced if they cannot be made up in adjacent open areas. However, it is likely that the change in catch would only be minor relative to the total stock size. Thus this alternative was judged to have no effect on stock biomass.

Spatial/Temporal Concentration (E-) – The distribution and intensity of scallop fishing effort is expected to change slightly in the Yakutat and Kayak Island areas under Alternative 6. The genetics and population structure of scallops are not known, and the fishery is managed to protect discrete bed, or populations. As such, this alternative was judged to have a negative effect on spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The closure areas designated under this alternative have substantial overlap with scallop populations in the Yakutat and Kayak Island areas. Therefore, Alternative 6 is anticipated to have positive effects on spawning and breeding of weathervane scallops in those areas. However, on the whole, this alternative was judged to have no substantial effect on spawning and breeding of the entire scallop stock.

Feeding (Ø) – The closure areas designated under this alternative overlap with the Yakutat and Kayak Island scallop populations, and some increases in fishing effort in nearby adjacent areas would be expected. However, fishing effort is not projected to increase in other areas with scallops. Thus this alternative was judged to have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in overall scallop dredge effort is expected under Alternative 6, and no changes in effort redistribution to scallop grounds would be expected for most areas (with the

Yakutat and Kayak Island exception), so Alternative 6 was judged to have no effect on growth to maturity.

4.3.8.3 Effects of Alternative 6 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects on federally managed fisheries, assuming Alternative 6 were in place in 2001. For additional detail and supporting analysis, refer to Section 3.8 of the RIR/IRFA (Appendix C).

4.3.8.3.1 Effects on Passive Use Values (E+)

Under Alternative 6, all bottom-contact fishing activities targeting all FMP managed species would be prohibited from 20 percent of the fishing grounds (areas shallower than 1,000 m) in the GOA, EBS, and AI. While it is currently impossible to provide an empirical estimate of the passive-use value attributable to this protection of EFH, it is assumed that Alternative 6 would yield some incremental increase in the passive-use benefit of EFH over the status quo Alternative 1. Alternative 6 would reduce the impact of bottom-contact fishing over 61,991 sq. km of GOA (17.4 percent of the current 356,199 sq. km of habitat), 136,031 sq. km of EBS habitat (17.0 percent of the current 798,870 sq. km of habitat), and 20,729 sq. km of AI habitat (19.7 percent of the current 105,243 sq. km of habitat), for a total of 218,750 sq. km, or 17.4 percent of the total fishable area of 1,260,312 sq. km in the GOA, EBS, and AI.

Alternative 6 is designed to reduce the effects of bottom contact fishing on EFH in the GOA, EBS, and AI beyond measures currently in place or planned as part of other fishery management actions. Current scientific knowledge does not permit either a quantitative or qualitative assessment of the use benefits derived from minimizing the effects of fishing on EFH. However, the assumption implicit in the Magnuson-Stevens Act requirement to minimize effects of fishing on EFH is that doing so would result in the sustained or enhanced production from FMP species and contribute to a healthy ecosystem. As such, Alternative 6 would contribute additional measures that would further reduce the impacts of fishing on EFH. Whether these measures would provide increased future use and productivity benefits over no action Alternative 1 or other action Alternatives 2, 3, 4, 5A, or 5B is unknown at this time.

4.3.8.3.2 Effects on the Fishing Fleet

<u>Gross Revenue Effects (E-)</u>
Assuming for sake of this analysis that Alternative 6 had been in place in the 2001 fishing year, it would have placed $237.2 million of commercial fishing revenue at risk, or 18.9 percent of the total $1.26 billion status quo gross revenue in that year. It is unlikely that all of this revenue at risk could have been recovered by redeploying bottom-contact fishing effort from closed areas into open areas under the EFH fishing impact minimization measures imposed by Alternative 6. Without a thorough understanding of the fishing effort redeployment strategy that would be followed by fishermen in each fishery and the impact of effort redeployment among fisheries, it is impossible to accurately predict the amount of revenue at risk that might be recovered.

Alternative 6 would have placed $163.76 million of groundfish revenue at risk, or 16.0 percent of the overall Alaska status quo revenue of approximately $1.03 billion. The halibut fishery would have had $38.34 million at risk, or 34.2 percent of the status quo revenue of $112.16 million. Crab fisheries would have had $34.11 million at risk, or 29.4 percent of the total status quo revenue of $116.0 million.

Alternative 6 would have placed $980,000 in revenue at risk in the scallop dredge fishery, or 29.1 percent of the total status quo revenue of $3.37 million. Alternative 6 would not have directly affected salmon fisheries.

Alternative 6 would have imposed EFH fishing impact minimization measures in all FMP areas. The largest revenue at risk would have occurred in the EBS, with $934.36 million, or 19.0 percent of the status quo revenue at risk. The GOA would have had revenue of $46.52 million at risk, or 22.0 percent of the status quo revenue of $211.48 million. The AI would have had $13.14 million at risk, or 11.8 percent of the total revenue of $111.30 million.

Alternative 6 would have placed $86.30 million in revenue at risk for the catcher-vessel fleet component or 21.6 percent of the total status quo revenue of $398.67 million in this fleet component. The catcher-vessel fleet component would have had the most revenue at risk in the halibut fishery at $38.28 million, or 34.2 percent of total status quo revenue. Other impacts to the catcher-vessel fleet would have included the revenue placed at risk in the crab industry ($31.26 million, or 29.5 percent of status quo revenue) and the groundfish fisheries ($16.76 million, or 9.3 percent of status quo revenue). The largest impacts in the catcher-vessel fleet would have occurred in the GOA hook and line and NPT fisheries, as well as in the EBS and AI hook and line and pot fisheries.

For the catcher-processor fleet component, Alternative 6 would have placed $150.89 million at risk, or 17.6 percent of the $858.47 million status quo revenue. Catcher-processors harvesting groundfish would have had $147.00 million in revenue at risk, or 17.4 percent of the $845.01 million status quo revenue in these fisheries. Catcher-processors operating in crab fisheries would have had $2.85 million in revenue at risk, or 28.6 percent of the status quo revenue. Catcher-processors operating in the scallop dredge fishery would have $980,000 in revenue at risk, or 29.1 percent of the status quo revenue of $3.37 million. Alternative 6 would primarily affect catcher-processors using hook and line and NPT in the GOA; catcher-processors using PTR, NPT, hook and line, and pot in the EBS; and catcher-processors using NPT, pot, and hook and line in the AI.

Alternative 6 could have significant adverse impacts on particular fisheries due to their location and their operational limitations. For example, Alternative 6 may have particularly adverse effects on the small catcher-vessel halibut longline fishery in the Pribilof Islands. These vessels have limited operational range, and the substantial area closed to longline fishing around the Pribilof Islands by Alternative 6 could preclude them from redeploying fishing effort to open fishing grounds that are beyond their safe operating range. Similarly, Alternative 6 would close significant portions of the GOA and AI scallop fishing grounds. Scallop dredging is conducted in known beds that are limited in number. ADF&G sets annual guideline harvest ranges (GHRs) for each management district based on the production potential from the scallop beds in each district. Loss of catch and revenue in one district cannot be recovered by transferring GHR to another district because each district is managed for its maximum sustained production. It is unlikely that fishermen would find new scallop beds in open areas. Therefore, scallop dredge revenue projected to have been placed at risk under Alternative 6 would more than likely have been lost. Similar revenue at risk losses may have occurred in regional groundfish and crab fisheries in each area.

In the EBS, Alternative 6 would have the largest effect on the pollock PTR fishery, with $104.04 million, or 16.8 percent of the total status quo revenue of $618.60 million at risk. Alternative 6 would have placed $28.45 million in revenue at risk, or 35.3 percent of the $80.70 million of status quo revenue in the EBS crab pot fisheries. The Pacific cod hook and line and NPT fisheries would have had $23.83 million of revenue at risk, or 17.2 percent of the $138.80 million in status quo revenue.

Alternative 6 would have placed $10.65 million of revenue at risk in the yellowfin sole NPT fishery, or 30.1 percent of the status quo revenue of $35.39 million in this fishery. The halibut hook and line fishery would have had $3.53 million of revenue at risk, or 36.0 percent of the total status quo revenue of $9.80 million.

Alternative 6 would affect nearly all bottom contact fisheries in each area. In the GOA, Alternative 6 would have had the largest effect on the halibut hook and line fishery, with $32.12 million in revenue at risk, or 33.9 percent of the status quo revenue of $94.62 million. Sablefish hook and line and NPT fisheries would have had $6.66 million in revenue at risk, or 12.5 percent of the status quo revenue of $53.21 million. Rockfish hook and line and NPT fisheries would have had $2.29 million of revenue at risk, or 21.5 percent of the status quo revenue of $10.67 million. There would have been $2.63 million of revenue placed at risk in the GOA hook and line and NPT Pacific cod fisheries, or 11.7 percent of the status quo revenue of $22.43 million. Alternative 6 would have placed $940,000 in revenue at risk, or 34.3 percent of the $2.74 million of status quo revenue in the GOA scallop dredge fishery. The GOA scallop revenue at risk almost certainly could not be recovered by redeploying fishing effort to open areas because the GHR is not transferable between districts.

Within the GOA, the CG would have had the greatest revenue at risk under Alternative 6, with $29.23 million, or 27.6 percent of the status quo revenue of $105.92 million. The WG would have had $9.73 million at risk, or 29.2 percent of the $33.20 million total status quo revenue. The EG would have had $7.56 million at risk, or 10.5 percent of the $72.26 million of status quo revenue.

In the AI, Alternative 6 would have had the largest effect on crab pot fisheries, with $5.30 million in revenue at risk, or 26.5 percent of the status quo revenue. The AI hook and line halibut fishery would have had $2.69 million at risk, or 34.7 percent of the $7.74 million of status quo revenue. The Pacific cod hook and line and NPT fisheries would have had $2.32 million at risk under Alternative 6, or 7.4 percent of the $31.35 million status quo revenue. Atka mackerel NPT, flatfish NPT, and sablefish hook and line and NPT fisheries would also have had revenue placed at risk in the AI under Alternative 6.

Revenue impacts from changes in product quality would be likely under Alternative 6 for the catcher-vessel fleet. The catch and revenue at risk impacts under Alternative 6 would be relatively large for the catcher-vessel fleet component and would likely result in longer fishing trips and extended running time for catcher vessels fishing in open areas. The increased running time, especially in more exposed and extreme sea and weather conditions, is inversely correlated with the quality of groundfish and halibut catch delivered for inshore processing. These conditions are also associated with increased deadloss in crab fisheries.

Product quality might not be affected in the catcher-processor fleet component, since these vessels process the catch onboard the vessel. However, the catcher-processor fleet would still be adversely affected if the average size of the fish or their condition were significantly different in the remaining open areas than would have been expected in the closed areas. For a number of economically important species (e.g., pollock, Pacific cod), the size of the fish is highly correlated with its use in production of specific products. As the fish get smaller on average, the product forms that can be produced and successfully marketed become fewer. Production that would have supplied a relatively high-value market (e.g., deepskin fillets) might have to be diverted to low-value product forms, with accompanying adverse effects on net revenues per unit output, and perhaps even downstream impacts on quality, product mix, supplies, and prices to consumers.

Operating Costs (E-)
Alternative 6 would likely have significant adverse impacts on the operational costs of most, if not all, of the bottom contact gear groups. Elimination of 20 percent of the fishing grounds in each region would require additional running time to reach open areas and return to port to deliver catch (or product). It is likely to result in fishing in areas with lower CPUE, requiring increased fishing effort to recover catch and revenue at risk. Additionally, it could promote exploration of unfamiliar fishing grounds, with associated gear damage and loss, and could aggravate gear conflicts that also cause expensive gear loss or damage. Fishermen may attempt to mitigate the loss of revenue at risk in bottom contact fisheries by converting to pelagic gear, when possible, requiring substantial investments in vessel modifications and/or new fishing gear. There may also be additional costs resulting from learning to fish new gear in new areas.

Costs to U.S. Consumers (E-)
There would very likely be an increase in costs and a reduction in consumer welfare from Alternative 6, because the total revenue at risk would most likely not be recovered in all areas and for all species. Reducing the supply and product mix produced by these fisheries would be expected to adversely affect both domestic and international markets. This would likely mean shorter supplies at the retail level, a reduced variety of seafood products, perhaps lower quality, and higher prices to consumers. These welfare losses, while not amenable to quantification at this time, would nonetheless represent a real cost attributable to Alternative 6. In accordance with OMB guidance, only consumer welfare losses accruing to United States consumers are appropriately included in these benefit/cost calculations. A substantial portion of the production from these fisheries would be destined for United States domestic markets.

Safety (E-)
Adoption of Alternative 6 is likely to adversely affect safety in many of the affected fleet components and fisheries. Large area closures to all bottom-contact gear could result in vessels traveling farther from their homeports and shoreside delivery locations, increasing the length of fishing trips. Fishing in remote areas could impose additional risks of weather-induced safety impacts and increase the time required for response to emergencies. Closures of traditional, local fishing areas may induce fishermen to take additional risks, run the extra miles of open seas, or fish in weather and sea conditions that they would normally avoid in order to remain economically viable in the fishery. All of these responses to the Alternative 6 closures would have placed greater strain on vessels and crew, reducing safety margins for the industry.

Impacts on Related Fisheries (E-)
Alternative 6 may have significant adverse impacts on related fisheries. Under Alternative 6, bottom-contact fisheries would be confined to the remaining fishing grounds unrestricted by EFH fishing impact minimization measures or other management closures. Significantly reducing the area available for bottom-contact fishing could result in incompatible gears attempting to fish the same area at the same time. These gear conflicts can result in loss of catch, ghost fishing by derelict gear, and higher costs for everyone fishing the grounds, even those not directly regulated by the provisions of Alternative 6. In extreme cases, these conflicts can cause considerable damage and can even place vessels and crew at risk.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs would likely increase under Alternative 6, although it is not possible to estimate by what amount. Additional on-water enforcement may be required to assure compliance with the EFH fishing impact minimization measures applied in the GOA, EBS, and AI. VMS equipment or 100 percent observer coverage could be required of all vessels using bottom contact

fishing gear in each area. Section 3.1.2.7 contains some additional discussion of the NMFS Enforcement and Coast Guard responses to resource demands connected with monitoring and enforcement provisions of Alternative 6.

4.3.8.3.3 Effects on Communities and Shoreside Industries (E-)

Overview

Alternative 6 is very different from the other alternatives in terms of potential impacts on dependent communities and shoreside industries. Unlike the other alternatives, had it been in effect in 2001, Alternative 6 would have had a direct impact on gear types other than nonpelagic trawl gear and on fisheries other than groundfish. In addition to those involved in the groundfish fishery, communities engaged in or dependent upon the crab, scallop, and halibut fisheries could also have experienced adverse impacts. Alternative 6 would have resulted in impacts to vessels using hook and line, jig, nonpelagic trawl, pelagic trawl, and pot gear in the groundfish fisheries, as well as pot gear in the crab fisheries, dredge gear in the scallop fisheries, and hook and line gear in the halibut fisheries.[2] This alternative would also impose a large geographic footprint, and potential impacts could have been realized in communities with links to a range of fisheries in the GOA, EBS, and AI areas.

In the following subsections, impacts to catcher vessels, catcher-processors, and shorebased processors are summarized, along with the links of these sectors to communities that would result in impacts having been realized in dependent communities. In addition to these more-or-less straightforward impacts, Alternative 6 also has a number of differences from the other alternatives under consideration. For this reason, Alternative 6 would have resulted in a different order of magnitude of impacts in some communities, based upon different types of interactive impacts. For an extensive treatment of community level effects the reader is encouraged to read Section 3.8.3.2, Impacts on Dependent Communities, in the Alternative 6 analysis contained in Appendix C of this EIS.

Unlike the other alternatives, Alternative 6 features large closure areas, close by (or immediately adjacent to) a number of communities. Thus, in addition to having impacts on a broad range of fishery participants utilizing wide-ranging fleets, it could result in profound localized impacts for a number of communities with small-boat-based fleets through the closure of a significant portion of (or even all) waters within the operational range of small vessels. One example of this would be St. George in the Bering Sea, where over 97 percent of waters within 20 miles of the community would have been effectively closed to halibut fishing, which at present is the only commercial fishery pursued by the local resident fleet. It is an enterprise that has seen considerable investment of time, effort, and resources, not only by local residents, but also by the federal government (e.g., U.S. Army Corps of Engineers) and the regional CDQ group (Aleutian Pribilof Islands Community Development Association), in an attempt to foster a more viable fisheries base for the local economy that has not recovered from earlier federal withdrawal from the community. In other communities, local small boat fleets engage in a range of fisheries that could not be pursued within EFH closure areas under this alternative.

In addition to having impacts on communities already engaged in or dependent upon a range of fisheries, this alternative would also make it more difficult, if not impossible, for a number of other communities to develop small-boat-based commercial fisheries in the future. Perhaps the most extreme

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[2] At its April 2003 meeting, the North Pacific Fishery Management Council clarified that subsistence and recreational fisheries would not be included in Alternative 6; therefore, the discussion in this section assumes that the only potential impacts to these fisheries would be indirect (and would result from direct impacts to commercial fishing).

example of this would be Nelson Lagoon, in the Aleutians East Borough. While not a major participant in halibut fisheries at present, virtually all waters within 20 miles of the community would have been closed to bottom gear, meaning future development of a small boat fishery would be effectively precluded as long as the closure remains in effect. Of course, EFH area closures would be only one of the factors that could impede such development. The fact that halibut and sablefish fishing is now governed by an IFQ system that restricts entry would be another significant barrier.

The type of localized impacts associated with Alternative 6 would also have interactive effects when applied in conjunction with existing management measures and ongoing dynamics. This type of interaction would, of course, occur under all of the alternatives, but is expected to be most profound in terms of community impacts for Alternative 6. A primary example of this would be the cumulative impact of Alternative 6 closures near communities, combined with Steller sea lion protection measure closures recently put in place near a number of those same communities. Both serve to effectively limit the areas available to small boat fleets.

