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 from 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 reviewed 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; hence, the former may be the principal effect in relatively vulnerable areas.

The analysis did not explicitly include the effects of crab, scallop, 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.

<u>Effects on Prey Species</u>

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.

<u>Effects on Habitat Complexity</u>

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 would 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 would 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 that 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 indicate that this movement would have to be 10 to 100 times greater 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 the actual contact coverage and the 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 the 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 are analyzed. 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, analysts 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 MSST. Stocks below 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, has 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 Final Programmatic Groundfish SEIS (PSEIS) (NMFS 2004), 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 knew 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 are 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 depend 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 when 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 to groundfish target species.

4.3.1.2.2.1 Salmon

Stock Biomass – All five species of salmon (Chinook, chum, pink, coho, and sockeye) in Alaska are currently considered to be at biomass levels above MSST. None is 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 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 depends 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. As they grow, 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, and 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 a 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 depend 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 are 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 exceed 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. Other sources of mortality are 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 nearshore 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 depends 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 could 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 focuses on 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. Appendix C, Section C-3.9, summarizes all of these benefits, costs, and distributional impacts across all the alternatives.

Appendix C 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, costs to the industry, and the distributional impacts of costs and benefits. The benefit elements considered in Appendix C include passive use (or non-use) benefits, use benefits (including non-consumptive use benefits, consumptive use benefits, non-market benefits, and market benefits), and productivity benefits. The revenue impact elements considered in Appendix C include gross revenue at risk and revenue impacts related to changes in product quality. The industry cost elements considered include operating cost impacts, safety impacts, impacts to related fisheries, costs to consumers, and management and enforcement costs. The fleet distributional impact elements considered include gross revenue at risk effects by geographic area, fishery, and fleet component. Appendix C contains 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 are 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. Appendix C discusses three types of benefits: passive use, use, 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 to the resource (wild birds), nor does such 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 within 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: 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. Ecosystems such as those that comprise EFH are enormously complex and, as yet, are 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; 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).

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 would 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 would sustain or

[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.

even increase the production and yield from FMP-managed species and other species important to the fishing industry in Alaska, as well as enhancing 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. 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. Appendix C addresses 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 the following: (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) redeploying fishing effort to an area of unknown production and operational potential, using 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. 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 exceeds 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. Economists treat the difference between what they would have been willing to pay and what they had to pay 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 decreases, the size of this benefit also declines. Provisions of the proposed EFH actions could reduce the value consumers receive from the fisheries for several reasons, including the following:

1. Consumers may be supplied with fewer fish products.
2. Consumers may have to pay a higher price for the products they do consume.
3. The quality of fish supplied by the fishing industry may decline.
4. The value consumers place on (and receive from) them would decline if quality declined.

Appendix C analyzes the EFH minimization alternatives for potential impacts on costs to consumers.

Safety

There is the potential that the EFH fishing impact minimization measures may affect vessel safety several ways. These include actions that may force the fleet to fish farther from shore, reduce profitability for some fleet components, and 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, is sparsely populated, has relatively few developed ports, and has commercial fisheries that 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. 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 Appendix C: displacing capacity and effort, compression of, and/or overlapping fishing seasons, and increased costs of gearing up and standing down.

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 Appendix C clarifies 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 the complexity and cost of enforcement. In addition to this information, Appendix C provides a discussion of potential changes in vessel monitoring system (VMS) and observer costs.

Socioeconomic Effects on Fishing Communities

Many of the coastal communities adjacent to the EBS and GOA are engaged in, and depend highly 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 off Alaska.

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 they include communities of widely varying size 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. 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 waters (0 to 3 nm) 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, 5C, 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. Refer to “An Inventory of Marine Managed Areas in Alaska” for more information on specific state-managed fisheries restrictions (Mabry et al. 2003).

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. ADF&G manages demersal shelf rockfish in the EGOA 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. 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. Refer to “An Inventory of Marine Managed Areas in Alaska” for more information on specific fisheries restrictions (Mabry et al. 2003). 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 (Funk, personal communication). 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. 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. Both Alternative 5C (the preferred alternative) and Alternative 6 contain provisions that would impose restrictions on hook-and-line gear (HAL), used to harvest halibut. The economic and operational impacts of each alternative are addressed in Appendix C. None of the remaining alternatives under consideration would place restrictions on vessel operators employing HAL gear and would, therefore, not be expected to adversely impact directed halibut fishing.

4.3.1.5 Protected Species

Marine mammals, seabirds, and ESA-listed species of Pacific salmon and steelhead are considered protected resources because 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 are 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: (1) ESA-listed marine mammals (Steller sea lions and ESA-listed whales), (2) other marine mammals (other cetaceans, northern fur seals, harbor seals, other pinnipeds, and sea otters), (3) ESA-listed Pacific salmon and steelhead, 4) ESA-listed seabirds (short-tailed albatross and other ESA-listed seabirds), and 5) 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 Final PSEIS (NMFS 2004).

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.

Effects on Predator-Prey Relationships

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 Final PSEIS (NMFS 2004).

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. Organisms fouling vessel hulls 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 on the amount of surplus production (the excess of reproduction and growth over natural mortality) (Hilborn and Walters 1992) for fish stocks. Because stocks vary widely 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 more than ten times greater 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 for 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 the 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

<u>Effects on Prey Species (Ø)</u> – 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.

<u>Effects on Benthic Biodiversity (Ø)</u> – Hard corals had the highest LEI values. Because of the very slow recovery rate of these organisms, the LEI values directly reflected 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 ranged 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 indicated 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.

<u>Effects on Habitat Complexity (Ø)</u> – Long-term reductions in structure-forming habitat features were not different from the status quo for any of the habitat types or features examined in the fishing effects analysis. Hence, this issue received 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 were primarily determined by the fishing distribution and 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 Alternative 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 Alaska 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.

<u>Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U)</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 is 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 that 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 Final PSEIS (NMFS 2004), 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 Alaska waters disperses catch in time and space. The spatial temporal impacts of Alternative 1 on EFH do not appear to impact 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 walleye pollock's abundance and potential impact on the ecosystem, a number of programs have focused research on its reproductive biology. 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 stock's 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 from 1998 to 2000. The increase confirms the projection from the 2004 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 criterion, 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 criterion, 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 depend substantially 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 to depend substantially on physical structure, all structure (biological, nonliving, coral) is significantly 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. Analysts' understanding of the habitat requirements for growth to maturity and possible fishing effects on that habitat is incomplete. Although sablefish do not appear to depend substantially on physical structure, all structure (biological, nonliving, coral) is significantly 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 depend substantially on benthic prey, which may be adversely affected by fishing. Little is known about sablefish spawning habitat and the 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 to depend substantially on physical structure, all structure (biological, nonliving, coral) on the GOA slope is significantly 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 Final PSEIS (NMFS 2004) 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 one 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 more than 100 m deep 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 its MSST (Lowe et al. 2002). Also, the Final PSEIS (NMFS 2004) showed that the effects of fishing under the current fishery regime on the Atka mackerel stock do 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 the 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 generally less than 200 m deep. 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 generally less than 200 m deep.

The current stock assessment determined that the EBS Atka mackerel stock is above its MSST (Lowe et al. 2002). Also, the Final PSEIS (2004) showed that fishing effects 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, the current harvest practices are not expected to 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, fishing impact on EFH is not expected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs on benthic infauna throughout the continental shelf during summer 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, fishing impact on EFH is not expected to have 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, the current harvest practices probably have not 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, the current harvest practices probably have not 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, fishing is not expected to have 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, fishing impact to EFH is not expected to have 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, generally 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, the current harvest practices are not expected to 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, fishing impact to EFH is not expected to have 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, the current harvest practices probably have not 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, fishing impact to EFH is not expected to have 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, fishing impact to EFH is not expected to have 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. Rex sole 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 impact to habitat is not expected to have 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, the current harvest practices are not expected to 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, fishing impact to EFH is not expected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Adult feeding primarily occurs during summer throughout the continental shelf on benthic infauna and, therefore, depends 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, fishing impact to EFH is not expected to have 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, the MSST level for this management category is unknown (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, the current harvest practices are not expected to have affected the genetic diversity of the stock.

Spawning/Breeding (Ø) – Although eggs are demersal and adhesive (specific gravity of 1.047, Hart 1973), the role the habitat has in spawning success is unknown. 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, fishing impact on EFH is not expected to have 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, the MSST level for this management category is unknown (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, the current harvest practices are not expected to 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 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 impact on EFH is not expected to have 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 was estimated to be 374,000 mt, which was above the MSST (Spencer and Ianelli 2002). Model projections conducted for the Final PSEIS (2004), based on estimated recruitments in recent years, indicated 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 occurred in the month of July. Harvest data from 2000 through 2002 indicated 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 have led 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 and 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 Final PSEIS (2004), 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 to 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 Final PSEIS (2004), 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 were only 1,100 mt by 1985. 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 was 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 $B_{35\%}$. By definition, therefore, 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 $B_{35\%}$. By definition, therefore, 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 Final PSEIS (NMFS 2004) for the status quo, the 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 criterion, 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 the 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 stock's 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 are two species of rougheye rockfish with overlapping distributions (Dr. Tony Gharrett, University of Alaska, personal communication) 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 degrees), 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.

<u>Spawning/Breeding (U)</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.

<u>Feeding (Ø)</u> – 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.

<u>Growth to Maturity (U)</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 are 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. To evaluate this possible problem thoroughly, 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. 140º 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 to 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 to 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 have led 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 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) are 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 $B_{35\%}$. By definition, therefore, 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 $B_{35\%}$. By definition, therefore, the stock is also not currently approaching an overfished condition (Heifetz et al. 2002). However, the uncertainty of the survey biomass estimates and 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 Final PSEIS (NMFS 2004) for the status quo, the 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).

Most 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 criterion, 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. Under Alternative 1, however, 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. Older juveniles and adults have been observed in association with corals and sponges (Krieger and Wing 2002), however, 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. 140º 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 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. 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 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 a 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 are 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 are 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 Alaska waters. Off the west coast of the United States, 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 Alaska waters. A few studies conducted off 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 it 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 no work has been 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 a manner that is not thought 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 composed primarily 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 are 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 nonexistent 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 Alternative 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 nonexistent 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 do not have 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 nm^2 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 are 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 nm^2), 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 license 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 Appendix C. Gross revenues at risk in this section and in subsequent economic and socioeconomic analyses in Section 4.3 are expressed in 2001 dollars. See Appendix C, Section 3.1.2.1, Revenue at Risk, for a full explanation of the construct established to evaluate economic and socioeconomic effects of the proposed alternative.

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 prevailing passive use values associated with the status quo management of EFH off Alaska. Assuming that such values do exist, as evidenced by the political, legal, and public (e.g., Council) attention being given to EFH, it follows that if current (i.e., status quo) EFH management practices were retained no net benefit in the passive use value of this resource would be expected.