Another source of interactive or cumulative impacts for a number of communities (and not just those with small vessel fleets immediately at risk under this alternative) would be seen in the fishery management measures not yet in place, but under active consideration for implementation in the immediate or foreseeable future. These include BSAI crab and GOA groundfish fisheries rationalization actions. Of the two, the BSAI crab rationalization initiative is further along in the alternative development process. It is clear that, depending on the alternative ultimately selected for implementation, 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 would also include a number of other communities, such as those in the Aleutians East Borough, depending on the features of the particular rationalization approach taken.

Another type of interactive effect that would influence the magnitude of impacts felt under Alternative 6 would be the 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 the decline of the crab fishery over the past several years has already resulted in adverse impacts to a number of those 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 impacts of Alternative 6 would be magnified. 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 CDQ region 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 could have been adversely affected by area closures under this alternative. Examples 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.

In the following sections, potential impacts to communities are discussed in terms of links to catcher vessels, catcher-processors, processors, and their respective activities. The likely impacts in any given community depend on the nature of engagement in the fisheries (and the relative level of dependence on the relevant fisheries), and this varies from community to community. Some communities have substantial engagement in the fishery through direct participation of a local catcher-vessel fleet, while engagement for other communities occurs primarily through local processing activity. Some communities are substantially engaged through both harvesting and processing, and local fishery support service businesses form a part of the economic foundation of the community for others. Additionally, a few communities participate through engagement with the catcher-processor sector.

Changes in each of these sectors have the potential for different types of community impacts. For example, local catcher-vessel fleets tend to provide employment and income to local residents. On the other hand, few long-term community residents may be involved in processing operations in a number of communities, but processing activity may underpin local economies through generation of municipal revenues. Both sectors may stimulate business for support service providers in a number of different ways. In the following discussions, engagement by sector by fishery by community is provided, along with associated impacts to dependent communities. A treatment of multi-sector impacts and small-boat-fleet impacts from near-community closures follow the individual sector discussions.

Catcher Vessel Community Impacts Summary

For catcher vessels, there would have been revenue at risk in the groundfish, crab, and halibut fisheries (but not the scallop fishery, as all participants in that fishery are classified as catcher-processors). In the groundfish fishery, for the affected catcher-vessel sector as a whole, at-risk revenue accounts for 9.3 percent of total relevant 2001 status quo revenue ($16.76 million at risk out of $180.60 million). Both halibut and crab fisheries would have had higher absolute and relative amounts of revenue at risk, notwithstanding that groundfish status quo revenues are higher than for either crab or halibut. As noted elsewhere, figures given for catcher vessels represent ex-vessel revenues, which would tend to understate the overall value to associated communities that derive benefits from both harvesting and processing activities, if examined separately. Values for first wholesale revenues at risk by shoreside processors from landings of catcher vessels are referenced in the discussion of shoreside processor locations provided below. For halibut, 34.2 percent of the 2001 status quo revenues of all affected vessels would have been placed at risk ($38.34 million out of $112.16 million), with the analogous figure for affected crab catcher vessels being 29.5 percent ($31.25 million out of $106.03 million).[3]

The likely effects of Alternative 6 on communities through catcher vessels are complex and interactive. Community catcher vessel fleets vary in the extent to which they diversify or participate in multiple fisheries. For example, many of the vessels participating in the EBS groundfish fisheries specialize in pollock and may also fish for some Pacific cod and perhaps for crab. Boats fishing the GOA fisheries tend to participate in more fisheries (although large pollock boats specialize more than others even there). In general, the more diversified a catcher vessel is (i.e., the more fisheries in which it participates), the better able it is to adapt to changes (and especially negative changes) in any one fishery. However, if more than one such fishery is affected at the same time, as would most likely have been the case under Alternative 6, fishery diversification may actually intensify such negative effects.

[3] As a methodological note, fishery revenue totals in the different data sets used for different parts of the analysis in the EFH RIR and EIS are similar, but not identical, due to different assumptions and derivations of the information. Further complications are introduced when revenues from a number of different fisheries with different records are distributed to communities, which requires a number of simplifying assumptions. The quantitative information presented in this section is most useful for relative comparisons and for understanding the direction and general magnitude of change likely under this alternative, rather than for a precise quantification of the exact dollars involved.

Catcher vessels (and community fleets) also differ in the extent to which they participate in more local versus more distant water fisheries. EBS groundfish boats are almost all distant-water vessels – whether from the Pacific Northwest (Seattle or Newport, for example) or larger Alaska ports (such as Kodiak and Homer). Unlike the groundfish fisheries, there are small local fleets in the EBS for halibut (in the Pribilofs). GOA fisheries, on the other hand, tend to have a significantly more local fleet character due to the participation of many Alaska vessels homeported in or near the GOA, although many vessels from the Pacific Northwest participate in GOA fisheries as distant water vessels. An important aspect of this in terms of community effects is that catcher vessels have a variety of direct and often more pervasive ties to the communities in which they are homeported than do catcher-processors or even locally operating fish processing plants. Catcher vessels tend to be operated by year-round community residents who hire other residents and buy goods and services locally. While catcher vessels are relatively small operations compared to other fishery entities, they are numerous and exist in communities of all sizes. In contrast, catcher-processors tend to be from larger communities, and processors are often not well integrated into the day-to-day economic flow of the communities where they operate. While often major contributors to local government revenue, a number of plants import their labor force and buy most goods and services from outside of Alaska.

Under Alternative 6, catcher vessels would have been most affected by EFH measures through the pollock, crab, and Pacific cod fisheries in the EBS, and the halibut, sablefish, and Pacific cod fisheries in the GOA. Those communities with a catcher-vessel fleet that had significant participation in these fisheries in 2001 form a relatively small class. Seattle and Kodiak stand out because of the magnitude of potential effects in one fishery, the combination of effects in multiple fisheries, or both. However, Seattle is a very large community, and while Alternative 6 effects would no doubt have been significant for individual operations and industry sectors, they would not likely have been significant on the community level. For Kodiak, however, the catcher fleet would have faced a significant percentage of the normal harvest as being at risk – an undefined percentage of EBS pollock (and some Pacific cod), about 23 percent of the total halibut at risk, about 16 percent of the total crab at risk, and a significant portion of the sablefish at risk. Halibut and sablefish are primarily GOA fisheries, where Kodiak boats participate as part of a more local fleet. It is not uncommon for Kodiak catcher vessels to participate in several of the affected fisheries, so that individual operations would certainly have been affected. Because of the number of such operations in Kodiak, it is likely that there would have been community-level economic effects as well. Much would depend on the degree to which fishing operations were successful in replacing their harvest from closed areas with harvest in areas that remain open.

Other communities also host vessels that participate in multiple fisheries, so that these communities may also have experienced effects from multiple fisheries. Most are Alaska communities – Homer, Sitka, and Petersburg. Newport, Oregon, may also fit in that category, although its participating vessels are fewer and less diversified in terms of fisheries. Vessels from these communities participate in the halibut, sablefish, pollock, and Pacific cod fisheries, but not in the numbers that those from Kodiak do. Many of these boats also tend to be more local or to fish strictly in the GOA than do Kodiak boats as a fleet, although many Kodiak boats also follow that pattern. Whether the impacts on the fleets of these communities would achieve the threshold to cause community-level effects is not clear. Because much of the at-risk revenue is from GOA fisheries (especially halibut and sablefish) or EBS fisheries (especially crab and, to a degree, pollock) in which GOA community fleets participate, Alternative 6 effects on catcher vessels would have been most likely to translate into community-level effects for GOA communities. Kodiak and Homer would have been the primary communities where these effects would have been likely to occur, but a number of other communities would also have been affected. In terms of specific effects, much would depend on the ability of fishermen to catch fish in areas other than where they have caught them in the immediate past.

There are also a few other communities for which more fishery-specific Alternative 6 effects should be assessed. These arise because of the nature of catcher-vessel fleets from those communities. The Pribilof communities of St. George and St. Paul both have local fleets whose only harvest is halibut. There has been interest in, and some effort to, include cod jigging as an additional focus for the Pribilof small-vessel fleets, but the current lack of local processing on St. George and the lack of true multi-species processing on St. Paul have limited development in this area. Vessels from St. George harvest a significant portion of the halibut at risk in Alternative 6. This fishery is an important component of the community development of St. George, and any adverse impact on it would be significant. Other effects are also possible. Although not apparent in the 2001 existing conditions data, St. Paul fishermen reported that Steller sea lion protection measures and competition from nonlocal (distant water) halibut vessels have resulted in current redistribution of at least some effort to areas that would have been closed under Alternative 6. To the extent that such a redistribution has occurred, potential impacts would increase. The communities of Sand Point and King Cove have catcher-vessel fleets that participate in a wide range of fisheries, many of which would have been affected by Alternative 6 (pollock, Pacific cod, and halibut, especially). Vessels from these communities tend to be smaller than other groundfish vessels and so may be disadvantaged relative to the overall fleet in terms of ability to fish other areas to replace at-risk catch. The larger boats, participating in these fisheries as a distant water fleet, suffer no such disadvantage (assuming that there are other fish to be found), since this extra distance is a small percentage of their total trip in any event. The local fleets of Sand Point and King Cove are also located such that they, too, are experiencing effects from restrictions on fishing due to Steller sea lion measures. At the same time, the salmon fishery, upon which they also depend, is in poor economic shape and is facing increasingly restrictive Area M (salmon) management measures. These factors would serve to amplify any adverse impact that would accompany Alternative 6.

Catcher-Processor and Mothership Community Impacts Summary

For motherships and catcher-processors, there would have been revenue at risk in the groundfish, crab, halibut, and scallop fisheries. For the affected catcher-processor sector in the groundfish fishery as a whole, at-risk revenue accounted for 17.6 percent of total relevant 2001 status quo revenue ($147 million at risk out of $845.01 million). Halibut, crab, and scallop fisheries would have had higher percentages of revenue at risk for the affected catcher-processors, but much lower absolute at-risk values than seen for groundfish. For halibut, 48.0 percent of the status quo revenues of affected vessels would have been at risk, but this is only approximately $60,000 out of $120,000. For crab catcher-processors, 28.6 percent of the status quo revenues of the affected vessels would have been at risk ($2.85 million out of $9.97 million), while 29.1 percent of the status quo revenues of the affected vessels for scallop catcher-processors would have been at risk ($980,000 out of $3.37 million).

Overall, community impacts associated with catcher-processors under Alternative 6 would have been concentrated in Seattle, with a few exceptions. These exceptions include the few communities in Alaska with individual catcher-processor ownership and CDQ entities with group ownership interests in catcher-processors.

Although there would likely have been adverse impacts to a number of the fishery participants in the catcher-processor sector, impacts to Seattle as a community would potentially have been insignificant due to the size and diversity of the local economy and the fact that the workforce for the catcher-processor sector is not drawn from any single community. Catcher-processor employment, at least for the processing positions for vessels owned by Seattle residents, is mostly transient and drawn from a large region, primarily the Pacific Northwest, but also includes other western states in the continental United States, as well as Alaska. Ownership of mothership operations is concentrated exclusively in Seattle. As is the case with catcher-processors, while individual operations may experience adverse

impacts under this alternative, no community-level impacts associated with motherships would have been likely to occur.

Catcher-processor-related impacts to Alaska communities under Alternative 6 would have accrued to few communities (primarily Kodiak, Petersburg, and Unalaska), but as detailed earlier, community level impacts associated specifically with catcher-processors would potentially have been relatively insignificant. Impacts directly associated with catcher-processors, due to the mobile nature of their operations and their limited numbers, would have been much less apparent in engaged communities than are larger catcher-vessel fleets and continuously present shoreside processors. The activities of these latter two groups also tend to generate more indirect local economic activity than catcher-processors. Catcher-processor support service businesses are important for some Alaska communities, especially Unalaska and, in more recent years, Ketchikan.

CDQ group investments in the catcher-processor fleet have grown substantially in recent years, and CDQ communities would be vulnerable to adverse impacts to the Seattle catcher-processor fleet with whom they partner or with whom they have capital invested. The level of significance of these impacts would depend on a number of factors and is unknown at this time.

Shoreside Processor Community Impacts Summary

The total first wholesale value at risk of catch delivered inshore for processing represents approximately 21 percent of the total 2001 status quo value ($53.61 million out of $261.26 million) of the relevant fisheries of the GOA area, about 23 percent for the AI area ($7.97 million out of $35.04 million), about 14 percent for the EBS area ($71.20 million out of $514.54 million), and about 16 percent for all areas combined ($132.77 million out of $810.84 million). No breakdown by port of landing is available. Caution must be exercised in the interpretation of these wholesale value data as (1) they are not additive with ex-vessel values presented above and (2) they cannot be used as a proxy for potential levels of impacts to specific communities without considering the basic caveats laid out in the introductory paragraphs of the shoreside processor section of the Alternative 2, Effects on Communities, discussion presented above. Overall revenue at risk under Alternative 6 is more than 33 times greater than for any of the other alternatives. The following sections provide information on potential processor related community impacts by major species group by community.

Analysis of potential community effects due to Alternative 6 on shoreside processors is less straightforward than for other sectors. Initially, how communities are affected by shore plants depends upon how those shore plants would have been affected by Alternative 6-related changes in delivery patterns. Secondly, the quantitative information available on processors is less amenable to analysis and more subject to confidentiality restrictions than the vessel-related information.

The primary avenues for Alternative 6-related effects on processors to affect communities would appear to be related to a limited number of fisheries:

- EBS crab
- EBS pollock and, to a lesser degree, EBS Pacific cod
- GOA halibut
- GOA sablefish
- GOA rockfish
- GOA Pacific cod

Using 2001 data, shore plants located in the EBS communities did not process at-risk GOA fish in that year, but processors located in GOA communities did process at-risk BSAI crab.

In the EBS, Unalaska processors would have potentially been affected by Alternative 6 through the crab, pollock, and Pacific cod fisheries. These three fisheries represent a significant (and typically predominant) percentage of Unalaska shore plant production, and any reduction in the volume of fish would translate into direct effects on these operations. In addition, these shore plants (and the deliveries associated with them) are an important source of tax revenue to the communities in which they are located, primarily through fish taxes. Reductions in volumes of fish processed would translate directly into reduced community tax revenue. The degree to which potential Alternative 6 effects would be realized would depend on the ability of the catcher fleets that deliver to these plants to replace the at-risk fish with harvest from areas where they have not fished in the immediate past. Even if the volume could be replaced, if catcher vessels incurred increased costs that must be passed on to the processors, some operational effects would be possible (although this may actually increase tax receipts for communities). Given the relatively large amount of fish and crab involved, some degree of effect, at least in terms of fish tax revenues, would likely have occurred, had this rule prevailed in the 2001 fisheries. Other EBS shore plant locations cannot be discussed in detail due to confidentiality restrictions. The plant in Akutan is probably similar in potential effects to those in Unalaska.

The Pribilofs, and especially St. Paul, may be a special case in terms of potential impacts due to effects on processors from multiple fisheries affected by Alternative 6. The processors in St. Paul rely very heavily on opilio crab and have also processed halibut in recent years. The local catcher-vessel fleet relies strictly on halibut, but local halibut processing is reported to be highly dependent upon crab processing in the sense that halibut alone would not induce a processor to operate on St. Paul (although crab processing in the absence of halibut processing has been viable). Local halibut processing relies on deliveries from outside vessels as well as local vessels. The boats that would have at-risk revenues under Alternative 6 that delivered halibut in recent years to St. Paul were from Gig Harbor, Homer, Kodiak, Newport, Seattle, and St. Paul itself (although the data show St. Paul vessels delivering at-risk revenue catch only in 2000). Amounts processed in the community are confidential, but halibut numbers taken from the areas that would have been closed by Alternative 6 were modest from 1998 to 2000, before rising substantially in 2001. The effects Alternative 6 would have had on these processing dynamics are uncertain, particularly because crab processing in the Pribilofs has been variable in the past. A number of apparently unconnected services available in the community are often related to local processing and fishing activities. For a given community, for example, 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 certainly the case in the Pribilofs and Adak, as well as in 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 on the general quality of life in these communities.

GOA processors are concentrated in Kodiak, and Kodiak processors would potentially have been affected through the GOA halibut, sablefish, rockfish, pollock, and Pacific cod fisheries. In addition, Kodiak processors (and others in the GOA) have processed an increasing amount of EBS crab from

1998 to 2001. The dependence of any processor on this mixture of fisheries was not available for this analysis, but potentially a significant percentage of the fish Kodiak processors have depended on in the past would have been at risk. The degree to which the catcher fleet that delivers to these plants can replace those fish at risk would determine the extent of effects. The catcher fleet is composed of both local and nonlocal (distant waters) vessels, which differ in their capabilities in harsh weather and sea conditions. Assuming that alternative locations for productive fishing exist for those closed by Alternative 6, potential effects on the catcher fleet should have been at least partly mitigated.

Processors in Sitka, Petersburg, and perhaps other locations could also have been affected in similar ways to those in Kodiak, although the number of vessels delivering to them is fewer than for Kodiak. Their fleets tend to be more local and thus may be less able to find productive alternative fishing areas to those that would have been closed by Alternative 6. These processors would have been more affected by the halibut, sablefish, rockfish, Pacific cod, and in some cases the EBS fisheries than the pollock fishery.

Information needed to discuss potential effects on communities due to effects on niche processors is available. The loss of such enterprises could be significant for small communities, and small vessels and these processing enterprises/outlets may be quite interdependent in such locations.

Multi-Sector Impacts

Individual communities would have experienced different outcomes resulting from Alternative 6 based on a variety of factors involving the specific attributes of local fishery engagement and dependency. Different communities have different constellations of local fleets, processors, and support service sectors. Communities also differ in the way municipal revenues are derived from fisheries-related activities including, in some cases, local raw fish taxes, business taxes, sales taxes, fuel taxes or transfer fees, fees for the provision of services, or similar mechanisms in various combinations. Communities also variously derive fishery-associated revenue benefits from the resource landing tax and state shared taxes. In the case of boroughs, communities that have little if any direct engagement in commercial fisheries may substantially benefit from fishery-related revenues generated in other communities within the borough, or activities outside of city boundaries but still within borough jurisdiction. Other benefits vary from community to community based on a number of factors, including the presence and composition of local private sector businesses that to varying degrees may derive revenue or income directly or indirectly from fisheries-related activities.