4.3.2.3.2 Effects on Direct Use (Ø)

Gross Revenue, Operating Costs, Cost to Consumers, Safety, Related Federally Managed Fisheries
There would be no direct industry revenues placed at risk under Alternative 1, because no additional fishery management measures would be put in place. Similarly, Alternative 1 would not result in impacts on product quality, revenue, operating cost, safety, related federally managed fisheries, or costs to consumers. Further, since no revenue is placed at risk under Alternative 1, there would not be any distributional impacts associated with retention of this alternative. Likewise, non-market uses (e.g., subsistence use) would be unaffected by retention of the status quo option.

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 potential 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. Thus, the opportunities for fishery interactions with these species is minimal. Alternative 1 would, therefore, 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.

<u>ESA-listed Seabirds (Ø)</u> – 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 Stellers 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.

<u>Other Seabirds (Ø)</u> – 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 they 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

<u>Predator-Prey Relationships (Ø)</u> – 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 total catch biomass (including non-groundfish removals) as a percentage of total system biomass (excluding dead organic material, known as detritus) under Alternative 1 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 greater 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 would 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 the 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 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 (Ø) – Alternative 2 would institute closures to rockfish trawling in 11 areas of the GOA. All of these areas primarily 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 would 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 might occur, this would not be 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 Alaska 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 are almost 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 would be 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 would be 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 would have 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 would be 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 2 would be outside of Pacific cod EFH, and because those additional closures would 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 would close 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 would be relatively small in the central GOA, so that the increase in concentration would be small. The closed areas would be relatively larger in West Yakutat and especially 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 (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 would 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 would be 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 would be 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 would be 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 would be 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 would be 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 would probably not impact the stock biomass of Atka mackerel relative to the status quo. Alternative 2 would close 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 that they are not retained by any fishing gear. In addition, the closed area in Alternative 2 would be 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 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 the 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 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 would close 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 would not affect harvest policies in the EBS; 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 would not affect harvest policies in the EBS; 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, the current harvest practices probably have not 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 would not be expected to affect the availability of prey for arrowtooth flounder since the modeled benthic disturbance for infauna and epifauna prey is 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, fishing probably has not 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 would not be expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey is 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, fishing probably has not 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 would not be expected to affect the availability of prey for flathead sole, since the modeled benthic disturbance for infauna and epifauna prey is 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 would 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 would not be expected to affect the availability of prey for rex sole, since the modeled benthic disturbance for infauna and epifauna prey is 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 has not 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 would not affect harvest policies in the EBS; 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 would not be expected to affect the availability of prey for rock sole, since the modeled benthic disturbance for infauna and epifauna prey is 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 2 would not be expected to affect the availability of prey for Dover sole, since the modeled benthic disturbance for infauna and epifauna prey is 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, 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 would not affect harvest policies in the EBS; 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 would be geographically small and generally would not be 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 they generally are 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 criterion, the fishing effects of Alternative 2 on Pacific ocean perch 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 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 would be geographically small and would generally not be 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 coincided 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 would not affect harvest policies in the EBS; 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 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). 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 would be widely distributed small geographical areas, this alternative would have a negligible effect on the spatial/temporal concentration of catch. Fishery data indicate that 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. 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 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. The closure areas proposed under Alternative 2 would be small in total geographic area and would be closed only to directed slope rockfish fishing, which generally is only a few weeks long. Therefore, it is unlikely that 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. To firmly conclude that a negative impact of bottom trawling exists, however, additional information would be 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 would prohibit the use of bottom trawls for rockfish in 11 areas of the GOA slope (200 to 1,000 m) and would have the objective of allowing benthic habitat in these areas to recover or remain relatively undisturbed. Alternative 2 would not affect harvest policies in the EBS; 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)

<u>Stock Biomass (Ø)</u> – 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.

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

<u>Spawning/Breeding (Ø)</u> – GOA northern rockfish are currently sustaining themselves above MSST. Because the fishing closures would be geographically small and generally would not be in areas with high northern rockfish concentrations, Alternative 2 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 2 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.

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

<u>Growth to Maturity (Ø)</u> – Alternative 2 would likely have little impact on the growth to maturity of GOA northern rockfish compared to the status quo. The fishing closures would be geographically small and generally would not be 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 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 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 would cover a relatively small portion of the slope and would all be 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 would not be 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 that they are not retained by any fishing gear, Alternative 2 probably would have little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closure areas apparently would be 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 would be too small and would be located in areas inhabited by few light dusky rockfish, so they would provide very little benefit to these fish.

4.3.3.2.1.21 Other Rockfish Species (EBS)

Alternative 2 would not affect harvest policies in the EBS; 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 would not affect harvest policies in the EBS; 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 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 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 would not be in areas of significant forage species bycatch. Alternative 2 would probably have a negligible effect on the spatial/temporal concentration of catch.

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

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

Growth to Maturity (Ø) – The areas closed by Alternative 2 probably would not be important to the feeding ecology of forage species. Alternative 2 would have a 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 would be expected under Alternative 2.

Spawning/Breeding (Ø) – No fisheries in Alaska would 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 would 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; thus, Alternative 2 would not be considered to affect 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 would 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 would not overlap with scallop distribution, 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; thus, there would be no effects on the feeding of scallops under Alternative 2.

Growth to Maturity (Ø) – No additional dredge effort would be expected under Alternative 2; 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 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 the resulting protection of EFH, it is assumed that Alternative 2 would yield some incremental increase in the passive-use benefit of EFH over Alternative 1 (status quo). Alternative 2 would reduce the impact of NPT fishing for slope rockfish over

10,228 square kilometers (km^2) of GOA shelf and slope edge habitat, or 3.7 percent of the existing fishable area of 279,874 km^2 in the GOA.

Alternative 2 would 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 estimate of the probable change in passive use value associated with adoption of Alternative 2 under this action. Adopting new fishing impact minimization measures (as compared to the status quo) would probably result in a net benefit in the passive use value of EFH.

4.3.3.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (Ø)
Alternative 2, if it were in place in 2001, would place 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 be equal to 9.6 percent of the total status quo revenue in the fishery of $9.36 million (Table 3.3-1). Alternative 2 would impose no EFH fishing impact minimization measures in the EBS and AI.

Within the GOA, the largest amount of revenue at risk would be 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) would total $230,000, or 28.9 percent of the total status quo revenue of $790,000, reported in 2001. There would be 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 this area.

The only target fishery that would be directly affected by the EFH fishing impact minimization measures under Alternative 2 would be the NPT slope rockfish fishery in the GOA. The total revenue at risk in this fishery would be $900,000, or 9.6 percent of the status quo revenue of $9.36 million. The catcher-processor fleet would have 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 revenue at risk only 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 $620,000, or 10.9 percent of the 2001 status quo. The catcher-vessel fleet would also have $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 almost all of the $22,711 in revenue at risk in the EG as well.

The revenue at risk in the catcher-vessel fleet would be very small compared with the status quo revenue. Therefore, some or all of the revenue at risk could possibly be 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 be 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 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 be recovered by redeployment of fishing effort to adjacent areas or to alternative fishing gears without a thorough understanding of the fishing strategies that fishermen actually would have used in response to the impacts of the EFH fishing impact minimization measures imposed by Alternative 2.

Revenue impacts from changes in product quality would be negligible 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 be 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 be 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 would be 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 increase 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 a lower CPUE of slope rockfish, requiring additional fishing effort to mitigate the catch and revenue at risk. There may be crowding externalities, as well, as effort became concentrated in remaining open areas (Table 3.3-1).

Costs to U.S. Consumers (E-)
If it were in place in 2001, Alternative 2 would likely have some potential to impact on the cost to consumers of rockfish because, although some or all of the revenue at risk may be recovered by redeployment of fishing effort, there would likely be some operational cost increases for the fleet components. These operational cost increases due to Alternative 2 EFH fishing impact minimization measures might result in changes in the product mix, quality, and/or availability of GOA rockfish and, therefore, could, under these rules, result in a measurable increase in the cost to consumers of species caught in fisheries directly or indirectly affected by redeployment of the fishing effort. The ability of GOA slope rockfish NPT operators to pass their increased costs along to consumers would depend on the demand elasticity associated with the various product forms and markets supplied by these operations. With the data and market models currently available, it is impossible to empirically estimate the expected size and sign of these economic factors potentially influencing consumer price, gross revenues, and net receipts from adoption of this alternative.

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

Impacts to Related Fisheries (Ø)
Alternative 2 would probably not have significant impacts on related fisheries because NPT fishing effort for slope rockfish would likely be 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 might increase under Alternative 2 in 2001, although it is not possible to estimate by what amount (Table 3.3-1). Under these regulations, additional on-water enforcement might be needed, and a VMS system or 100 percent observer coverage would be needed on

all vessels targeting slope rockfish with NPT gear to ensure 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 be insignificant if Alternative 2 had been in effect in 2001, although at least a few individual operations might experience adverse impacts, as detailed below. The only fisheries directly affected by this alternative would be the rockfish fisheries in the GOA, and the only gear group directly affected (for both catcher vessels and catcher-processors) would be non-pelagic trawl. Using 2001 fleet data, 23 vessels (both catcher vessels and catcher-processors) would be 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 be affected by this alternative.

Catcher Vessels

For catcher vessels, revenue at risk would be 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. 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. Given the location and size of the closure areas and the small proportion of catch at risk, it is assumed that vessels could recover 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 of potentially impacted boats, with just one vessel each. No significant impacts would be likely for these communities as a result of changes that would be 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 be 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 make 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 be 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 ties to the NPT rockfish catcher-processor sector, and then only for one vessel; one catcher-processor was owned in an another state). No significant impacts would be likely for the community of Kodiak as a result of changes that would be associated with catcher-processors under this alternative, due primarily to having only a single vessel involved. Community-level impacts would not be 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 might experience increased costs and/or reductions in harvest under this alternative in 2001.

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 (presented above) associated with this alternative. 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 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 associated with 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 the 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 be unlikely to change substantially as a direct result of this alternative (and a number of other alternatives). While individual entities may be relatively advantaged or disadvantaged, it is likely that these gains and losses would be more or less neutral at the community level, although some cost increases may have occurred.

For shoreside processors in Alaska, no substantial impacts would be 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 be 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 process 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 be likely for Kodiak or for any other dependent community as a result of changes that would be associated with processors under this alternative.

Multi-Sector Impacts
Multiple sector impacts are unlikely to be significant at the community level under Alternative 2. Among Alaska communities, only Kodiak participated in more that one sector that would have 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 be insignificant due to the low volumes that would be at risk and the assumption that overall delivery patterns would be 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 be small. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which in this case would be concentrated in Kodiak. Given the assumption that general landing patterns would remain consistent, however, any vessel expenditure associated impacts would likely be 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 of 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: reports from the industry and reports 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 of 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 of the area 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 of 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 when 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 have 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 of Pacific cod, PWS pollock, sablefish, and rockfish fisheries in state waters.