Dependence on the fisheries also differ from community to community. For example, some fisheries that would have been affected by Alternative 6 are managed quite differently than others. The halibut fleet is fully rationalized under an IFQ management approach, EBS pollock is partially rationalized under a harvester cooperative allocation system, and the crab fleet still participates in derby type fisheries. These different management systems would likely lead to differences in the relative ability to recover revenues, perhaps for the fishery as a whole, but certainly for individual fishing enterprises (vessels) within each fishery. All other things being equal, if there are fish to be found to replace those harvested in the past in areas that would have been closed by Alternative 6, rationalized fisheries give the best chance for each individual vessel to do so, because rationalization imparts quasi-property rights to a known share of the TAC to each quota holder (or group of cooperating operations), whether large or small. Under rationalized fishing rules (e.g., ITQ, QS, cooperatives), no vessel (or cooperating group of vessels) can increase its relative harvest share without lawfully acquiring harvesting rights from someone else in the fishery willing to part with those rights. Under open access fishing rules, on the other hand, vessels would be expected to display a differential pattern of success in replacing at-risk

catch and revenues (i.e., the race for fish goes to the swiftest, most technologically advanced, most seaworthy vessels). This, in turn, would lead to different community outcomes.

As noted earlier, Alternative 6 would potentially have affected a number of different fisheries. While often managed more or less independently, for many fishing enterprises these different fisheries are highly interdependent. Thus, impacts to fisheries-dependent communities under Alternative 6 would have been interactive and would have varied by fishery and relative community dependence upon particular fisheries (through individual sectors or combinations of sectors). While the groundfish harvest database used for this analysis currently does not have information on the region from which vessels caught their fish, those fisheries with such information for 2001 (halibut and crab) indicate that GOA fishing fleets that would have been affected by Alternative 6 tend to be more local than affected BSAI fishing fleets (with some exceptions). The same Alaska communities tend to have the greatest number of vessels participating in the halibut and crab fisheries as in groundfish – Kodiak, Homer, Sand Point, Petersburg, and Sitka. Kodiak vessels also participate heavily in EBS fisheries. All of these communities are heavily engaged in fishing, and several are relatively dependent upon fishing, with Sand Point being perhaps the most extreme case. Several communities stand out as likely to have experienced multi-sector impacts from Alternative 6.

Kodiak, as mentioned in earlier sector discussions, is engaged in the most heavily affected GOA and BSAI fisheries through its local groundfish, halibut, and crab catcher-vessel fleets; through locally owned catcher-processors; and through locally operating shoreside processors. No other Alaska community has the same depth of multi-sector engagement with fisheries at risk under this alternative. Kodiak is predominant in virtually all the major catcher vessel fisheries, with the exception of the BSAI halibut fishery. As a community, Kodiak derives substantial benefits from support service activities as well as through public sector means, such as harbor fees. While Kodiak has a relatively large and diversified economy, multi-sector impacts from the different fisheries would likely have occurred at the community level.

Within the Aleutians East Borough, Sand Point would have experienced multi-sector impacts through substantial catcher vessel participation in the major at-risk GOA groundfish fisheries, the EBS pollock fishery, the GOA halibut fishery, and through local shoreside processing of at-risk harvests. Sand Point in general is heavily engaged in and dependent upon commercial fishing; as noted earlier, a number of other factors that have weakened local commercial fisheries make Sand Point especially vulnerable to any level of impact from EFH-related actions. King Cove, also within the Aleutians East Borough, would have experienced similar impacts, but likely to a lesser degree due to an apparently lower level of engagement in at-risk fisheries.

St. George and St. Paul in the Pribilofs would have experienced a range of local fleet and processor impacts. While at present only St. Paul has local processing, local St. George catch is currently tendered to St. Paul, meaning adverse impacts to St. Paul processors would likely have been felt in both communities. St. Paul itself is particularly vulnerable to adverse impacts to opilio processing under this alternative.

Within the Kenai Peninsula Borough, Homer is a port of ownership for vessels that harvest a substantial portion of the at-risk catch in the major GOA groundfish fisheries and BSAI groundfish fisheries and, thus, would have been affected by Alternative 6 primarily through its local fleet. Processing would have been affected relatively little compared to some other communities. The Kenai Peninsula Borough community of Seward would also have felt impacts through its local fleet, but to a lesser degree than Homer. Overall, due to a diversified, road-connected local economy and their relatively large size, these

communities are less dependent on fishing in general than either Kodiak or the Aleutians East Borough communities noted. While individual sector impacts may involve higher values than seen for the Aleutians East Borough communities, Homer and Seward would likely have been less adversely affected at the community level than Kodiak and the Aleutians East Borough communities.

The Southeast Alaska communities of Sitka and Petersburg are involved in a number of affected fisheries through both local catcher-vessel fleets and shoreside processing and, in the case of Petersburg, through catcher-processor ownership. In general, however, dependency on Alternative 6 at-risk revenues would generally have been lower for these communities than that seen in some of the other communities, due to the size of the local fleets and the overall relative size and diversity of the local economies.

Unalaska would have experienced impacts primarily through local shoreside processing, but there is some local ownership of affected catcher-processors as well. Unalaska has a relatively large fisheries economic sector, so it is not likely that the level of risk associated with Alternative 6 would have been significant at the community level, although a degree of uncertainty for processor impacts remains.

Seattle would have experienced a wide range of impacts under Alternative 6. Seattle is the most heavily engaged of any community in the at-risk fisheries in terms of catcher vessel, catcher-processor, and mothership participation, and it is the dominant center of shoreside processor ownership as well. Given the size and the diversity of the local economy, however, Seattle cannot be considered a community that is dependent upon the affected fisheries, despite the fact that if Seattle engagement were to end, a number of the affected fisheries would be a fraction of their current size. While individual operations and sectors based in Seattle may have experienced adverse impacts under this alternative, community-level impacts are not forecast for the city.

Small Boat Fleet Impacts from Near-Community Closures

As noted earlier, Alternative 6 features large closure areas close to a number of communities. This could result in profound localized impacts for a number of communities with small-vessel-based fleets through the closure of a significant portion of (or even all) waters within the range of small vessels. In addition to having impacts on communities already engaged in, or dependent on, a range of fisheries, this alternative would also make it more difficult, if not impossible, for a limited number of other communities to develop small-vessel-based commercial fisheries in the future due to permanent closures of nearby waters. While it is impossible to quantify these future effects that may or may not occur, closure areas near communities would have created different potential futures with and without Alternative 6.

The actual range of community small-vessel fleets varies considerably based on a number of factors, including the size of vessels in the fleet and nearby ocean conditions. All things being equal, larger vessels have greater range, as do fleets from communities with relatively protected nearby waters.

As a simplifying assumption, the first step in identifying those communities most likely to experience small-vessel-related impacts (or potential future impacts) due to nearby closures was to consider coastal communities within 20 miles of a closure area. To identify these communities, a 20-mile buffer was drawn around areas that would have been closed under Alternative 6. A second buffer was drawn inland 5 miles from those areas of the coast that were touched by the first buffer. Communities within the intersection of these two buffers (that is, within 20 miles of an EFH closure area and within 5 miles of the coast) were identified as coastal communities with nearby Alternative 6 closure areas within the assumed range of a local small-boat fleet. While actual small-boat-fleet ranges vary, and communities

more than 5 miles inland could also have been affected (meaning that a greater or lesser number of communities could have been affected), these simplifications were used to derive an initial list of affected communities. Using this methodology, 26 communities were identified, including 25 contemporary civilian communities and the Coast Guard/military station at the historic community of Attu.

To establish a potential measure of gross, spatial-based, effects, maps were compiled by drawing a 20-mile radius around the identified communities to show the assumed range of locally based small vessels. The maximum available ocean area within this radius was calculated (area within the radius, minus existing Steller sea lion closures). Under actual conditions, some area less than the maximum would actually be available for fishing, due to factors such as bathymetric constraints. Within the total existing conditions maximum available ocean area, the area that would have been closed under Alternative 6 was calculated, as well as the area that would have remained open, along with the area that would have been closed as a percentage of existing conditions maximum available area. Communities ranged from having well less than 1 percent to more than 98 percent of nearby waters that would have been closed under this alternative. Of the communities identified as having at-risk catcher vessel revenues under Alternative 6, St. George would have had by far the largest percentage (97.1 percent) of nearby waters closed under this alternative. Five communities (Nelson Lagoon, St. George, Port Heiden, Nikolski, and Akhiok) would have had more than 70 percent of the maximum available nearby waters closed, an additional four communities (Toksook Bay, Larsen Bay, Tununak, and Chenega Bay) would have had between 33 1/3 and 50 percent of otherwise available nearby waters closed, and a further nine communities would have between 10 and 25 percent of nearby waters closed under this alternative.

In terms of actual consequences that could have resulted from these closures, the existing conditions maximum available ocean area varies greatly between communities due to the geography of nearby land forms, with the result that percentage closed areas might not be the most important variable in determining overall spatial-related impacts. For example, a community located on a small island would have a great deal more ocean area available to it than a community along a coast with a concave geometry. A 50 percent closure near a community with a large available area nearby, all things being equal, might leave enough waters within range of the community to support a local fleet, but the same might not be true for communities with a relatively small area accessible under existing conditions. Again, real world constraints would determine the utility of those waters for productive fishing. Communities in many different areas of Alaska would potentially have been affected by nearby waters closures.

Figure 3.8-1 in Appendix C graphically displays open and closed areas within 20 miles of identified communities. The figure also displays overall Alternative 6 closure areas in the same regions.

Of the potential existing conditions, small-vessel fisheries affected by nearby waters closures, halibut is clearly the most important, and only a subset of the communities identified as potentially affected actively participate in the fishery. A multi-step method was used to identify communities with currently active small-vessel halibut fisheries, as well as the potential scale of effects. The first step was to search Alaska Commercial Fisheries Entry Commission (CFEC) permit records by community to define those communities with current (in 2001) resident halibut permit holders in the "vessels less than 60 feet in length" category. Unfortunately, this also includes fairly large vessels, but permit types are not broken down into smaller length increments. Communities that lack active resident permit holders were eliminated from the list of potentially affected communities. The 13 relevant communities with current halibut permit holders (less than 60-foot category) are Chignik Lagoon, False Pass, King Cove,

Mekoryuk, Old Harbor, Pilot Point, Port Alexander, Port Lions, St. George, St. Paul, Toksook, Tununak, and Yakutat. Information on the number of permits held, permits fished, total pounds landed, and estimated gross earnings by community for 2001 is presented in Appendix C. As shown, 210 halibut permits are held in these communities, and the number of permits held by residents of individual communities ranged from 1 to 43.

Estimating small-vessel harvest placed at risk under Alternative 6 is problematic. Such an analysis would be possible, in part, through extensive queries of AKFIN halibut harvest data on a vessel-by-vessel basis, but (even if successful) the fundamental difficulty in performing such queries is that much of the data is confidential and cannot be reported. In fact, CFEC harvest data are restricted due to confidentiality for several of the 13 relevant communities. If one were to add another set of criteria defining small vessels as those under 28 feet in length, for example, the confidentiality restrictions would make consistent evaluation of the potential effects on communities using vessel-by-vessel data impractical.

Three other sets of data with less problematic confidentiality restrictions provide information on the scale of potential effects on communities. First, the closed ocean surface area in specific statistical reporting areas within 20 nm of the affected communities was calculated, as was the percentage that each of these closures represents of the total surface area in the affected statistical area. This differs somewhat from the total nearby waters closed area data presented elsewhere because it is broken down by statistical area. The list of affected statistical areas was extracted from the GIS mapping of the intersection of 20 nm ranges from communities with EFH Alternative 6 closure areas. The second set of data provided is halibut landings in ports from NMFS Restricted Access Management (RAM) program reports. Due to the halibut fishery being managed through an IFQ structure, these data are publicly available. They are, however, only available for that subset of the 13 relevant communities defined by RAM as ports (Chignik, King Cove, Old Harbor, Port Lions, St. George, St. Paul, and Yakutat). Finally, 2001 total halibut harvest data by statistical area from AKFIN are included. While these data are from statistical areas near the communities, however, the reported catch for these areas may be (and in some cases surely is) associated with vessels from more distant communities.

The available data suggest that the small-vessel halibut fleet from several potentially affected communities would probably have experienced only slight effects from Alternative 6. For example, Old Harbor, Pilot Point, and Port Lions would all have had nearby ocean areas closed under this alternative; however, no harvest was reported in the affected statistical areas in 2001. In the case of False Pass, two adjacent statistical areas within 20 nm of the community would have been closed, in part, under Alternative 6. While approximately 40 percent of one of these statistical areas and nearly 20 percent of the other would have been closed, only the statistical area with the 20 percent closure had reported harvest (about 14,000 pounds). Thus, small-vessel effects in False Pass appear slight and may have been recovered in nearby open areas. A similar condition exists for King Cove where closure areas would range from less than 1 to more than 43 percent of the statistical areas within 20 nm of the community. King Cove is also a major port, with 69 vessel deliveries totaling 679,374 pounds in 2001. Less than 20,000 pounds (under 3 percent of the total) was, however, harvested in the affected statistical area. Thus, small-vessel effects in King Cove appear slight and might have been recovered in nearby open areas.

Two statistical areas around Mekoryuk would have been affected by EFH closures under Alternative 6. One of these would have had just under 22 percent of its area closed, and the other would have had nearly 60 percent of the area closed within 20 nm of the community. The total harvest in those statistical areas combined would have been, however, just over 6,000 pounds. Affected statistical areas

around Tooksook Bay and Tunanak also would have accounted for just over 6,000 pounds of total harvest. Thus, based on 2001 data, small-vessel effects in the Mekoryuk, Toksook, and Tunanak area appear slight and might have been recovered in adjacent open areas.

Closure areas around Yakutat would have been limited to two statistical areas and relatively small percentages of each. Yakutat is a major halibut delivery port with more than a million pounds landed in 2001. However, just over 40,000 pounds was harvested from the two affected statistical areas. Thus, while some effects might have accrued to the Yakutat small-vessel fleet component, they are likely to have been slight.

In contrast to the communities that appear to have a very small localized harvest, several communities appear to have the potential for considerable small-vessel-related effects. In the Chignik area, three statistical areas would have been affected by EFH Alternative 6 closures, with a range of 5 percent to almost 41 percent closed. The Port of Chignik received landings from 38 vessels in 2001, totaling 478,257 pounds. Harvest in the three affected statistical areas combined was almost 300,000 pounds, which is equivalent to a vast majority of the total landings in the port. Thus, it is possible that EFH Alternative 6 closures might have had considerable impacts on small-vessel halibut fleet components in the Chignik area, but much of the affected catch would have been taken by vessels from outside of the community. It could also mean that those outside vessels would choose to fish and land catch elsewhere due to the closures, which would have had its own impacts on the community unrelated to the local small vessel fleet.

Port Alexander would have had four affected statistical areas within 20 nm, with less than 1 to nearly 55 percent of each statistical area closed within the 20 nm range. The total harvest for these statistical areas was just under 800,000 pounds, with just over 700,000 pounds coming from the statistical area with a 55 percent closure. Thus, based on these 2001 data, it appears that considerable impacts could have accrued to the Port Alexander small-vessel halibut fleet.

Similarly, St. Paul and St. George would have had very large portions of nearby statistical areas closed by EFH Alternative 6. In fact, between approximately 43 and 93 percent of the three statistical areas around St. George would have been closed. Given that the St. George harvests are spread among these statistical areas, considerable impacts on the St. George small-vessel halibut fleet would have been likely under EFH Alternative 6. Similarly, the vast majority of harvest around St. Paul is caught in a statistical area that would have had an 85 percent closure.

It is assumed that small-vessel subsistence activity would not have been directly regulated or otherwise restricted by EFH closures under Alternative 6, but some indirect impacts to subsistence users might accrue through loss of joint production opportunities if vessels used for both commercial and subsistence purposes were affected (or if income derived from commercial fishing that otherwise would be used to facilitate subsistence production were unavailable). In 2003, NMFS began to issue subsistence halibut permits to residents of rural communities and to tribal members. As of June 18, 2003, 6,673 subsistence halibut registration certificates (SHARCs) were issued, and this count is continuously increasing. While it is impossible to estimate the joint production effects EFH Alternative 6 closures might have had on subsistence users, Appendix C provides the count of SHARCs for each rural community identified as having EFH closures in nearby waters. As shown, 127 permits are held by residents of these communities, with individual communities ranging between 0 and 24 permits held locally.

4.3.8.3.4 Effects on Regulatory and Enforcement Programs

Closing fishable waters shallower than 1,000 meters creates an enforcement challenge similar to that encountered under Alternative 3. The boundary would be defined by a bathymetric contour and would have to be translated into surface coordinates, so that enforcement personnel patrolling the area in either boats or aircraft would be able to tell if a vessel were in the restricted area. Enforcing the presence of vessels in those areas would require VMS systems for all or virtually all fishing vessels regardless of gear, size or target fishery.

If regulations as part of this alternative absolutely restrict vessels from carrying bottom tending gear in these areas then enforcement is greatly simplified. For example if bottom tending gear such as bottom trawls are allowed on board with pelagic gear, as described in the previous sections, then enforcement becomes much more complicated. Vessels cannot be identified as having violated the particular ban with fish caught in the restricted area if they have ability to claim the fish were caught with an appropriate gear type.

Other additional needs in terms of fisheries management might arise as a result of changes in fishery behavior. Since this alternative does not propose a TAC reduction proportional to the reduction in area, presumably fishermen would turn their attention to other locations, which could bring up a variety of issues that might need additional attention from management. This could include crowding, increased take of prohibited species or groundfish species at risk of overfishing, and other issues that arise when effort is concentrated in new locations or on new species, as has been described in the discussion of the closed areas proposed under Alternatives 4 and 5.

4.3.8.4 Effects of Alternative 6 on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (E-)
Alternative 6 closes several strips of seafloor from the shore out to the shelf break to any bottom contact fishing gear. Because these closures occur in state waters, the Board of Fisheries would have to take action to mirror the federal closures in state-managed fisheries, if they chose to do so. If so, there would be some displacement of effort into adjacent areas for state waters fisheries, including Pacific cod, sablefish, lingcod, and rockfish, around Chirikof, Sutwik, Shumagins, and Sanak Islands, in Shelikof Strait, and off the southeast coast of the Kenai Peninsula.

Because most nearshore waters in the GOA and Bristol Bay are already closed to bottom trawl, and many other closures are already in place to protect spawning populations and important habitat, the increased benefit to state-managed groundfish stocks from this mitigation alternative would likely be small or non-existent. So, the finding of E- reflects displaced effort, increased costs, and potentially reduced catch in the fisheries that outweigh any potential benefits to the stocks.

State-managed Crab and Invertebrate Fisheries (E-)
Alternative 6 closes an area around the Pribilof Islands in the EBS to all bottom contact gear. This area encompasses the Korean hair crab fishing grounds. If the state of Alaska chose to mirror closures in the federal fisheries, this closure around the Pribilof Islands would likely prohibit up to 75 percent of the catch in the fishery (pers. com., Bowers).

If the state of Alaska chose not to mirror the closures in the federal fisheries, it is unlikely that there would be any additional benefit to the hair crab stock from the closures. Most of the Pribilof Islands area is already closed to bottom trawling, and there have been no red or blue king crab fisheries

conducted since 1998, so impact from other fisheries is currently minimal, and would likely not change under this alternative.

Similarly, under Alternative 6 there is a closure immediately south of Kodiak Island around the Trinity Islands, and a closure inside Shelikof Strait where Dungeness crabs and sea cucumbers are harvested (Kruse et al. 2000). If the state chose to mirror the federal closures, these closures would displace effort in these fisheries, likely into adjacent open areas.

Also, as recently as 1999 there has been a state-managed bottom trawl shrimp fishery in the EBS, in and slightly adjacent to the rotating closure areas under this alternative. If this fishery were to occur under this alternative, it could be restricted to a smaller area.

Because most nearshore waters in the GOA and Bristol Bay are already closed to bottom trawl, and many other closures are already in place to protect spawning populations and important habitat, the increased benefit to crab and invertebrate stocks from this mitigation alternative would likely be small or non-existent. So, the finding of E- reflects displaced effort, increased costs, and potentially reduced catch in the fisheries that outweigh any potential benefits to the stocks.

Herring Fisheries (Ø)
Effects on herring fisheries for Alternative 6 are very similar to those discussed in Alternative 4 above. Alternative 6 would not offer any additional protection to the herring stock or restrict the fishery. Most of the GOA waters where herring are caught are already closed to bottom trawl, and the other gear groups restricted under this alternative have not historically resulted in herring bycatch, and have not been associated with herring habitat impairment.

Halibut Fisheries (E-)
Alternative 6 would amend the Pacific Halibut Act regulations to prohibit the use of all bottom tending gear including longlines within 20 percent of the fishable waters in the BSAI and GOA. The location of these closures would likely displace effort into adjacent areas. Specific locations from which effort could be displaced include nearshore waters of St. George Island, waters to the east and southeast of St. Paul Island, nearshore waters around St. Matthew Island, waters to the west and south of Sanak Island, waters around the southeast Shumagin Islands, waters around Chirikof Island, Kayak Island, and waters off the southwest tip of Baranof Island. In most of these cases, adjacent waters would remain open to halibut fishing under Alternative 6, and effort would likely move into these adjacent areas with added costs to the fleet and perhaps spatially concentrated fishing pressure on the stock in specific areas.

4.3.8.5 Effects of Alternative 6 on Protected Species

The discussion on protected species provided in this section relative to Alternative 6 is based on the detailed review of potential fishery-related impact in Wilson (2003).

ESA-listed Marine Mammals (E-) – Alternative 6 may result in increased fishery interactions with Steller sea lions and the ESA-listed species of whales. Concentrated fishing for Atka mackerel in the western GOA, because of the 100 percent fishery displacement out of the EFH closed areas in the western GOA, and for Atka mackerel and pollock in the AI, similar large displacements, may threaten Steller sea lions through increased chances for injury or mortality from vessel or gear contact where fishing activities may be concentrated geographically, or from concentrated removal of prey items important for sea lion nutrition. This alternative also may shift fishing activities in such a manner that concentrated fishing in the AI area may increase the potential for vessel strikes or gear entanglement

with some ESA-listed great whale species. Thus Alternative 6 is judged to have a potential negative effect on ESA-listed marine mammals.

Other Marine Mammals (U) – Alternative 6 would likely result in a moderate amount of displaced fishing effort in the GOA and BSAI bottom trawl fisheries, which presumably would then be prosecuted in adjacent areas that remain open to bottom trawling or in other trawl fisheries. In some of these areas of concentrated fishing activity, fishery encounters with some marine mammals could increase, and if these fisheries occur near coastal areas they may encroach on harbor seal foraging areas, particularly in the Western Reporting Area of the GOA. In the AI, given the relatively smaller areas that would remain open to bottom fishing, the displaced fisheries would then be concentrated in relatively smaller areas. The result could be increased levels of fishery encounters with some marine mammals. These fishing activities would not likely affect sea otters because these fisheries occur in offshore locations distant from sea otter habitat. Fur seals would have some chance of encountering these fisheries in summer foraging habitat, but the impacts are largely unknown. Similarly increased fishing in some areas could adversely impact harbor seals, but the population level effects are unknown. Displaced fishing concentrations would not likely impact the ice seals and walrus because they only inhabit the EBS. Northern elephant seals would not likely be adversely affected under Alternative 6 because they essentially are not present in this area. Other cetaceans are not currently adversely affected by GOA or BSAI fisheries, either through injury or other take or because of fishery removal of prey; thus it is reasonable to assume that the changes in the overall pattern of groundfish fishing in the AI would not change this. Overall, however, these analyses conclude that the impacts of Alternative 6 on other marine mammals are unknown, and this ranking is assigned to this group, largely because of the potential but unknown concerns over concentrated fishing activities on harbor seals and fur seals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Under Alternative 6, ESA-listed species of salmon and steelhead would be co-mingled with non-ESA-listed stocks, and thus would be susceptible to take in trawl fisheries. It is likely that very few endangered or threatened salmon or steelhead are taken as bycatch in the fisheries in the GOA and BSAI; bycatch is almost exclusively in the GOA midwater pollock trawl fishery. Alternative 6 would redistribute bottom fisheries, and would not likely affect midwater trawl fisheries except that some vessels might convert to this gear type. Overall, however, it is unlikely that there would be large fishery changes and thus effects on ESA-listed salmon or steelhead would likely be fairly small. Under the salmon PSC limits in the EBS, the groundfish fisheries in the BSAI likely would continue to be prosecuted in a manner which minimizes salmon bycatch, which in turn would continue to minimize the chance of incidental take of an ESA-listed species. Also, it is not likely that the displaced bottom trawl fishing under Alternative 6 would affect the prey field for ESA-listed salmonids.

ESA-listed Seabirds (Ø) – The ESA-listed seabirds would likely encounter fishing activities in the GOA, BSAI, and AI under Alternative 6 at levels above the status quo. Concentrated fishing activities in the GOA or BSAI could increase the rate of encounters between vessels and gear and short-tailed albatross. However, current mitigation techniques used by industry would likely obviate the potential for any mortality. Industry initiatives in the trawl sector may further reduce chances for such mortality. Steller's and spectacled eiders likely do not interact to any great extent with offshore fisheries. Thus Alternative 6 would not likely have adverse effects on ESA-listed seabirds.

Other Seabirds (Ø) – Alternative 6 may increase bottom trawl and longline fishing levels in some areas of the GOA and BSAI, with some potential concentration of fishing activities in these areas from the displaced fishing from closed areas. Concentrated fishing, or perhaps increased fishing time in these fisheries, would likely increase the incidental mortality of fulmars, black-footed and Laysan albatross,

and shearwaters through bycatch, vessel strikes, and trawl third-wire gear interactions. These impacts may be more acute for Laysan albatross in the AI where this species may be more abundant.

Alternative 6 would likely have minimal effect on red-legged kittiwakes and Kittlitz's murrelets, although there could be additional overlap of trawl fishing activities and red-legged kittiwakes near their Pribilof and Bogoslov Islands colonies. Although there are few concerns over fishery-related depletion of seabird prey, some concerns would continue over the occasional intense fishing activity near seabird colonies that might interrupt or displace seabird foraging; Alternative 6 may increase potential overlap of trawl and longline fishing activities and both piscivorous and non-piscivorous seabird foraging areas, particularly during the summer breeding and nesting period in the GOA and the BSAI. Under Alternative 6, some species of seabirds would continue to strike vessels and suffer mortality, particularly storm-petrels, fulmars, some albatrosses, and crested auklets, perhaps at moderately increased levels under this alternative. Seabird mortality under Alternative 6 would likely be mitigated in the continuing implementation of seabird bycatch reduction programs in the longline fisheries and in the emerging programs to reduce bycatch of seabirds in trawl third-wire gear.

4.3.8.6 Effects of Alternative 6 on Ecosystems

Predator-Prey Relationships (Ø) – Alternative 6 would have the is judged to have no effect on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, or increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No large changes would be expected in species composition in the ecosystem due to Alternative 6, although catches of some fish and invertebrate species may be somewhat reduced from status quo. Similarly, trophic level of the catch would not be much different from status quo, and little change in the functional species composition of the groundfish community, or in the removal of top predators, is expected.

Energy Flow and Balance (Ø) – Under Alternative 6, the amount and flow of energy flow in the ecosystem would be the same as the status quo with regards to the total level of catch biomass removals from groundfish fisheries, crab fisheries, scallop fisheries, and salmon fisheries. No substantial changes in catch or discarding (except perhaps some reduction in the catch of scallops) would be expected.

Diversity (E+) – Marine reserves, which are similar in nature to those proposed in Alternative 6, are thought to enhance biodiversity (NRC 2001). Alternative 6 would eliminate fishing gears contacting the bottom on about 20 percent of the nearshore, shelf, and slope areas of the GOA, AI, and EBS. Most of this effort would probably be redistributed to nearby adjacent areas. However, some species that are less mobile and occur within closure areas would tend to benefit from the reserve area closures. Thus, species level diversity may increase. Additionally, closure of the areas to bottom contact gear may preserve representative habitats and ecosystems, and may enhance productive fish habitat and thereby help sustain fish populations that rely on these areas. Thus, structural habitat diversity would also improve in closed areas. Genetic diversity could slightly increase under Alternative 6 if older, more heterozygous individuals were left in the populations of fish that do not migrate out of the closure areas to be caught in the open areas. Overall, this alternative was judged to have positive effects on diversity.

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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.

Future Management Actions Contributing to Cumulative Effects

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.

Contributions to Cumulative Effects Related to EFH Description and Identification

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.

Contributions to Cumulative Effects Related to HAPC Identification

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.

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

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 Draft Programmatic Groundfish SEIS (NMFS 2001a). 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 Draft Programmatic Groundfish SEIS; 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 and 5B 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 had exacerbated the risks in an already high-risk profession. Other factors that have influenced the improved safety record include the more widespread use of position-indicating radio beacons, immersion suits, and life rafts; improved crew training; and the forward placement of long-range search helicopters. These factors have been particularly effective in reducing deaths associated with capsized or sinking vessels, both by keeping crew members afloat and warm and by speeding the 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. Alternative 5B 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 5B 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 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 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 5B 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

Past and Present Trends Contributing to Cumulative Effects

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.

External Factors Contributing to Cumulative Effects

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 sq. km 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, 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 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 and 6 would 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.

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4.5 Summary and Conclusions

4.5.1 Comparison of Effects of the Alternatives for Describing and Identifying EFH

The alternatives for describing and identifying EFH comprise a range of options that use different methodologies and result in different geographic areas being identified as EFH for each of the species managed under the Council's FMPs. Section 4.1 discusses the effects of each alternative on habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities. The effect ratings (E-, Ø, E+, or U) for each issue evaluated are summarized in Table 4.5-1.

The effect ratings alone do not provide a basis for distinguishing among some of the alternatives. The ratings characterize effects as positive or negative, but do not convey their magnitude or intensity. The accompanying text in Section 4.1 explains the anticipated effects for each alternative, but makes few direct comparisons among them. The following sections, therefore, summarize the most pertinent effects comparatively to highlight relevant issues and provide a clearer basis for choice among the alternatives.

4.5.1.1 Comparative Summary of Effects

As discussed in Section 4.1, description and identification of EFH does not in and of itself have any direct environmental or socioeconomic impacts, but can lead to indirect impacts because EFH description and identification triggers requirements to minimize adverse effects of fishing and to consider the effects of non-fishing actions. Those indirect effects are summarized below.

4.5.1.1.1 Effects on Habitat

Description and identification of EFH, regardless of the alternative selected, generally would have a positive effect on habitat because the purpose of the designation is to identify important fish habitats that would be subject to potential measures to protect, conserve, and enhance them. The broader the area identified as EFH, the more habitat that would be subject to such measures. From the standpoint of effects on habitat, therefore, the most relevant considerations for distinguishing among the alternatives are the habitat types and areas that would or would not be included within designated EFH.

<u>What types and areas of habitat would or would not be included within designated EFH under each alternative?</u>

Alternative 1: No habitat types or areas would be designated as EFH.

Alternative 2: Under the status quo alternative, the existing EFH description and identification would remain unchanged. EFH would include those habitats found within areas representing the general distribution of the managed species. The specific areas are described in detail in Chapter 2 and Appendix D.

Alternative 3: (Preliminary Preferred Alternative) EFH description and identification would be revised, and the geographic extent of individual EFH designations would be smaller than under Alternative 2 in some cases. As a result, fewer species might have EFH designated in any given location, but the total aggregated area of EFH description and identification for all managed species would be identical under Alternatives 2, 3, and 4. The specific areas are described in detail in Chapter 2 and Appendix D.

Alternative 4: EFH description and identification would be revised, and the geographic extent of individual EFH designations would be smaller than under Alternatives 2 or 3 in many cases. As a result, fewer species might have EFH designated in any given location, but the total aggregated area of EFH designations for all managed species would be identical under Alternatives 2, 3, and 4. The specific areas are described in detail in Chapter 2 and Appendix D.

Alternative 5: EFH description and identification would encompass eight ecoregions (freshwater, nearshore and estuarine, inner and middle shelf, outer shelf, upper slope, middle slope, lower slope, and basin). A larger area and additional types of habitat (basin habitats in deeper waters) would be included under this alternative than in the other alternatives.

Alternative 6: EFH description and identification in the EEZ would be identical to Alternative 3. No habitat types or areas would be designated as EFH in state waters.

4.5.1.1.2 Effects on Target Species

EFH description and identification would have the following mixed effects on target species:

- Potential positive effects on productivity, prey availability, and growth to maturity
- Potential negative effects on the spatial/temporal concentration of catch (which could have effects on genetic diversity)
- A neutral effect on fishing mortality

From the standpoint of effects on target species, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which populations of the target species would benefit from protective measures that might result from EFH description and identification.

<u>How would each alternative affect the potential for target species to benefit from measures implemented to conserve or protect EFH?</u>

Alternative 1: The existing EFH description and identification would be rescinded, so any benefits for target species would be lost.

Alternative 2: Under the status quo alternative, target species could continue to benefit from measures the Council and NMFS implement to minimize the adverse effects of fishing on EFH, as well as from measures various action agencies implement to minimize the effects of non-fishing activities on EFH.

Alternative 3: (Preliminary Preferred Alternative) Target species could benefit from measures the Council and NMFS implement to minimize the adverse effects of fishing on EFH and from measures various action agencies implement to minimize the effects of non-fishing activities on EFH. To the extent that EFH designations for some species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternative 2, there could be a slightly greater potential for target species to benefit from measures implemented to conserve or protect EFH. Smaller EFH designations may be beneficial if they reflect the habitats that are most important for managed species, because conservation efforts could focus on those more discrete areas to avoid habitat loss or degradation.

Alternative 4: Target species could benefit from measures the Council and NMFS implement to minimize the adverse effects of fishing on EFH, and from measures various action agencies implement to minimize the effects of non-fishing activities on EFH. To the extent that EFH designations for many species would be reduced in geographic scope to describe essential habitats even more precisely, as compared to Alternatives 2 and 3, there could be a greater potential for target species to benefit from measures implemented to conserve or protect EFH. Smaller EFH designations may be beneficial if they reflect the habitats that are most important for managed species, because conservation efforts could focus on those more discrete areas to avoid habitat loss or degradation.

Alternative 5: Target species could benefit from measures the Council and NMFS implement to minimize the adverse effects of fishing on EFH and from measures various action agencies implement to minimize the effects of non-fishing activities on EFH. Under this alternative, however, it might be more difficult to focus habitat conservation efforts on specific species, because EFH would be designated for entire complexes of species rather than separately for each species.

Alternative 6: In the EEZ, target species could benefit from measures the Council and NMFS implement to minimize the adverse effects of fishing on EFH and from measures various action agencies implement to minimize the effects of non-fishing activities on EFH. Any such benefits for target species in state waters would be lost because there would be no EFH description and identification in those habitats.

4.5.1.1.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

EFH description and identification by itself does not enact any specific management measures, and thus it creates potential rather than actual effects. EFH description and identification may have mixed indirect effects on federally managed fisheries. Potential costs could result from implementation of measures to minimize the adverse effects of fishing on EFH. Indirect long-term benefits could occur if EFH description and identification prompts conservation measures that lead to higher production rates of target species. From the standpoint of effects on federally managed fisheries, therefore, the most relevant consideration for distinguishing among the alternatives is how different EFH designations may potentially affect economic costs and benefits. The assumption here is that the size of EFH would be correlated with the amount of costs and benefits.

<u>How would each alternative affect the potential for economic costs and benefits for federally managed fisheries?</u>

Alternative 1: The existing EFH description and identification would be rescinded, so any costs associated with management measures to protect EFH would be avoided, and any benefits to fisheries from conserving productive habitats would be lost.

Alternative 2: The status quo alternative would not change the potential for economic costs and benefits for fisheries.