Lingcod are harvested using jig gear in the CG and WG under state management. 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 would likely to have no effect on this fishery.

State-managed Crab and Invertebrate Fisheries (E+) – Alternative 2 would close 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 would likely 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 were 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 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 when 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 through injury, other take, fishery dispersal, or depletion of prey. The attributable minor changes 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, as well as 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. For this reason, areas of higher salmon bycatch would likely be avoided by GOA fisheries to the degree practicable. Avoiding areas of high salmon bycatch in general 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 to be 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, Alternative 2 would probably have a 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 probably 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 biomass or numbers in prey populations in any substantial way, increase the catch of higher trophic levels, or increase the risk of exotic species introductions. No significant 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, the trophic level of the catch would not vary much from the status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators would occur 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 regard 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 cause little change in species level diversity relative to the status quo, except that it could potentially help to maintain productive fish habitat and, thus, aid in sustaining fish populations that rely on slope areas. Functional (structural habitat) diversity could increase in the GOA if the bottom trawl closures overlapped 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 would be small enough that fish would likely move into areas where they would be vulnerable to harvesting. Overall, this alternative would 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 the 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 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 Habitat Complexity (E+) – Alternative 3 would close the entire GOA slope to rockfish fishing. The rockfish trawl fishery is the fishery with the greatest 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 Alaska 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be nearly entirely outside of walleye pollock habitat, and because those additional closures would apply only to vessels targeting rockfish, Alternative 3 would be 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 under Alternative 3 would generally not correspond with locations where walleye pollock reside, it 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be almost entirely outside of walleye pollock habitat, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be nearly entirely outside of pollock habitat, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be nearly entirely outside of walleye pollock habitat, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be outside of

Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be outside of Pacific cod EFH, and because those additional closures would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas in the GOA closed to bottom trawling for rockfish. Because the additional areas closed under Alternative 3 would be outside of Pacific cod EFH, and because those additional closures would 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 would close 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 an inconsequential 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 could target rockfish in one or more tows, but the fishing would not be classified as directed towards rockfish if the cumulative rockfish catch for the trip or week were 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 probably be 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 would 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 would probably 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 would improve habitat (minor improvements would be 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 would probably 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. Conversely, trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any effects on habitat for sablefish would also continue, 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) might 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. Conversely, trawl fishing for deepwater flatfish would continue in the slope rockfish closure areas, so that any effects on habitat for sablefish would also continue, 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) might 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 would only affect bottom trawling in the GOA for species in the slope rockfish management. Closure of bottom trawling for slope rockfish might reduce the bycatch of GOA Atka mackerel somewhat 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 would probably not 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 that they are not retained by any fishing gear. In addition, the closed area in Alternative 3 would be 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 might use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to the 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 would close 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 would not affect harvest policies in the EBS; 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 would not affect harvest policies in the EBS; 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Adult Feeding (Ø) – Relative to the status quo, Alternative 3 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, fishing probably has not 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 would not affect harvest policies in the EBS; 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, the current harvest practices probably have not 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 probably has not 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, fishing probably has not 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 would probably 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 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 has not 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 would not affect harvest policies in the EBS; 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.

<u>Stock Biomass (U)</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.

<u>Spatial/Temporal Concentration of the Catch (Ø)</u> – 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, the current harvest practices probably have not affected the genetic diversity of the stock.

<u>Spawning/Breeding (Ø)</u> – 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 probably has not had a substantial effect on spawning and breeding.

<u>Feeding (Ø)</u> – Relative to the status quo, Alternative 3 would probably 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, fishing probably has not had a substantial effect on adult feeding.

<u>Growth to Maturity (Ø)</u> – 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, the current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 3 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 has not 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 would not affect harvest policies in the EBS; 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 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, 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 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 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 could increase the risk of localized depletion in these areas under a short-duration, open-access fishery.

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 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 criterion, the fishing effects of Alternative 3 on Pacific ocean perch 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 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 coincided 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 would not affect harvest policies in the EBS; 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 would close 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, the measures under Alternative 3 would probably not have an effect on stock biomass.

Spatial/Temporal Concentration of the Catch (Ø) – Fishery data indicate that shortraker and rougheye rockfish catches are evenly spread along the continental slope of the GOA and occur as bycatch to other target fisheries; therefore, there is no specific concentration of effort or removals. Since multiple target fisheries, including longline fisheries, 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, 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 would cover a large geographic area, but would be closed only to directed slope rockfish fishing, which generally is only a few weeks in duration. Therefore, the effects of Alternative 3 probably would not 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. To conclude that a negative impact of bottom trawling exists, however, 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 would only be closed to directed rockfish bottom trawling and would still be open to other directed fisheries, which might continue to damage sensitive benthic fauna. To really evaluate this possible problem, additional research is needed to determine how essential these associations are to the health of the stocks and how much damage is actually being done by fishing gear. Therefore, the effects Alternative 3 would have on these species are currently unknown.

4.3.4.2.1.18 Northern Rockfish (EBS)

Alternative 3 would not affect harvest policies in the EBS; 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 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 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 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, Alternative 3 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 3 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 3.

Growth to Maturity (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures would not likely 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 would 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 (Dave Clausen, personal communication). 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 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.

4.3.4.2.1.20 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.