Alternative 3: (Preliminary Preferred Alternative) To the extent that EFH description and identification for some species would be reduced in geographic scope to describe essential habitats

more precisely, as compared to Alternative 2, there may be a slightly lower potential for economic costs of management measures implemented to conserve or protect EFH.

Alternative 4: To the extent that EFH description and identification for many species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternatives 2 and 3, there may be a slightly lower potential for economic costs of management measures implemented to conserve or protect EFH and a slightly greater potential for benefits from such measures. Relative to Alternative 2, these differences presumably would be greater for Alternative 4 than for Alternative 3.

Alternative 5: Compared to all of the other alternatives, EFH description and identification based on the ecoregion approach might result in an increased potential for economic costs of management measures implemented to conserve or protect EFH and a slightly reduced potential for benefits from such measures. The total size of EFH designations would be largest under Alternative 5, making it more difficult to focus on protecting the habitats that are most important or vulnerable.

Alternative 6: In the EEZ, there may be a slightly lower potential for economic costs of management measures implemented to conserve or protect EFH and a slightly greater potential for benefit from such measures to the extent that EFH designations for some species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternative 2. In state waters, existing EFH designations would be rescinded, so any costs associated with management measures to protect EFH there would be avoided, and any benefits to fisheries from conserving productive habitats would be lost.

4.5.1.1.4 Effects on Other Fisheries and Fishery Resources

EFH description and identification would have mixed effects on other fisheries and fishery resources. Many of the species targeted by these fisheries use the same habitats as Magnuson-Stevens Act managed species, and thus could benefit indirectly from EFH protective measures. However, there could be some negative effects on these fisheries if EFH description and identification lead to restrictions on harvesting. From the standpoint of effects on other fisheries and fishery resources, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which populations of the target species for those fisheries would benefit from protective measures that might result from EFH description and identification.

<u>How would each alternative affect the potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH?</u>

Alternative 1: The existing EFH description and identification would be rescinded, so any costs associated with management measures to protect EFH would be avoided, and any benefits to fisheries or target species from conserving productive habitats would be lost.

Alternative 2: The status quo alternative would not change the potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH.

Alternative 3: (Preliminary Preferred Alternative) To the extent that EFH designations for some species would be reduced in geographic scope to describe essential habitats more precisely, as

compared to Alternative 2, there may be a slightly lower potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species). On the other hand, there could be a slightly greater potential for target species to benefit from measures implemented to conserve or protect EFH to the extent that EFH designations for some species would be reduced in geographic scope to more accurately describe EFH, as compared to Alternative 2. Smaller EFH designations may be beneficial if they reflect the habitats that are most important for managed species, because conservation efforts could focus on those more discrete areas to avoid habitat loss or degradation.

Alternative 4: To the extent that EFH designations for many species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternatives 2 and 3, there may be a lower potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species).

Alternative 5: Compared to all of the other alternatives, EFH description and identification based on the ecoregion approach might result in a slightly increased potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH (if larger EFH designations include important habitats for these species).

Alternative 6: In the EEZ, to the extent that EFH designations for some species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternative 2, there may be a slightly lower potential for target species for other fisheries to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species). In state waters, target species for other fisheries would lose the potential benefits of measures intended to conserve EFH.

4.5.1.1.5 Effects on Protected Species

EFH description and identification may have a positive effect on protected species of salmon, marine mammals, and seabirds, should measures be taken to protect, conserve, and enhance EFH, because many of these species use the same habitats as Magnuson-Stevens Act managed species. From the standpoint of effects on protected species, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which populations of protected species would benefit from protective measures that might result from EFH description and identification.

<u>How would each alternative affect the potential for protected species to benefit from measures implemented to conserve or protect EFH?</u>

Alternative 1: The existing EFH description and identification would be rescinded, so any benefits to protected species from conserving productive habitats would be lost.

Alternative 2: The status quo alternative would not change the potential for protected species to benefit from measures implemented to conserve or protect EFH.

Alternative 3: (Preliminary Preferred Alternative) To the extent that EFH designation for some species would be reduced in geographic scope to describe essential habitats more precisely, as

compared to Alternative 2, there may be a slightly lower potential for protected species to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species).

Alternative 4: To the extent that EFH designations for many species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternatives 2 and 3, there may be a lower potential for protected species to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species).

Alternative 5: Compared to all of the other alternatives, EFH description and identification based on the ecoregion approach might result in a slightly increased potential for protected species to benefit from measures implemented to conserve or protect EFH (if larger EFH designations include important habitats for these species).

Alternative 6: In the EEZ, there may be a slightly lower potential for protected species to benefit from measures implemented to conserve or protect EFH (if smaller EFH designations exclude important habitats for these species) to the extent that EFH designations for some species would be reduced in geographic scope to describe essential habitats more precisely, as compared to Alternative 2. In state waters, protected species would lose the potential benefits of measures intended to conserve EFH.

4.5.1.1.6 Effects on Ecosystems and Biodiversity

EFH description and identification would have neutral or unknown effects on predator-prey relationships, energy flow and balance, and biodiversity. From the standpoint of effects on ecosystems and biodiversity, therefore, there are no clear differences among the alternatives for EFH description and identification. Nevertheless, if EFH description and identification leads to actions that conserve, protect, or enhance habitat, there may be some ecosystem benefits from those actions.

4.5.1.1.7 Effects on Non-fishing Activities

EFH description and identification could have indirect negative effects on costs to federal and state agencies that authorize, fund, or undertake actions that may adversely affect habitats identified as EFH and to non-fishing industries or other proponents of such activities. From the standpoint of effects on non-fishing activities, therefore, the most relevant consideration for distinguishing among the alternatives is the geographic scope. The broader the geographic scope of EFH description and identification, the greater the number of non-fishing activities that may trigger the Magnuson-Stevens Act requirements for EFH consultations and conservation recommendations.

<u>What are the differences in the geographic scope of EFH description and identification under the alternatives?</u>

Alternative 1: There would be no EFH description and identification at all. Existing EFH designations would be rescinded, and no attributable costs would be imposed on non-fishing uses or users.

Alternative 2: Under the status quo alternative, the existing EFH designations would remain in effect, suggesting no change in cost to non-fishing users. The current EFH designations are

relatively broad in scope, encompassing the general distribution areas that comprise approximately 95 percent of the population of each managed species, based on information available in 1998.

Alternative 3: (Preliminary Preferred Alternative) EFH description and identification would be updated by applying the same basic methodology used for the existing designations in 1998, but using revised regulatory guidance from the EFH final rule, more recent scientific information regarding distribution of the managed species, new analytical tools, and improved mapping. The EFH designations would be smaller for some life stages of some species. However, the total aggregated area of EFH designations for all managed species would be identical under Alternatives 2, 3, and 4, suggesting no substantial change in cost to non-fishing users.

Alternative 4: EFH description and identification would be updated using a more narrow interpretation of the best available science, resulting in smaller EFH designations for species for which sufficient information exists to identify possible areas of higher habitat function. Alternative 4 would result in smaller EFH designations for many species as compared to Alternatives 2 and 3, although the total aggregated area of EFH designations for all managed species would be identical under Alternatives 2, 3, and 4, suggesting no substantial change in cost to non-fishing users.

Alternative 5: Using ecoregions, rather than distribution or relative abundance data, to identify EFH would result in larger areas being designated as EFH for many species. Alternative 5 would result in the largest EFH designations of any of the alternatives, suggesting potentially increased costs to non-fishing users.

Alternative 6: In the EEZ, EFH description and identification would be updated as per Alternative 3, yielding smaller designations for some life stages of some species, although the total aggregated area of EFH designations for all managed species would be identical to the EEZ portions of Alternatives 2, 3, and 4. In state waters, there would be no EFH designations at all. Therefore, any changes in cost to non-fishing users would depend on the specific location of the proposed activity.

4.5.1.2 Adverse Effects that Cannot be Avoided When Describing and Identifying EFH

EFH description and identification under any of the alternatives (except for the no action Alternative 1) will inevitably affect a variety of fishing and non-fishing activities. EFH designation triggers the Magnuson-Stevens Act requirements to minimize to the extent practicable the adverse effects of fishing on EFH and to consider the effects of non-fishing activities on EFH. These requirements are likely to prompt the Council, NMFS, and other agencies to take actions to protect fish habitat that they might not have taken absent the description and identification of EFH. The environmental consequences of those potential actions are discussed in Sections 4.1 and 4.5.1 of this EIS.

Conservation measures resulting from EFH designations will not avoid all adverse effects to EFH or to fish habitat in general. A variety of fishing and non-fishing activities will continue to occur and will continue to result in environmental impacts, including the degradation and loss of EFH. EFH description and identification may lead to actions that will minimize those effects, but will not avoid further habitat damage entirely.

4.5.1.3 Conclusions

The alternatives for describing and identifying EFH use different methodologies and result in different areas being designated as EFH for managed species. Differences in the environmental consequences of the alternatives are directly related to the areas and habitats encompassed by the resulting EFH designations. Different size designations may increase or decrease the efficacy of EFH conservation measures and the effects on other components of the environment.

Table 4.5-1 summarizes the effect ratings (E-, Ø, E+, or U) for each issue evaluated in Section 4.1. These ratings describe the effects of each alternative on habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities.

In summary, Alternative 1 would eliminate the existing EFH description and identification, resulting in the loss of potential benefits of EFH protective measures for habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, and ecosystems. Alternative 1 may have benefits for non-fishing activities because EFH consultations would no longer be required, eliminating an existing procedural step in the review of many proposed actions. It also could result in reduced operating costs for fishermen, at least in the short run, although potential benefits for fishermen (from conserving habitats that produce fish they harvest) would be lost. Alternative 2 would retain the status quo EFH description and identification and associated effects. Alternative 3 (preliminary preferred alternative) would refine the existing EFH description and identification, but would not lead to substantial changes in environmental effects because the areas identified would not be substantially reduced in size. To the extent that EFH designations for some species would be reduced in geographic scope to reflect essential habitats more precisely, there may be a slightly increased potential for benefits to target species, because conservation efforts could focus on those more discrete areas to avoid habitat loss or degradation. Alternative 4 would revise the existing EFH description and identification and result in smaller EFH designations for many species. As with Alternative 3, there may be an increased potential for benefits for target species because smaller EFH designations that reflect the most important habitats would allow conservation efforts to be focused more effectively. Alternative 5 would change the EFH description and identification to use an ecoregion approach, resulting in larger EFH designations and perhaps a greater potential for indirect benefits for resources such as protected species and ecosystems. This approach may, however, be less beneficial for target species and federally managed fisheries because it would be harder to distinguish EFH from all potential habitats. In other words, Alternative 5 would provide less information about EFH for particular species than Alternatives 2 through 4. Alternative 6 would refine the existing EFH description and identification in the EEZ as in Alternative 3, but would eliminate the EFH designations in state waters.

In addition to comparing the environmental consequences of the alternatives, it is relevant to consider the degree to which the different alternatives are consistent with the requirements of the Magnuson-Stevens Act and the EFH regulations at 50 CFR 600.815(a)(1). Alternatives 1 and 6 are not consistent with the Magnuson-Stevens Act or the EFH regulations because they would not describe and identify any habitats (Alternative 1) or all habitats (Alternative 6) necessary to managed species for spawning, breeding, feeding, and growth to maturity. Alternative 2 is not consistent with the Magnuson-Stevens Act or the EFH regulations because it does not reflect the best (most recent) scientific information available, as required by national standard 2 (16 U.S.C. 1851[a][2]) and 50 CFR 600.815(a)(1)(ii)(B). Alternatives 3 through 5 are consistent with the Magnuson-Stevens Act and the EFH regulations. Those alternatives take different approaches that influence their overall efficacy and allow decision makers to compare relative costs and benefits. Table 4.5-2 provides a comparison of the alternatives in terms of three

summary factors: relative size of EFH designations, consistency with the Magnuson-Stevens Act and the EFH regulations, and overall efficacy and relative merits.

4.5.2 Comparison of Effects of the Alternative Approaches for Identifying HAPCs

The alternatives for identifying HAPCs are a range of different methodological approaches, rather than different specific types or areas of habitat. As discussed in Section 2.3.2, the Council decided to identify an approach to HAPC designation first, and then subsequently to identify specific HAPCs. Therefore, the likely effects of HAPC designation cannot be evaluated with specificity in this EIS. Section 4.2 discusses the effects of each alternative on habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities. The effect ratings (E-, Ø, E+, or U) for each topic evaluated are summarized in Table 4.5-3.

The effect ratings alone do not provide a basis for distinguishing among the alternatives. The ratings characterize effects as positive or negative, but do not convey their magnitude or intensity. The accompanying text in Section 4.2 explains the anticipated effects for each alternative, but makes few direct comparisons among them. The following sections, therefore, summarize the most pertinent effects comparatively to highlight relevant issues and provide a clearer basis for choice among the alternatives.

4.5.2.1 Comparative Summary of Effects

As discussed in Section 4.2, identification of HAPCs, like the description and identification of EFH, does not in and of itself have any direct environmental or socioeconomic impacts, but could lead to indirect impacts. The identification of HAPCs provides a means for the Council and NMFS to highlight priority areas within EFH for more focused conservation and management. The indirect effects of the different approaches for identifying HAPCs are summarized below.

4.5.2.1.1 Effects on Habitat

Identification of HAPCs, regardless of the alternative selected, generally would have a positive effect on habitat, because the purpose of the designation is to identify particularly valuable and/or vulnerable subsets of EFH that may then be subject to increased scrutiny to consider potential protective measures. From the standpoint of effects on habitat, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which a particular approach would facilitate identification of subsets of EFH that exhibit one or more of the four considerations for HAPCs in the regulations (50 CFR 600.815[a][8]): ecological importance, sensitivity to environmental degradation, susceptibility to stress from development, and rarity.

<u>How well would the alternative facilitate identification of especially important, sensitive, stressed, and/or rare habitats within EFH?</u>

Alternative 1: No habitat types or areas would be designated as HAPCs.

Alternative 2: Under the status quo alternative, the existing HAPC designations would remain unchanged. HAPCs would include living substrates in shallow waters, living substrates in deep waters, and freshwater areas used by anadromous salmon.

Alternative 3: (Preliminary Preferred Alternative) The existing HAPC designations would be rescinded, and the Council would adopt an approach allowing specific sites within EFH, selected to

address a particular problem, to be identified as HAPCs in the future. Alternative 3 would limit HAPC identification to cases involving site-specific information, rather than permitting HAPCs for general types of habitat wherever they may be found.

Alternative 4: The existing HAPC designations would be rescinded, and the Council would adopt an approach that would allow specific sites selected within given habitat types within EFH to be identified as HAPCs in the future. Alternative 4 is similar to Alternative 3, except that the Council would first specify types of habitat that might warrant HAPC designation and then would identify specific sites within those habitat types as HAPCs, perhaps resulting in a more structured process for identifying HAPCs that address specified goals.

Alternative 5: The existing HAPC designations would be rescinded, and the Council would adopt an approach that would allow areas within EFH to be identified as HAPCs in the future based on productivity of the habitat for individual species. Resulting HAPC identification would be species-specific and would rely on information about habitat functions for the target species. However, such information is not readily available for most species.

4.5.2.1.2 Effects on Target Species

HAPC identification would have positive effects on target species because the habitats identified presumably would receive increased protection from activities that could reduce productivity, prey availability, and growth to maturity for target species. From the standpoint of effects on target species, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which populations of the target species would benefit from protective measures that might result from HAPC identification.

<u>How would each alternative affect the potential for target species to benefit from measures implemented to conserve or protect HAPCs?</u>

Alternative 1: The Council would no longer have HAPC designations, so any benefits for target species would be lost.

Alternative 2: Under the status quo alternative, living substrates and freshwater areas used by anadromous fish would continue to be designated as HAPCs, so target species may benefit from any resulting conservation measures. However, the broad and general nature of these HAPC designations may limit their efficacy.

Alternative 3: (Preliminary Preferred Alternative) Depending on the specific sites selected as HAPCs, Alternative 3 could encourage protective measures that would be tailored explicitly to benefit target species.

Alternative 4: Depending on the types of habitat used to focus HAPC identification and the specific sites selected as HAPCs, Alternative 4 could encourage protective measures that would be tailored explicitly to benefit target species. Alternative 4 may offer more potential benefits for target species than Alternative 3 because the stepwise process of selecting habitat types and then specific sites could yield a more rational and structured effort to

ensure that HAPCs would focus on the habitats that are most valuable and/or vulnerable within EFH.

Alternative 5: HAPC identification would be species-specific and reliant on information about habitat functions for individual target species. Alternative 5 would therefore have the potential to benefit target species more directly than the other alternatives, although scarce scientific information about habitat requirements of individual species could limit the effectiveness of this approach.

4.5.2.1.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

HAPC identification would have mixed effects on federally managed fisheries. Potential costs may arise from measures to minimize adverse effects of fishing on HAPCs. Indirect long-term benefits could occur if protective measures based on HAPC identification lead to higher production rates of target species. From the standpoint of effects on federally managed fisheries, therefore, the most relevant consideration for distinguishing among the alternatives is how different approaches for HAPC identification might affect economic costs and benefits.

<u>How would each alternative affect the potential for economic costs and benefits for federally managed fisheries?</u>

Alternative 1: The Council would no longer have HAPC designations, so any costs associated with management measures to protect HAPCs would be avoided, and any benefits to fisheries from identifying and conserving discrete subsets of EFH would be lost.

Alternative 2: The status quo alternative would not change the potential for economic costs and benefits for fisheries. However, the broad and general nature of the existing HAPC designations may limit their efficacy.

Alternative 3: (Preliminary Preferred Alternative) Depending on the specific sites selected as HAPCs, adoption of this alternative could encourage protective measures that would impose costs on federally managed fisheries, but that would be designed to boost productivity of target species over the long term, thereby yielding potential economic benefits.

Alternative 4: Depending on the types of habitat used to focus HAPC designations and the specific sites selected as HAPCs, Alternative 4 could encourage protective measures that would impose costs on federally managed fisheries but that would be designed to boost productivity of target species over the long term, thereby yielding potential economic benefits.

Alternative 5: Depending on the core areas selected as HAPCs for individual species, Alternative 5 could encourage protective measures that would impose costs on federally managed fisheries but that would be designed to boost productivity of target species over the long term, thereby yielding potential economic benefits. Alternatives 3 and 5 would have comparable potential for economic costs and benefits for federally managed fisheries.

4.5.2.1.4 Effects on Other Fisheries and Fishery Resources

HAPC identification would have mixed effects on other fisheries and fishery resources. Many of the species targeted by these fisheries use the same habitats as species managed under the Magnuson-Stevens Act, and thus could benefit from protective measures that may stem from HAPC identification. However, there could be some negative effects on these fisheries if HAPC designations lead to restrictions on harvesting and a displacement of fishing effort. From the standpoint of effects on other fisheries and fishery resources, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which populations of the target species for those fisheries would benefit from protective measures that might result from HAPC designations.

How would each alternative affect the potential for target species for other fisheries to benefit from measures implemented to conserve or protect HAPCs, and how would the fleet be impacted?

Alternative 1: The Council would no longer have HAPC designations, so any indirect benefits for target species for other fisheries would be lost, although the fleet would avoid potential future costs from restrictions on fishing in HAPCs.

Alternative 2: The status quo alternative would not change the potential for target species for other fisheries to benefit from measures implemented to conserve or protect HAPCs. Living substrates and freshwater areas used by anadromous fish would continue to be designated as HAPCs, so target species for other fisheries may benefit indirectly from any resulting conservation measures. There would be no change in costs to fleets that target these other fishery resources.

Alternative 3: (Preliminary Preferred Alternative) Depending on the specific sites selected as HAPCs, Alternative 3 could yield indirect habitat benefits for target species for other fisheries. Such potential benefits are comparable for Alternatives 3, 4, and 5. Any management measures resulting from HAPC designations could impose costs to fisheries ranging from minimal to substantial. Such costs would be evaluated before being implemented.

Alternative 4: Depending on the types of habitat used to focus HAPC designations and the specific sites selected as HAPCs, Alternative 4 could yield indirect habitat benefits for target species for other fisheries. Any management measures resulting from HAPC designations could impose costs to fisheries ranging from minimal to substantial. Such costs would be evaluated before being implemented.

Alternative 5: Depending on the core areas selected as HAPCs for individual species, Alternative 5 could yield indirect habitat benefits for target species for other fisheries. Any management measures resulting from HAPC designations could impose costs to fisheries ranging from minimal to substantial. Such costs would be evaluated before being implemented.

4.5.2.1.5 Effects on Protected Species

HAPC identification could have a positive effect on protected species of salmon, marine mammals, and seabirds because many of these species use the same habitats as species managed under the Magnuson-Stevens Act, and thus could benefit from protective measures that may stem from HAPC identification. From the standpoint of effects on protected species, therefore, the most relevant consideration for

distinguishing among the alternatives is the degree to which populations of protected species would benefit from protective measures that might result from HAPC identification.

How would each alternative affect the potential for protected species to benefit from measures implemented to conserve or protect HAPCs?

Alternative 1: The Council would no longer have HAPC designations, so any indirect benefits for protected species would be lost.

Alternative 2: The status quo alternative would not change the potential for protected species to benefit from measures implemented to conserve or protect HAPCs. Living substrates and freshwater areas used by anadromous fish would continue to be designated as HAPCs, so protected species may benefit indirectly from any resulting conservation measures.

Alternative 3: (Preliminary Preferred Alternative) Depending on the specific sites selected as HAPCs, this alternative could yield indirect habitat benefits for protected species. Such potential benefits are comparable for Alternatives 3, 4, and 5.

Alternative 4: Depending on the types of habitat used to focus HAPC designations and the specific sites selected as HAPCs, this alternative could yield indirect habitat benefits for protected species.

Alternative 5: Depending on the core areas selected as HAPCs for individual species, this alternative could yield indirect habitat benefits for protected species.

4.5.2.1.6 Effects on Ecosystems and Biodiversity

HAPC identification could have positive effects on overall ecosystem health and stability. From the standpoint of effects on ecosystems and biodiversity, therefore, the most relevant consideration for distinguishing among the alternatives is the degree to which ecosystem health might potentially benefit from protective measures that may result from HAPC identification.

How would each alternative affect the potential for ecosystems and biodiversity to benefit from measures implemented to conserve or protect HAPCs?

Alternative 1: The Council would no longer have HAPC designations, so any indirect benefits for ecosystems would be lost.

Alternative 2: The status quo alternative would not change the potential for ecosystems to benefit from measures implemented to conserve or protect HAPCs. Living substrates and freshwater areas used by anadromous fish would continue to be designated as HAPCs, so those ecosystems may benefit indirectly from any resulting conservation measures.

Alternative 3: (Preliminary Preferred Alternative) Depending on the specific sites selected as HAPCs, this alternative could yield indirect benefits for ecosystems. Such potential benefits are comparable for Alternatives 3, 4, and 5.

Alternative 4: Depending on the types of habitat used to focus HAPC designations and the specific sites selected as HAPCs, this alternative could yield indirect benefits for ecosystems.

Alternative 5: Depending on the core areas selected as HAPCs for individual species, this alternative could yield indirect benefits for ecosystems.

4.5.2.1.7 Effects on Non-fishing Activities

HAPC identification could have negative indirect effects on costs to federal and state agencies that authorize, fund, or undertake actions that may adversely affect habitats identified as HAPCs, and to non-fishing industries or other proponents of such activities. From the standpoint of effects on non-fishing activities, therefore, the most relevant consideration for distinguishing among the alternatives is the geographic scope. The broader the geographic scope of HAPC designations, the greater the number of non-fishing activities that might face associated conservation recommendations.

<u>What are the differences in the geographic scope of HAPC identification under the alternatives?</u>

Alternative 1: No habitat types or areas would be designated as HAPCs.

Alternative 2: Under the status quo alternative, the existing HAPC designations would remain unchanged. HAPCs would include living substrates in shallow waters, living substrates in deep waters, and freshwater areas used by anadromous salmon.

Alternative 3: (Preliminary Preferred Alternative) The existing HAPC designations would be rescinded, and the Council would adopt an approach that would allow specific sites within EFH, selected to address an identified problem, to be designated as HAPCs in the future. The geographic scope of HAPCs would depend upon the number and size of HAPCs adopted by the Council in the future.

Alternative 4: The existing HAPC designations would be rescinded, and the Council would adopt an approach that would allow specific sites selected within identified habitat types within EFH to be identified as HAPCs in the future. Alternative 4 is similar to Alternative 3, except that the Council would first specify types of habitat that may warrant HAPC identification, and then identify specific sites within those habitat types as HAPCs. The geographic scope of HAPCs would depend upon the number and size of HAPCs adopted by the Council in the future.

Alternative 5: The existing HAPC designations would be rescinded, and the Council would adopt an approach that would allow areas within EFH to be identified as HAPCs in the future based on productivity of the habitat for individual species. Resulting HAPC designations would, therefore, be species-specific and would rely on information about habitat functions for the target species. The geographic scope of HAPCs would depend upon the number and size of HAPCs adopted by the Council in the future.

4.5.2.2 Adverse Effects that Cannot be Avoided When Establishing an HAPC Approach

Establishing an approach for the identification of HAPCs may lead to future actions to identify specific HAPCs, which may affect a variety of fishing and non-fishing activities, as discussed in Sections 4.2 and 4.5.2 of this EIS. Selecting an approach for identifying HAPCs will have no direct environmental consequences, but will provide policy direction for future HAPC actions by the Council, and will shape future HAPC proposals brought before the Council. Nevertheless, the Council may or may not adopt specific HAPCs in the future. Selecting an approach for identifying HAPCs does not obligate the

Council to identify HAPCs, and HAPC identification is not required by the Magnuson-Stevens Act or the EFH regulations.

If and when the Council identifies specific HAPCs, accompanying analyses will evaluate associated direct and indirect costs and benefits for fishing and non-fishing activities. Conservation measures resulting from HAPC designation probably will not avoid all adverse effects to HAPCs. A variety of fishing and non-fishing activities will continue to occur and will continue to result in environmental impacts, including potential degradation and loss of HAPCs. HAPC identification may lead to actions that will minimize those effects, but probably will not avoid further habitat damage entirely.

4.5.2.3 Conclusions

The alternatives for HAPC identification in this EIS are a range of different methodological approaches, rather than different specific types or areas of habitat. Differences in the environmental consequences of the alternatives are therefore related to the type of approach that would be used to identify HAPCs and the anticipated effects of HAPCs that would be designated under each approach.

Table 4.5-3 summarizes the effect ratings (E-, Ø, E+, or U) for each topic evaluated in Section 4.2 to describe the effects of each alternative on habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems and biodiversity, and non-fishing activities. In summary, HAPC identification could have benefits for habitat, target species, federally managed fisheries, other fisheries and fishery resources, protected species, and ecosystems. Alternative 1 would eliminate HAPC designations, resulting in the loss of potential benefits from the designations and any resulting protective measures. Alternative 1 may have benefits for both non-fishing activities and fisheries targeting non-FMP species, insofar as no particular areas within EFH would be highlighted for direct fishing restrictions or review during interagency EFH consultations for development activities. Alternative 2 would retain the status quo HAPC designations and associated effects. However, the broad and general nature of the existing HAPC designations may limit their efficacy. Alternatives 3 (preliminary preferred alternative) through 5 would rescind the existing HAPC designations in favor of other approaches that would allow HAPC identification in the future. The resulting indirect effects would depend upon the specific HAPC designations implemented in future Council and NMFS actions. Alternatives 3 through 5 would have comparable potential effects on habitat, federally managed fisheries, other fisheries and fishery resources, protected species, ecosystems, and non-fishing activities. Alternative 4 may offer more potential benefits for target species than the other alternatives because the stepwise process of selecting habitat types and then specific sites could yield a more rational and structured effort to ensure that HAPCs would focus on the habitats within EFH that are most valuable and/or vulnerable.

Table 4.5-4 provides a comparison of the alternatives in terms of three summary factors: relative size of HAPC designations, consistency with the EFH regulations, and overall efficacy and relative merits.

4.5.3 Comparison of the Alternatives for Minimizing the Effects of Fishing on EFH

The alternatives for minimizing the adverse effects of fishing on EFH are a range of specific management options. The alternatives all start with the status quo fishery management regime that includes a variety of measures that help to reduce the potential effects of fishing on habitat. Alternatives 2 through 6 would add progressively more restrictive management measures. Section 4.3 discusses the effects of each alternative on habitat, target species, federally managed fisheries, other fisheries and fishery resources,

protected species, and ecosystems and biodiversity. The effect ratings (E-, Ø, E+, or U) for each issue evaluated are summarized in Table 4.5-5.

The effect ratings alone do not provide a basis for distinguishing among the alternatives. The ratings characterize effects as positive or negative, but do not convey the magnitude or intensity of effects. The accompanying text in Section 4.3 explains the anticipated effects for each alternative, but makes few direct comparisons among alternatives. For a quick comparison across alternatives, see Table 4.5-6. The following sections, therefore, summarize the most pertinent effects comparatively to highlight relevant issues and provide a clearer basis for choice among the alternatives.

4.5.3.1 Comparative Summary of Effects

The short-term economic and socioeconomic effects of the alternatives to minimize the effects of fishing on EFH are relatively easy to describe: fishery management measures impose costs. Their measurement and analysis are more complex. It is possible to hypothesize some economic relationships that can be quantitatively approximated, for example, by revenue at risk, product output values, or other empirical statistics. The ecological effects of the alternatives are more difficult to assess, because existing scientific information does not provide a clear picture to link habitat conservation measures with specific quantifiable gains in the productivity, survival, and recruitment of managed fish species. Likewise, available information and empirical experience are insufficient to allow a concrete measure of the long-term economic and socioeconomic benefits that may result from future changes in fish production possibly attributable to today's habitat conservation decisions. Nevertheless, the effects of the EFH fishing impact minimization alternatives are summarized below using the best information available.

This section also contrasts each of the alternatives with a pre-status quo condition suggested by the Council to provide additional context. The Council has implemented numerous measures to protect habitat over the roughly 27 years since establishment of the U.S. EEZ. The pre-status quo condition reflects a hypothetical scenario with today's environment, stock size, etc., absent all area closures, effort reduction, gear measures, and rationalization programs. By contrasting each of the alternatives with pre-status quo conditions, the comparative summary illustrates that all seven of the alternatives start with a common suite of existing conservation and management measures that provide a substantial degree of habitat protection.

The status quo alternative (Alternative 1) includes only existing management measures, whereas all of the other alternatives include the existing management measures plus additional measures. All of the alternatives as well as the pre-status quo condition are compared here (and in Section 4.3) to the status quo.

4.5.3.1.1 Effects on Habitat

The analysis indicated that current fishing activities affect EFH in a manner that is minimal and temporary in nature (Appendix B). However, additional measures to reduce the effects of fishing on habitat would, by design, have positive effects on EFH. Measures considered in the alternatives include new area closures to bottom trawling (all alternatives), gear restrictions (Alternatives 4, 5A, 5B), TAC reductions (Alternative 5B Options 1 and 2), bycatch limits for bryozoans/corals and sponges (Alternative 5B Options 1 and 2), and area closures to all bottom tending gear types (Alternative 6). From the standpoint of effects on habitat, the most relevant factor for distinguishing among the alternatives is the additional amount of area closed to bottom tending gear, and especially trawling, year-round.

How would each alternative provide for protection, conservation, or enhancement of habitat, particularly EFH?

Pre-status quo conditions: Without any measures to control the effects of fisheries on benthic habitat, EFH would likely be adversely affected. No area would be closed to bottom trawling. Trawling and scallop dredging would occur in areas essential for king crab settlement and survival, especially in the Bristol Bay, Pribilof Islands, Cook Inlet, and Kodiak areas. The effects on habitat in Southeast Alaska would increase without trawl restrictions. Trawl fishing effort, particularly for pollock and flatfish, would be substantially higher (30 percent or more) in the absence of Council-imposed OY limits and PSC closures. Fisheries would become more temporally concentrated as effort increased due to higher catch limits, roe stripping of pollock, lack of permit limitation or rationalization programs, and absence of bycatch closures. Without IR/IU limitations for pollock and Pacific cod, wasteful underutilization of these economically important resources would occur, with substantially greater discharges of offal and economic discards. As was the case with roe stripping, this practice could result in eutrophication of EFH in some areas. Fewer areas would remain unaffected and unexploited. Without gear restrictions, more bottom contact would occur in the pollock trawl fisheries.

Alternative 1: (Preliminary Preferred Alternative) Under the status quo alternative, existing fishery management measures that control the effects of fishing on habitat (trawl closure areas, effort limits and rationalization programs, catch limits, and gear restrictions) would remain unchanged. Fisheries would continue to affect fish habitat, but not in a manner that has substantial impact on EFH, prey species, habitat complexity, or habitat biodiversity. The long-term effects would remain low overall across available habitat types and features, although effects would not be evenly distributed.

Alternative 2: The GOA slope rockfish closures would provide insignificant marginal benefits for EFH. Bottom trawling would still occur in these areas for deepwater flatfish and other species, and the rockfish effort would shift to other areas of the slope, intensifying any associated fishing effects on those areas.

Alternative 3: The closure of the entire GOA slope to rockfish trawling would reduce the effects on epibenthic structures and coral that may occur on the slope area. Trawl effort for rockfish would likely shift to the gullies on the shelf, but the effect indices are relatively low in those areas.

Alternative 4: Closures in the AI area would provide substantially more protection of coral in that management area. In addition, gear modifications required for EBS bottom trawl fisheries may substantially reduce effects on habitat complexity. The relatively small closures in the EBS and GOA would provide insignificant benefits to habitat in those regions.

Alternative 5A: Closures to all bottom trawling on the GOA slope would provide substantial benefits to epibenthic structures and coral. As with Alternatives 4 and 5B, the trawl gear modifications would provide positive effects for habitat complexity in the EBS. The trawl closure areas in the Aleutians would provide substantially improved protection of coral in that region, thus providing positive benefits to habitat biodiversity. In the EBS,

the large closure areas proposed under this alternative would not substantially reduce the effects of fishing on benthic habitat, due to the limited fishing effort that has occurred.

Alternative 5B: The effects of Alternative 5B would be the same as those for Alternative 5A for the GOA and EBS. For the AI, the large trawl closures would be expected to result in substantial increases in protection of coral in this area. The closures would be largest under Option 2, slightly smaller under Option 1, and smaller yet under Option 3.

Alternative 6: When added to existing trawl closure areas, the bottom tending gear closure areas comprising 20 percent of each area would provide moderately positive effects on habitat complexity and biodiversity.

4.5.3.1.2 Effects on Target Species

Measures to reduce the effects of fishing on habitat may also affect target species. From the standpoint of effect on target species, the most relevant factors for distinguishing among the alternatives are the location of the alternative areas closed to trawling (and in the case of Alternative 6, all bottom-tending gear types) and the relative dependence of the species upon those habitat areas for spawning/breeding, feeding, and growth to maturity. The effects on biomass and spatial and temporal concentration of the catch are also relevant factors.

<u>How would each alternative affect target species?</u>

Pre-status quo conditions: Target species may be adversely affected in the absence of measures to control the effects of fisheries on benthic habitat. Opening areas essential for king crab settlement to trawling and scallop dredging may reduce the overall productivity of red and blue king crab populations in Bristol Bay, Pribilof Islands, Cook Inlet, and Kodiak areas. In the absence of OY limits, significantly more pollock and flatfish would be caught, although catch limits would still be set within acceptable biological limits.

Alternative 1: (Preliminary Preferred Alternative) Under the status quo alternative, target species, with the exception of three BSAI crab stocks, are all considered to be at healthy population sizes and are not overfished. Overfishing is not allowed under existing catch limits. For those species where enough information is available for evaluation, Alternative 1 was judged to have no substantial effect on target stocks as measured by effects on stock biomass, spatial/temporal concentration of the catch, spawning/breeding, feeding, and growth to maturity.

Alternative 2: The small closures to rockfish fishing would not affect target stocks because the areas are very small relative to available habitats and are closed only to directed rockfish fishing with bottom trawls.