<u>Stock Biomass (Ø)</u> – Alternative 3 would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo. Alternative 3 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. Closure of bottom trawling for slope rockfish might reduce the bycatch of light dusky rockfish in the slope rockfish fisheries somewhat, but the closure would only apply to waters of the continental slope at depths from 200 to 1,000 m, where few light dusky rockfish are found.

<u>Spatial/Temporal Concentration of the Catch (Ø)</u> – Because the area closed to fishing generally would 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.

<u>Spawning/Breeding (U)</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 that they are not retained by any fishing gear, Alternative 3 probably would have little or no direct effect on the availability of prey to adult light dusky rockfish. In addition, the closed area in Alternative 3 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 light dusky rockfish. It is debatable, however, 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, fishermen might 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 benefit 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. The large closed area in this alternative would, however, be located in deeper water than that inhabited by most light dusky rockfish; therefore, it would provide little benefit to these fish.

4.3.4.2.1.21 Other Rockfish Species (EBS)

Alternative 3 would not affect harvest policies in the EBS; 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 would not affect harvest policies in the EBS; 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 would 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 would not be 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 would not be important to the spawning and breeding of forage species. Alternative 3 would have minimal effects on the essential spawning, nursery, or settlement habitat of forage species.

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

Growth to Maturity (Ø) – The areas closed by Alternative 3 would not be important to the feeding ecology of forage species. Alternative 3 would have minimal effects 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 that there is almost no effort (except some very small recreational and subsistence fisheries) in freshwater spawning and rearing areas. Alternative 3 would 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 in the survival of juvenile salmon would be expected under Alternative 3. The bycatch amounts of juvenile salmon in the GOA rockfish fisheries are 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; thus, Alternative 3 would 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 would 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 would be expected under Alternative 3.

Spawning/Breeding (Ø) – Alternative 3 closures, which would 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; thus, no effects on the feeding of scallops would be anticipated.

Growth to Maturity (Ø) – No additional dredge effort would be anticipated under Alternative 3; 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 Appendix C.

4.3.4.3.1 Effects on Passive Use Values (E+)

Under Alternative 3, NPT fishing activities targeting rockfish along the slope (200 to 1,000 m) 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 3 would yield some incremental increase in the passive-use benefit of EFH over Alternative 1 (status quo). Alternative 3 would minimize the impact of NPT fishing for slope rockfish over 29,059 km^2 of GOA shelf and slope edge habitat, or 10.4 percent of the existing fishable area of 279,874 km^2. Whether this additional habitat protection would provide increased future use and productivity compared to the status quo benefits compared is unknown.

4.3.4.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)
Had it been implemented in 2001, Alternative 3 would place $2.65 million of gross revenue at risk in the GOA NPT slope rockfish target fisheries, including the value of retained bycatch. This would be 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 greatest amount of revenue at risk would be 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 be directly affected by the EFH fishing impact minimization measures under Alternative 3 would be 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 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 the status quo. In the EG, catcher-processor revenue at risk would account for almost all of the $210,000 revenue at risk in that region.

The EFH fishing impact minimization measure areas described under Alternative 3 would be 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, most of the NPT commercial catch of the slope rockfish complex occurs deeper than 150 m (NMFS 2002d). There is a 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 be limited areas where the revenue at risk might be 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 is 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 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 (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, revenue at risk could be recovered by vessels fishing adjacent to the proposed closures or using PTR gear, but catch share and revenue may transfer from the smaller catcher-vessel fleet to the larger catcher-vessels and catcher-processors. The magnitude of this transfer is impossible to estimate without specific knowledge of the redeployment fishing effort strategies that would be 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 be 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 actually be used 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 be possible under Alternative 3, particularly for the smaller catcher-vessel fleet component that might have 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 be 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 be 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 would probably be 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 result 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 probably impose some impact on costs to consumers because, although some or all of the revenue at risk might be recovered by redeployment of fishing effort, there would likely be some operational cost increases for the fleet components. These operational cost increases due to Alternative 3 EFH fishing impact minimization measures might result in a measurable increase in price to consumers of species caught in fisheries directly or indirectly affected by redeployment of the fishing effort, if these measures were in place for the 2001 fisheries. There might also be 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 might very well be 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 be 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 might impose substantial negative externalities on these fisheries.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs would be 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 be required of all vessels targeting slope rockfish with NPT gear in the GOA to ensure 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 be insignificant at the community level under Alternative 3, although a number of individual operations might experience adverse impacts. The only fisheries directly affected by this alternative would be GOA slope rockfish species within the overall rockfish category, and the only gear group directly affected (for both catcher vessels and catcher-processors) would be non-pelagic trawl. Using 2001 fleet data, 39 vessels (catcher vessels and catcher-processors) would be 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 be potentially affected by this alternative.

Catcher Vessels

For catcher vessels, revenue at risk would be exclusively concentrated in the CG and would represent 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 be at risk, it is assumed that, as an overall sector, vessels could recover 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 might experience 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 that there would be some net flow away from the community if smaller vessels lost share to larger vessels. For the relevant Kodiak fleet in 2001, the at-risk revenues in the rockfish fishery would represent somewhat more than 2 percent of total ex-vessel payments to these vessels for all fisheries in all areas combined. Ex-vessel revenues, previously reported, for catcher vessels tend to understate the overall value to communities that derive benefits from participation in both harvesting and processing activities. 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. Were this alternative in effect in 2001, individual entities within Kodiak might experience adverse impacts, particularly smaller vessels, as there might be shifts in harvests away from smaller vessels to both larger catcher vessels and catcher-processors, but the magnitude of this potential shift is unknown. 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 result in significant impacts 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 be likely for any dependent community outside of Kodiak as a result of changes associated with catcher vessels under this alternative. No significant community-level impacts would be likely for Pacific Northwest communities, due to the size and diversity of the local economic base in 2001(although there might be some loss of revenue or catch for a number of involved vessels).

Catcher-Processors

For catcher-processors, revenue at risk would be concentrated in the CG, but not exclusively so, and would represent 31.5 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 represent 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 be minimal (although impacts to any particular operation might be greater, depending on specific operational characteristics). Similar to the larger catcher vessels, it is assumed that catcher-processors may be 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 be 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 be hardships for some of the entities involved, no significant impacts would be likely for the community of Kodiak as a result of changes that would be associated with catcher-processors under this alternative. For Washington communities, it is unlikely that significant community-level impacts would result from this alternative, given the size and diversity of the local economy, although individual firms might experience 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 would be reduced by the small proportion that the at-risk revenues would contribute 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 occur under this alternative because it is expected that catcher-vessel harvest levels would remain at or near the status quo levels. It is not expected that substantial changes in the fishery that would affect delivery patterns would occur (although there may be some redistribution of catch among individual vessels). There may be 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 be 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 be at risk for catch delivered inshore for processing would represent 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 be at risk compared to overall processing in these communities, however, no significant impacts would be likely to occur for Kodiak or any other dependent community as a result of changes associated with processors under this alternative, although some individual processing entities might experience greater impacts than others.

Multi-Sector Impacts
Multiple sector impacts are unlikely to be 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 be at risk under this alternative. Revenue at risk for relevant catcher vessels and catcher-processors would be roughly 2 percent of total revenues for these vessels, but individual vessels may experience lesser or greater losses. As noted, impacts to shoreside processors are likely to be insignificant due to the low volumes at risk and the assumption that overall delivery patterns would be 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 some compensation at risk, but overall potential for employment and wage or crew share compensation loss would be small. Transient vessels, owned outside of Alaska, typically also make expenditures in ports of landing, which, in this case, would be concentrated in Kodiak. Given the assumption of general landing patterns remaining consistent, however, any vessel-expenditure-associated impacts are likely to be minor. Overall, while community impacts in Alaska would be 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 be affected by the alternative compared to the overall community fleet, and the relatively low magnitude of the revenue that would be 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 of 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 of it. For catcher-processors, reporting requirements would not change, except that there would be new areas to report on.

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 of the area 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 of 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 would result in a complex curving line that does not provide an explicit, simple border for USCG or NMFS Enforcement agents. 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. Currently, however, 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 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, unless observers saw otherwise.

Pelagic trawls can be fished in contact with the bottom as well, so if the intent were that all trawls be fished off bottom at all times a new monitoring program would have 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 might 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 impacts 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 have 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 was 5,050 mt, 82 percent of which was 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 was 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 might be redundant under current management practice, have no effect on fishing practice, may have no impact on where bottom trawling occurs, and not decrease impact on EFH.

Enforcing Alternative 3 would be complex, however, given the problems outlined above in terms of the difficulty of defining protected areas by using contour lines, verifying how much catch would be caught inside and outside of such areas, and verifying how much would be 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 would be negligible under this alternative, as was discussed previously for Alternative 2.

State-managed Crab and Invertebrate Fisheries (E+) – Effects on state-managed fisheries would be very similar to those discussed previously for Alternative 2. Benefits to deepwater Tanner crab would be anticipated under this alternative. Because more area would be closed under Alternative 3, 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 were 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 might result in increased encounters with ESA-listed marine mammals in the areas where fishing is displaced could 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 would be 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 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 would 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 alter this situation. 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 would 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 avoid areas of high salmon bycatch to the degree practicable, the incentive to reduce salmon bycatch in the GOA might 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 might encounter short-tailed albatross, although the potential exists 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 would likely be small, and since no short-tailed albatross mortalities have been documented to date for Alaska 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; thus, they 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 the status quo levels, with the potential for a slight increase in bycatch from displaced fishing activities. This might 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, under Alternative 3 there would probably 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 would not be 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, increases in the catch of higher trophic levels, or increases in 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 the status quo. Similarly, the trophic level of the catch would not be much different from the status quo, and little change in the functional species composition of the groundfish community, or in the removal of top predators, would be expected.

Energy Flow and Balance (Ø) – The amount and flow of energy in the ecosystem would be the same as the status quo with regard 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 would probably 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 might increase relative to the status quo. Closure of the slope to the primary trawl fishery, slope rockfish, in the area might help to maintain (or even enhance) productive fish habitat and would 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 for any spawning aggregations of slope rockfish. Overall, Alternative 3 would 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 the status quo for Alternative 4. LEIs for Alternatives 1 and 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 would have a positive effect on the protection of coral due to trawl closures in the AI.

GOA – Alternative 4 would 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 might occur at these sites, this is not considered a substantial improvement in coral protection.

AI – In the AI, Alternative 4 would close 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 would institute 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 were 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 would close 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 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 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 reduced by only 4 percent for both sand/mud and slope habitats due to the closures.

An additional feature of Alternative 4 would be 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 they 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 Alaska 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 would be 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 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.