Alternative 3: The closure of the slope to rockfish fishing would provide some potential positive effects for slope rockfish growth to maturity. However, these benefits may be offset by increases in catch with pelagic trawl gear or movement of the fleet onto the shelf or in gullies.

Alternative 4: The trawl closures in the northwest area of the EBS, combined with the trawl gear roller size requirements, were judged to have positive effects on the growth to maturity of snow crabs. Otherwise, no effects on target species are anticipated.

Alternative 5A: The effects would be the same as Alternative 4.

Alternative 5B: The effects would be the same as Alternative 4.

Alternative 6: For some species and stocks with limited distribution (some crab stocks and scallop populations), the closure areas would overlap substantially with the effort distribution of the fishery, resulting in reduced catches or more spatial/temporal concentration of effort. Otherwise the effects of this alternative would be neutral with respect to target stocks.

4.5.3.1.3 Effects on Economic and Socioeconomic Aspects of Federally Managed Fisheries

Measures to reduce the effects of fishing on habitat would also have economic and socioeconomic effects. The effects on federally managed fisheries were evaluated on the basis of passive-use values, gross revenues, operating costs, costs to consumers, impacts on crew and vessel safety, impacts to related fisheries, effects on support industries, socioeconomic effects on fishing communities, and management and enforcement costs.

<u>How would each alternative affect federally managed fisheries?</u>

Pre-status quo conditions: Without the current management regime, the costs to the fishing fleets to prosecute these fisheries would be substantially reduced, at least in the short term. Trawl and dredge fisheries could operate wherever they could maximize their net revenues, but this would reduce passive-use values for undisturbed places. Significantly more pollock and flatfish would be caught in the absence of OY limits and PSC closures. Without effort controls or rationalization programs and other regulations, roe-stripping would likely be practiced by persons participating in an Olympic-style pollock fishery. Safety would be reduced as groundfish fishery seasons would be limited to weeks, days, or even hours as occurred in the halibut fishery prior to IFQ management. All these effects would impose costs on secondary users and, ultimately, on the final consumers of products derived from these fisheries. Initially, supplies would tend to spike, as catches expanded due to unregulated effort. This would tend to drive ex-vessel prices down, as would ultimately be the case at all levels of the market. The 'race for fish' would simultaneously put pressure on processors to move greater quantities of raw fish through their facilities, as the quantities increased and pace of deliveries quickened. Recovery rates would decline, resulting in more fish being diverted to meal plants, or grinders and discharge chutes. Accelerated rates of catching and processing imply temporally and spatially compressed fisheries. Under these circumstances, product quality tends to decline, some product forms may become less readily available, and less fresh product and more frozen product would have to be supplied to the marketplace, with associated reductions in product value. All these attributable effects would tend to reduce the net value to the nation derived from these living marine resources.

Alternative 1: (Preliminary Preferred Alternative) Under the status quo, the fishing industry continues to be vibrant in Alaska. However, some communities and fisheries have experienced

impacts of low salmon prices and changes due to stock sizes and regulations (e.g., sea lion protection measures). The status quo provides the effective regulatory baseline and a balance of passive-use values, gross revenues, operating costs, costs to consumers, safety, impacts to related fisheries, effects on support industries, socioeconomic effects on fishing communities, and management and enforcement costs.

Alternative 2: Alternative 2 was judged to have slightly positive effects on passive-use values, due to establishment of GOA slope rockfish closure areas. The alternative would have no substantial effects on gross revenue, as the projected maximum gross revenue at risk was less than $1 million, annually. Alternative 2 was judged to have slightly negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. No effects on shoreside support industries or fishing communities would be anticipated. Additional on-water enforcement, a VMS system, or 100 percent observer coverage may be required to ensure compliance with closure areas established under this alternative. These measures would add to the operating costs of participants.

Alternative 3: Like the other alternatives to the status quo, additional closures are assumed to result in increased passive-use values. The alternative would have negative effects on gross revenue, as the projected gross revenue at risk is $2.65 million, some of which may not be recovered. Alternative 3 was judged to have negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. No effects on shoreside support industries or fishing communities would be anticipated. Like other alternatives to the status quo, additional monitoring and enforcement efforts (and associated costs) may be required.

Alternative 4: Additional closures might result in even more positive effects on passive-use values. Alternative 4 would have negative effects on gross revenue, as the projected gross revenue at risk was at least $3.53 million, some of which may not be recovered. Alternative 4 was judged to have negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. No substantial effects on shoreside support industries or fishing communities would be anticipated. Like other alternatives to the status quo, additional monitoring and enforcement efforts (and associated costs) may be required.

Alternative 5A: This alternative has positive effects on passive-use values, at about the same level as Alternative 4. Alternative 5A would have negative effects on gross revenue, as the projected gross revenue at risk is at least $7.92 million, some of which may not be recovered. Alternative 5A was judged to have negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. No substantial effects on shoreside support industries or in most fishing communities (except Western GOA) would be anticipated. Like other alternatives to the status quo, additional monitoring and enforcement efforts (and associated costs) may be required.

Alternative 5B: This alternative has additional effects compared with Alternative 5A. Under any of the Alternative 5B options, revenue at risk due to the GOA measures would be $3.6 million, which is identical to the GOA portion of Alternative 5A. For Alternative 5B Option 1, the TAC reductions for cod, mackerel, and rockfish would result in a $15.16 million loss of revenue in addition to gross BSAI revenue at risk of $9.34 million, for a total of $24.50 million. For Option 2, the TAC reductions for mackerel and rockfish would

result in a $3.83 million loss of revenue in addition to gross BSAI revenue at risk of $5.62 million, for a total of $9.45 million. For Option 3, BSAI revenue at risk would be $3.86 million. Alternative 5B would have additional negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. There could be negative effects on shoreside support industries in those communities where inshore processors are involved in the at-risk fisheries, and those fisheries for which TAC is reduced under Options 1 and 2. Negative socioeconomic effects would be anticipated in western GOA communities. This alternative specifies that additional monitoring and enforcement efforts (and associated costs) would be required. Passive-use values may be higher due to additional habitat protection afforded under this alternative.

Alternative 6: Alternative 6 has additional positive passive-use values. Alternative 6 would have very substantial negative effects on gross revenue, as the projected gross revenue at risk is more than $163 million for groundfish, $38 million for halibut, $34 million for crab, and approximately $1 million for scallops. Alternative 6 was judged to have additional negative effects on operating costs, costs to consumers, safety, and impacts to related fisheries. There would be negative effects on shoreside support industries in those communities where inshore processors are involved in the at-risk fisheries. Negative socioeconomic effects would be anticipated to occur in coastal communities dependent upon fishing. Additional monitoring and enforcement efforts (and associated costs) may be required.

4.5.3.1.4 Effects on Other Fisheries and Fishery Resources

Fisheries and fishery resources not managed under a federal FMP may also be affected by proposed measures to reduce the effects of fishing on habitat. From the standpoint of effect on other fisheries, the relevant factors for distinguishing among the alternatives include the location of the areas closed to trawling (and in the case of Alternative 6, all bottom-tending gear) and the types of fisheries prohibited from these areas.

<u>How would each alternative affect other fisheries and fishery resources?</u>

Pre-status quo conditions: Without regulations, the halibut fishery would operate in an open-access mode, and consequently would have shorter seasons, more fishing effort, lower ex-vessel prices, and reduced overall product quality, with the loss of fresh markets and most fish being frozen for later delivery and distribution. Crew and vessel safety would also suffer. State-managed fisheries, including the herring fishery, may not be substantially affected.

Alternative 1: (Preliminary Preferred Alternative) The status quo alternative would have no substantial effect on other fisheries, including state-managed groundfish fisheries, state-managed crab and invertebrate fisheries, herring fisheries, and halibut fisheries.

Alternative 2: The GOA slope closures to rockfish fishing may provide some slight benefit for deepwater Tanner crabs and golden king crabs and their fisheries.

Alternative 3: Closure of the GOA slope to rockfish fishing may provide some benefit for deepwater Tanner crabs and golden king crabs and their fisheries.

Alternative 4: Alternative 4 would likely have effects similar to Alternative 2.

Alternative 5A: Alternative 5A would likely have effects similar to Alternative 3.

Alternative 5B: Alternative 5B would likely have effects similar to Alternative 3.

Alternative 6: The closure areas designated would prohibit the use of all bottom-tending gear, including gear used by non-FMP fisheries such as halibut. Consequently, this alternative would have negative effects on state-managed groundfish fisheries, state-managed crab and invertebrate fisheries, and halibut fisheries due to displacement of effort and potential reductions in catch and revenue. No effects on herring fisheries would be anticipated.

4.5.3.1.5 Effects on Protected Species

Marine mammals, seabirds, and ESA-listed salmon may also be affected by proposed measures to reduce the effects of fishing on habitat. From the standpoint of effects on protected species, the relevant factors for distinguishing among the alternatives include the location of the areas closed to trawling (and in the case of Alternative 6, all bottom-tending gear) and the localized harvest of important prey species.

How would each alternative affect protected species?

Pre-status quo conditions: Without regulatory measures such as area closures and OY limits, it is likely that the fisheries would have adverse effects on marine mammals and seabirds. It is possible that these effects could result in a conclusion that some fisheries jeopardize the continued existence and/or adversely modify the critical habitat of ESA-listed species (e.g., Steller sea lions, short-tailed albatross, North Pacific right whale).

Alternative 1: (Preliminary Preferred Alternative) Under the status quo alternative, the existing suite of regulations developed in compliance with the Magnuson-Stevens Act and ESA attempt to minimize the effects of fishing on protected species, including ESA-listed marine mammals, other marine mammals, ESA-listed Pacific salmon, ESA-listed seabirds, and other seabirds, to the extent practicable.

Alternative 2: Alternative 2 would have no substantial effect on protected species.

Alternative 3: Alternative 3 would have no substantial effect on protected species.

Alternative 4: Alternative 4 would have no substantial effect on protected species.

Alternative 5A: Alternative 5A would have no substantial effect on protected species.

Alternative 5B: Alternative 5B could have small negative effects on ESA-listed marine mammals. Steller sea lions in the Aleutians may be impacted by spatial and temporal concentrations of fishing effort in localized nearshore areas not fully offset by TAC reductions under Options 1 and 2. No substantial effects are anticipated for other marine mammals, ESA-listed Pacific salmon, ESA-listed seabirds, or other seabirds.

Alternative 6: Alternative 6 would have negative effects on ESA-listed marine mammals. Steller sea lions and ESA-listed whales in the western Gulf and Aleutians may be impacted by displacement of the Atka mackerel fishery, in particular. No substantial effects are anticipated for other marine mammals, ESA-listed Pacific salmon, ESA-listed seabirds, or other seabirds.

4.5.3.1.6 Effects on Ecosystems

Actions taken to minimize the effects of fishing on habitat could have positive effects on overall ecosystem health and stability, as measured by effects on predator-prey relationships, energy flow and balance, and biological diversity. From the standpoint of effects on ecosystems (particularly biodiversity), the most relevant consideration for distinguishing among the alternatives is the degree to which ecosystem health would benefit from area closures. Area closures can provide for increased functional diversity, especially in the case of structural habitat organisms, as well as increased genetic diversity if exploitation is reduced on localized spawning aggregations or on older, more heterozygous, individuals.

<u>How would each alternative affect ecosystem health and stability?</u>

Pre-status quo conditions: The baseline conditions would allow for increased exploitation rates in the absence of an OY cap and PSC closures, which, in turn, could affect predator-prey relationships and biodiversity. Energy flow and balance could be affected by allowing roe-stripping of pollock and allowing for open access of the fisheries and the consequent changes in discarding incentives. An absence of area closures would reduce functional and genetic biodiversity.

Alternative 1: (Preliminary Preferred Alternative) The status quo alternative would have no substantial effect on the ecosystem, as measured by the effects on predator-prey relationships, energy flow and balance, and biological diversity.

Alternative 2: The small rockfish closures on the GOA slope would have no substantial effects on ecosystems.

Alternative 3: The closure of the entire GOA slope to rockfish fishing may have positive effects on species diversity and genetic diversity by protecting living substrate and allowing some rockfish to remain nearly unexploited.

Alternative 4: Closures in the GOA, EBS, and AI may have positive effects on species diversity and genetic diversity. The large trawl closures would provide protection against extinction of sensitive sessile organisms within the closed area. Additionally, genetic diversity of less mobile fish species may be enhanced by allowing for some local areas to remain nearly unexploited.

Alternative 5A: The larger closure areas would provide additional beneficial effects on diversity.

Alternative 5B: The effects would be similar to Alternative 5A, but more pronounced benefits may accrue to diversity in the AI area due to much larger area closures. The closures would

be largest under Option 2, slightly smaller under Option 1, and smaller yet under Option 3.

Alternative 6: Alternative 6 may also have positive effects on species diversity and genetic diversity due to implementation of numerous closures to bottom-tending gear across all habitat types.

4.5.3.2 Summary of Cumulative Effects by Criterion for Alternatives to Minimize the Adverse Effects of Fishing on EFH

Historically, GOA, EBS, and AI fish habitat was influenced by an active foreign trawl fishery. The subsequent domestic trawl fishery also 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. In that respect, the 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 (preliminary preferred alternative) would maintain the status quo. Alternative 2, while providing some level of protection, would not have any substantial positive impact. Alternatives 3 through 6 would provide progressively more habitat protection, working cumulatively with other current and planned future management actions to reverse the negative effects that earlier fisheries had on habitat.

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. The tangible evidence for this is that 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. Planned future actions are meant to do the same. 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 alternatives are expected to have a neutral influence with respect to cumulative effects on target species.

The criteria used to evaluate effects on federally managed species offer a mixed set of cumulative effects. In terms of passive-use values, the past trend was negative, while current and planned future management actions, as well as the alternatives to minimize the effects of fishing on EFH, would be positive. One factor, safety, has had a positive trend that is expected to continue, although the alternatives to minimize the effects of fishing on EFH could push some smaller fishing vessels farther from shore in search of fish. Most of the other factors used to evaluate federally managed fisheries are in a downward trend that would be accentuated by current and future management plans, including the 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 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, current and planned future management actions are expected to have both positive (conservation) and negative (closures, increased costs) effects, and most of the 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 with associated positive and negative effects.

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 alternatives to minimize the effects of fishing on EFH would add cumulatively to the effects of other management actions.

The herring and halibut fisheries both appear to be healthy, with herring rebounding from earlier declines and halibut at near-record catch levels. None of the measures to minimize the effects of fishing on EFH, or other planned future management actions, is expected to have any substantial effects on herring or halibut stocks. However, the halibut fisheries, especially around the Pribilof Islands, may be negatively effected by Alternative 6.

The past trend has generally been 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. Most of the alternatives to minimize the effects of fishing on EFH are expected to have a neutral effect in this regard. The exceptions are Alternatives 5B 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 interactions of fisheries and marine mammals. Thus, while most of the minimization alternatives would have no substantial effect on marine mammals and seabirds, Alternatives 5B and 6 would add cumulatively to the existing negative trend.

The effects of past trends have generally been 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. 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 are expected to have positive effects on biodiversity.

The result of past trends in environmental regulation of all types has generally been to increase the costs of federal and state regulatory agencies and to increase the cost of doing business for non-fishing industries, such as timber, mining, and other forms of development. These increased costs have come in the form of agencies making and enforcing rules, adhering to environmental restrictions on the part of industry, and, for both parties, performing environmental studies and preparing environmental documentation. Future trends are not known, and they depend for the most part on whether the future brings a higher level of regulation and/or more economic activity, or a lower level of regulation and/or less economic activity. Regardless of the future trends affecting non-fishing activities, the alternatives to minimize the effects of fishing on EFH are not expected to have any cumulative effect.

4.5.3.3 Practicability Analysis for the Alternatives to Minimize the Effects of Fishing on EFH

Section 303(a)(7) of the Magnuson-Stevens Act requires that FMPs minimize to the extent practicable the adverse effects of fishing on EFH. The EFH regulations at 50 CFR 600.815(a)(2)(iii) provide the following guidance to Councils on evaluating the practicability of potential management measures:

> In determining whether it is practicable to minimize an adverse effect from fishing, Councils should consider the nature and extent of the adverse effects on EFH and the long and short-term costs and benefits of potential management measures to EFH, associated fisheries, and the nation, consistent with national standard 7. In determining whether management measures are practicable, Councils are not required to perform a formal cost/benefit analysis.

The evaluation of practicability should consider the economic and ecological costs and benefits of the identified management measures. NMFS has not identified a preferred methodology as national guidance for conducting the practicability analysis. This EIS uses a variety of quantitative and qualitative information to assess the practicability of the alternatives to minimize the effects of fishing on EFH.

Appendix B contains an evaluation of the effects of fishing on EFH and discusses the nature and extent of potential adverse effects to the habitat as well as the target species. Economic costs of the alternatives to minimize adverse effects of fishing on EFH are evaluated in Appendix C. Ecological costs and benefits are more difficult to evaluate. Limited information is available to describe the effects of habitat alteration on the survival and productivity of managed species. Likewise, there are no proven techniques for quantifying the benefits to target species that may accrue as a result of adopting any of the alternatives for minimizing the effects of fishing on EFH, although many studies worldwide have documented the results of implementing various closed areas.

The analysis in Section 4.3 and Appendix B indicates that there are long-term effects of fishing, particularly bottom trawling, on benthic habitat features off Alaska. Considerable scientific uncertainty remains regarding the consequences of such habitat changes for the sustained productivity of managed species. If the current pattern of fishing intensity and distribution continues into the future, living habitat features that provide managed species with structure for refuge would be reduced by 0 to 11 percent in each habitat area, with the greatest reduction occurring on soft substrates of the Aleutian slope area. Hard corals would be reduced by 0 to 16 percent, with the greatest reduction occurring on hard substrates of the Aleutian shallow water area. There would be almost no reduction (0 to 3 percent) in infauna and epifauna prey for managed species. Viewed another way, habitat loss due to fishing off Alaska is relatively small overall, with most of the available habitats unaffected by fishing (infaunal prey are 97 to 100 percent unaffected; epifaunal prey are 97 to 100 percent unaffected; living structure is 89 to 100 percent unaffected; and hard corals are 84 to 98 percent unaffected).

The evaluation of the effects of fishing on EFH (Appendix B) concludes that despite persistent disturbance to certain habitats, the effects on EFH are minimal because the analysis finds no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. The analysis concludes that no Council-managed fishing activities have more than minimal and temporary adverse effects on EFH for any FMP species, which is the regulatory standard requiring action to minimize adverse effects under the Magnuson-Stevens Act (50 CFR 600.815(a)(2)(ii)). Additionally, the analysis indicates that all fishing activities combined have minimal, but not necessarily temporary, effects on EFH. These findings suggest that no additional actions are required pursuant to the EFH regulations. However, the analysis has many limitations, and the effects of fishing on EFH for some managed species are unknown. Even though the available information does not identify adverse effects of fishing that are more than minimal and temporary in nature, that finding does not necessarily mean that no such effects exist. Thus, appropriate precautionary measures may be warranted.

To assist in determining whether additional management measures are practicable, the long- and short-term costs and benefits of the potential management measures to EFH, associated fisheries, and the nation, consistent with national standard 7, are evaluated in this EIS. A summary of the relative benefits to habitat conservation and the relative costs associated with each alternative is provided in Table 4.5-7, which allows for a quick comparison across alternatives. Given the apparent limited adverse effects on EFH, and the costs and benefits of the alternatives, most alternatives would be practicable to implement, with the exception of Alternative 6, which would have substantially greater adverse effects on fishermen, communities, and associated industries than attributable benefits. Further discussion of the practicability of the alternatives is provided below.

In regard to habitat conservation, Alternatives 2 and 3 would provide very little benefit relative to the status quo Alternative 1 because the closure areas would only reduce the effects of fishing slightly and only on the GOA slope area. Alternative 4 would provide some degree of additional habitat conservation for all three regions (EBS, AI, and GOA) through the use of bottom trawl closures in portions of each region (in the GOA, closures are for slope rockfish trawling only), as well as bottom trawl gear regulations for vessels fishing in the EBS. Alternative 5A would increase the amount of protection offered by Alternative 4 by expanding the size of the bottom trawl closures in the EBS and AI, and closing areas of the GOA slope to all bottom trawling. Alternative 5B would further minimize the effects of fishing by closing additional areas in the AI (including areas with high incidental catch rates of corals and sponges) and, under Options 1 and 2, reducing catch and setting bycatch limits for bryozoans/corals and sponges to control incidental removals. Alternative 6 would reduce the effects of fishing activities because approximately 20 percent of the available habitats would be left virtually undisturbed by fishing, and thus would be allowed to recover to an unfished state. However, the large amount of effort could be redistributed from areas of effort concentration to previously unfished or lightly fished areas, negating some potential benefits of this alternative.

There are also economic and socioeconomic costs associated with the alternatives to minimize the effects of fishing on habitat. Alternative 2 would have relatively minimal costs (gross revenue at risk $900,000). Alternatives 3, 4, and 5A would involve moderate costs to the fishing fleets (gross revenue at risk $2.7 million to $7.9 million). Alternative 5B would involve higher costs to the fleet (gross revenue at risk of $7.5 million to $28.1 million depending on which AI management option is selected), as well as negative effects on shoreside support industries and western GOA communities. Alternative 6 would have very high relative costs to the fleet (gross revenue at risk of $237 million) and would have negative effects on shoreside support industries and coastal fishing communities.

From a practicability standpoint, alternative closure areas differ in the habitat types closed and the resulting amount of habitat conservation, as well as the economic and social effects. Some areas considered for bottom trawl closures would provide habitat conservation benefits at almost no additional cost. For example, the closure area on the lower slope and basin would restrict future fisheries, but would not have direct economic costs to the current fishing industry. Likewise, limiting fishing to areas where it has occurred historically, and closing areas that are relatively undisturbed, as in the EBS and AI portions of Alternative 5B, would protect habitats from potential future disturbance without incurring significant short-term costs.

To better understand the practicability of each type of closure, Table 4.5-8 provides a comparison of the amount of area closed, by gear type, on the shelf and upper slope (less than 1,000 m) and on the lower slope/basin area (more than 1,000 m). Most fisheries, especially trawl fisheries, currently occur on the shelf and upper slope areas. Thus, the relative amount of closure area at depths less than 1,000 m reflects the relative amount of habitat conservation provided by restricting the current fisheries.

The closures to bottom trawling of deepwater habitats (more than 1,000 m) under Alternatives 4, 5A, and 5B are examples of precautionary measures, since actions taken to conserve the habitat would be proactive. To date, very little fishing effort has occurred in these habitats, but with improved technology and an ever-increasing human population, these areas could be explored and exploited. Commercially valuable species live in these habitats. Already, some small amount of trawling and longlining has been prosecuted on the lower slope (1,000 m to 3,000 m) for turbot, thornyhead rockfish, grenadiers, and sablefish (Fritz et al. 1998), as well as pot fishing for scarlet king crabs. In addition, hagfish and shrimp (as well as grenadiers and sablefish) have been photographed in Pacific coast deep basin areas down to 4,000 m (Isaacs and Schwartzlose 1975). Sablefish caught in the nearshore areas of Alaska use the basin area to some extent, as ascertained from movements of fish tagged on seamounts and later recovered in coastal areas (Maloney 2002). Clearly, the potential exists for significantly larger fisheries and fishing effort to occur on deepwater benthic habitats used by these species. Alternative 5B, and to a lesser extent Alternatives 4 and 5A, would prevent any potential adverse effects on deepwater benthic habitats due to bottom trawling by taking action in a proactive manner. Moreover, these closures would provide habitat benefits with almost no short-term costs.

4.5.3.4 Adverse Effects that Cannot be Avoided When Minimizing Effects of Fishing on EFH

Any new measures to reduce the effects of fishing on EFH will inevitably impose costs on the fishing industry and have other environmental consequences. The only ways to minimize the effects of fishing beyond status quo measures are to reduce fishing effort, shift effort to other areas, and/or change the methods and gear used to harvest fish, all of which have economic costs as well as indirect effects on other components of the environment. The environmental consequences of the alternatives evaluated in this EIS for minimizing the effects of fishing on EFH are discussed in Sections 4.3 and 4.5.3. These alternatives constitute a reasonable range of options for minimizing the effects of fishing on EFH. Other alternatives are possible, but the options evaluated in this EIS illustrate a variety of different measures, employing different degrees of precaution and resulting in different types of effects on the human environment.

Many different activities would continue to have negative effects on EFH and fish habitat in general, regardless of what actions the Council and NMFS take to minimize the effects of fishing on EFH. The alternatives considered in this EIS would reduce adverse effects on habitat. However, fishing inevitably has environmental impacts, and would be expected to continue to affect habitat negatively to some degree. Fishing activities would also continue to have negative effects on certain other aspects of the environment, as described for the status quo conditions throughout Chapter 4. In addition, non-fishing activities would continue to have negative effects on fish habitats (see Appendix G).

4.5.3.5 Conclusions

The analyses in Section 4.3 and Appendix B indicate that fishing has long-term effects on benthic habitat features off Alaska and acknowledges that considerable scientific uncertainty remains regarding the consequences of such habitat changes for the sustained productivity of managed species. Nevertheless, this EIS concludes that the effects on EFH are minimal because the analysis finds no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. The analysis concludes that no Council-managed fishing activities have more than minimal and temporary adverse effects on EFH, which is the regulatory standard requiring action to minimize adverse effects under the Magnuson-Stevens Act. These findings suggest that no additional actions are required to minimize the adverse effects of fishing on EFH pursuant to the Magnuson-Stevens Act and the EFH regulations (50 CFR part 600, Subpart J).

However, the analysis has many limitations, and the effects of fishing on EFH for some managed species are unknown. Even though the available information does not identify adverse effects of fishing that are more than minimal and temporary in nature, that finding does not necessarily mean that no such effects exist. Thus, appropriate precautionary measures may be warranted.

The analysis indicates that additional practicable measures could be taken to protect, conserve, and enhance EFH. Section 4.5.3.3 concludes that most of the alternatives are practicable, with the exception of Alternative 6, which would have substantially greater adverse effects on fishermen, communities, and associated industries than any of the other alternatives, well in excess of any potential offsetting benefits. As noted in the practicability analysis, certain precautionary management measures could provide habitat benefits with little or no short-term costs.

4.5.4 Relationship of Findings to the Programmatic Groundfish SEIS

NMFS recently prepared a programmatic supplemental EIS (PSEIS) for the groundfish fisheries, which examines alternative policies for conservation and fishery management (NMFS 2004). Part of that analysis examines the effects of the status quo management regime on habitat. This section provides information on how the approach used for analyzing habitat effects in the revised PSEIS, as well as its conclusions, may differ from this EFH EIS.

In the PSEIS, the potential effects of the groundfish fisheries on habitat were evaluated using criteria on the mortality of and damage to living habitat, changes to benthic community diversity, and changes to the geographic diversity of impacts and protection. Specific impacts are difficult to predict. Evaluation of effects requires detailed information on the distribution and abundance of habitat types, the ecology of living habitat, habitat recovery rates, and the natural disturbance regime, and such information is incomplete.

The PSEIS made qualitative judgments as to the significance of effects after considering information on the following:

1) Bycatch of living habitat derived from the multi-species projection model

2) The results of a habitat impacts model for estimates of the equilibrium levels of living habitat in fishable and currently fished areas

3) Estimates of the amount of area by habitat type and geographic zone closed year round to bottom trawling for all species

4) Evaluation of the spatial distribution of bottom trawl closures relative to fishing intensity and habitat types

Significance determination in the PSEIS differs from the more commonly used approach in scientific research. Typically, the null hypothesis of no effect is tested rigorously and only rejected if there is a very low probability of its being true (Type I error). Scientists are trained to minimize the chance of a Type I error. In the PSEIS analysis, however, rigorous tests of available data to reject the hypothesis of no fishing effects were not relied upon to determine significance, for two reasons. First, very few data were available to detect fishing effects, so rigorous statistical testing for a Type I error could not be performed. Second, NMFS determined that a more appropriate approach for the PSEIS was to decrease

the likelihood of making a Type II error (accepting a hypothesis of no effect to habitat that may, in fact, be false).

During the course of preparing the PSEIS, comments and questions were raised about the differing purpose and scope of the PSEIS and the EFH EIS. In response to these questions and to clarify the purpose and approach of the two EISs, the following summary compares the two analyses.

The Programmatic Groundfish SEIS and Its Relationship to the EFH EIS

The PSEIS and the EFH EIS have different scopes and areas of focus.

> PSEIS: The analyses consider adverse effects of fishing on benthic marine habitat from the perspective of ecosystem structure and function, as well as managed fish species. As such, the scope of this work is broader than a consideration of the effects on commercially important and functionally dependent fish species.
>
> EFH EIS: The analyses consider adverse effects of fishing on benthic marine habitat from the perspective of managed fish species that are dependent on certain qualities and features of that habitat. As such, the scope of this work is narrower than a consideration of these changes on the scale of entire marine ecosystems (as pursued in the PSEIS, for example).

These differences are reflected in the issues, criteria and assessments made in each document. To a lesser extent, the information available to each was somewhat different, because the PSEIS was developed on an earlier schedule than the EFH EIS, and some of the analytical techniques that were developed for the EFH EIS were not available to use in the PSEIS.

The purpose and need of the two documents differ as do their respective scopes and alternatives. The principal differences between these EISs are illustrated in Table 4.5-9.

The differences between the analyses used to assess the effects of fishing on habitat are illustrated below. While the PSEIS looked only at bottom trawl impact, bottom trawl fisheries were the predominant source of habitat impacts in the EFH EIS, which also examined trawl, pot, and longline gear. Another difference was that the PSEIS usually cited results using the slower recovery value for disturbed habitats (15 years, higher effects), while the EFH analysis cited a central value (5.5 years). Significant impact to the benthic habitat, however, occurs in those areas of high fishing intensity regardless of either recovery rate assumed in the analysis. The same quantitative model relating fishing effort to habitat impact was used for both analyses, and the results were highly comparable with only slight differences (Table 4.5-10).

Analyses of the Effects of Fishing on Habitat

The PSEIS baseline evaluation and the EFH effects of fishing evaluation had different purposes that reflected their respective emphases on ecosystem/community concerns and welfare of managed species. The PSEIS baseline evaluation identified 800 nm^2 of the EBS with high-impact values for living substrates. The analysis also considered the high fishing effort as an indication that those areas represent a unique habitat for managed fish species as determined by geography and oceanography, and were not equivalent to all other habitat in the same classification. The analysis also indicated that, coupled with historical impacts, impacts to long-lived, slow-growing species (i.e., coral) could cause long-term damage and possibly irreversible loss of living habitat, especially in the AI. The baseline impact to benthic

habitat was therefore rated in the PSEIS as "conditionally significant adverse." The PSEIS analysis evaluated impacts to the habitat itself, focusing on habitat features that might provide functions to managed species and speculating that linkages to productivity of fish stocks exist. Considering the lack of information on habitat function for managed species at different life stages, and the broader scope of the PSEIS, the PSEIS analysis did not depend on specifically demonstrating such linkages. The PSEIS used this approach because, for purposes of making policy decisions, any potential significant adverse effects, even if conditional, must be presented to decision-makers and the public so that consideration can be given to these effects when developing management measures in the future.

The EFH effects of fishing evaluation (Appendix B) described the same areas of high effect identified in the PSEIS, as well as broader areas of lesser effects to habitat features. Aggregate reduction values were computed by habitat areas and species EFH areas. The evaluation then considered the expected effects of all such reductions on the welfare of each managed species. Species-level evaluations included areas occupied by each species, available information on their use of the habitat, and the stock status of each species. The EFH analysis examined the likelihood of significant linkages between habitat effects and the welfare of each managed species.

While the PSEIS baseline evaluation identified areas of concern regarding the current state of habitat effects from fishing, the EFH EIS was designed to address specific criteria in the EFH regulations. While identifying areas of concern was one step in the EFH EIS, the purpose of the analysis was to evaluate whether fishing had negative effects on EFH of managed species that were more than minimal and temporary. The specific meanings of these terms are discussed in Appendix B.

Comparisons of the Alternatives

The approach and methodology used to assess the impacts on target groundfish species associated with each alternative in the PSEIS and EFH EIS were similar. For each species in each EIS, a knowledgeable scientist was designated to evaluate whether the alternatives affected the welfare of the species relative to a number of key issues. In the PSEIS, the key issues were as follows:

1) Fishing mortality
2) Change in biomass level
3) Spatial/temporal concentration of the catch
4) Prey availability
5) Habitat suitability

The key issues analyzed in the EFH EIS were as follows:

1) Stock biomass
2) Spatial/temporal concentration of the catch
3) Spawning/breeding
4) Feeding
5) Growth to maturity

These issues were evaluated relative to the status quo fishery as well as the alternatives developed under each EIS. Criteria were established for each issue to assist the analysts in making their evaluations. The primary consideration in these evaluations revolved around the ability of the stock to maintain its health and support a sustainable fishery.

In the National Standard Guidelines to the Magnuson-Stevens Act, sustainability is defined relative to a minimum stock size threshold (MSST), where stocks that fall below the MSST require an appropriate rate of rebuilding. This concept of sustainability was used in the PSEIS and EFH EIS to maintain consistency with the National Standard Guidelines. For fish stocks where information is available to estimate recruitment (Tiers 1, 2, and 3), recruitments from the late 1970s to the present were used in defining MSST proxies. These estimated recruitments thus cover a range of recent history when impacts to the stock from fishing practices would be expected. As part of the PSEIS, 10-year projections were made to assess whether the stocks would be likely to fall below their MSST levels under the status quo harvesting policy and each of the alternative policies. In the EFH EIS, projections were not available for the non-status quo mitigation alternatives. Because each of the EFH EIS alternatives to minimize the effects of fishing represents a more conservative management policy than the PSEIS status quo alternative, however, one can reasonably expect that the stock status of managed species would continue to remain above MSST under all of the EFH EIS alternatives. Also, in addition to considering effects on stock status relative to MSST, the final EFH EIS incorporates a broader evaluation of whether stock status and trends indicate any potential influence on habitat disturbance due to fishing. Specifically, Appendix B to the final EFH EIS assesses whether the temporal or spatial pattern of habitat disturbance on stock abundance is sufficient to adversely affect the ability of the stock to produce its maximum sustainable yield over the long term.

Stock status was not the only metric used for the evaluation in the EFH EIS. For most groundfish stocks, some information about habitat associations and how these may be impacted under various harvesting regimes is available, both from previous studies and the results from the EFH EIS application of the habitat impact model (Appendix B). This material is presented in the EFH EIS due to the more focused look at the links between habitat impacts and sustainability. Additionally, for stocks in Tiers 4 to 6, MSSTs are not available, and an evaluation is based, instead, on professional judgement using the best available scientific information and evidence.

Methodology for Cumulative Effects Analysis

As described earlier in this section, the purpose and scope of the PSEIS and the EFH EIS are different, which led to some differences in approach to the analyses. The PSEIS, as a programmatic document, has a much broader scope than the EFH EIS, and, as stated earlier, is focused on avoiding Type II error. The habitat and ecosystem sections of the cumulative effects analysis provide an example of how this focus leads to differences between the PSEIS and the EFH EIS. The SEIS took a conservative approach with respect to the effects of external factors such as climate and historic fishing practices. When NMFS analyzed cumulative effects on habitat in the PSEIS, the cumulative effects rating generally was conditionally significant adverse (CS-) if the adverse effects of all other actions were not offset by the alternative. Conversely, the EFH EIS notes an adverse cumulative effect on habitat and ecosystems only if the effect of an alternative would be additive to an existing adverse trend or cause an adverse trend. If the action would contribute to allowing natural recovery or reversal of the trend, the analysis indicated that there was no adverse cumulative effect.

For other criteria, the approach and methodologies used to analyze the cumulative effects in the PSEIS and the EFH EIS were similar. For criteria on groundfish, crab, salmon, herring, and halibut, the general approach used and the conclusions were similar. For economic analyses, different criteria were selected for each document, but the general approach to the analyses was the same. Due to differences in criteria and approaches for evaluating effects, the PSEIS and the EFH EIS contain some different conclusions for cumulative and economic effects.