4.3.5.2.1.2 Pacific Cod (EBS and GOA)

Stock Biomass (Ø) – As was determined in the Final PSEIS (NMFS 2004), 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 would be 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 great enough 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA would fall outside of Pacific cod EFH, and because they would 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 great enough 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA would fall outside of Pacific cod EFH and because they would 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 great enough 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA would fall outside of Pacific cod EFH and because they would 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA would fall outside of Pacific cod EFH and because they would 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 great enough 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 would be 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 would lie outside areas where intensive bottom trawling and sablefish concentrations overlap. Thus, the effects of Alternative 4 for the EBS would differ little from the status quo.

Any benefits of the rotational closures would depend on the recovery rate of the affected species. The 10-year length of the closures might be sufficient for fast-recovery species, but insufficient for slow-recovery species.

The closure areas in the AI would 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 would differ little from the status quo.

4.3.5.2.1.4 Atka Mackerel (EBS and GOA)

Stock Biomass (Ø) – This alternative probably would not impact the stock biomass of Atka mackerel relative to the status quo. Alternative 4 would prohibit 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 would also close 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 probably would not impact the spatial/temporal concentration of the catch of Atka mackerel relative to the status quo. Alternative 4 would prohibit 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 would also close 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 probably would not affect the spawning and breeding of Atka mackerel relative to the status quo. Alternative 4 would prohibit 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 would also close 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 that they are not retained by any fishing gear. In addition, the closed area in the GOA for Alternative 4 would be directed mostly 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 might use pelagic trawls to take the entire ABC of Pacific ocean perch. If so, food availability to Atka mackerel would be unchanged relative to the 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 probably would not affect the growth to maturity of Atka mackerel relative to the status quo. Alternative 4 would prohibit 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 would also close 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 that would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 probably would not affect the availability of prey for yellowfin 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, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. The effect that the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be 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 would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 probably would not affect the availability of prey for Greenland turbot, since the modeled benthic disturbance for infauna and epifauna prey would not be 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 would be 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 would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 probably would 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, small changes in future fishing probably would not have a substantial effect on adult feeding. The effect that the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be 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 that would be scheduled for rotating closures, there would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 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, it is not expected that small changes in future fishing would have a substantial effect on adult feeding. The effect that the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be 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. The current harvest practices probably have not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 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, 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 would be 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 stock's 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 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 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 has not 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 would be 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 that would be scheduled for rotating closures, there would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 4 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. The effect that the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be 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 Alternative 4 would have 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 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 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. The effect that the additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be 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.

<u>Stock Biomass (U)</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.

<u>Spatial/Temporal Concentration of the Catch (Ø)</u> – 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 that are scheduled for rotating closures, there is no expected negative effect to the future genetic diversity of the stock.

<u>Spawning/Breeding (Ø)</u> – 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 probably has not had a substantial effect on spawning and breeding.

<u>Feeding (Ø)</u> – Relative to the status quo, Alternative 4 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 has not had a substantial effect on adult feeding.

<u>Growth to Maturity (Ø)</u> – 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 would be no effect from fishing on survival and growth to maturity.

4.3.5.2.1.14 Pacific Ocean Perch (EBS)

<u>Stock Biomass (Ø)</u> – 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 would have 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 would also be rated as no effect.

<u>Spatial/Temporal Concentration of the Catch (Ø)</u> – The primary locations for Pacific ocean perch harvest in EBS would be on the slope to the southeast of the closure areas, so they would have little effect on the fishery. Similarly, the closure areas in the AI would be located in areas where few Pacific ocean perch are caught and would have little effect on the spatial/temporal concentration of the catch.

Thus, the expected pattern of fishing for Pacific ocean perch under Alternative 4 would probably be similar to that in Alternative 1, and Alternative 4 would have no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the Final PSEIS (2004), 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 would probably expected to be similar to Alternative 1; thus, Alternative 4 would probably have no substantial effect 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 probably have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the Final PSEIS (2004), based on estimated recruitments in recent years indicate that Pacific ocean perch is expected to maintain its ability to sustain itself above MSST under status quo management. The pattern of fishing under Alternative 4 would probably be similar to that under Alternative 1; thus, fishing would probably have no substantial effect on the survival of fish to maturity.

4.3.5.2.1.15 Pacific Ocean Perch (GOA)

For the GOA, Alternative 4 would be 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 stock's 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 the EBS are on the slope to the southeast of the closure areas, which would, 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 probably would not have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of bottom trawling in some areas of the AI probably would 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 would 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 would be so small (0 to 3 percent) that fishing probably would 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 would be 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 on the slope to the southeast of the closure areas, which, thus, would 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, and also bycatch of northern rockfish. The spatial/temporal concentration of the catch under Alternative 4 probably would not 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, might 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 would be 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 would be 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, would be areas where little to no light dusky rockfish have been observed. In the EBS, the closure areas would be in the northern parts of the shelf and slope region, which are areas with few 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 few 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. 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 are not presently known, these closure areas probably would have no effect on their abundance.

Growth to Maturity (Ø) – The closure areas would not be 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 would 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 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 would probably be 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 are not presently known.

Growth to Maturity (Ø)
The peak spawning biomass for shortspine thornyheads on the West coast is from 800 to 1,000 m deep (Wakefield 1990). Although the suggested 25 percent rotational closure areas in the EBS would 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). Under Alternative 4, therefore, there would be little to no effect on shortspine thornyheads' 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 would likely be minimal. The areas closed by this alternative would not have a large incidence of forage species bycatch. The changes in the fishing practices due to Alternative 4 would probably not 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 would not be in areas of significant forage species bycatch. Alternative 4 would probably have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas closed by Alternative 4 probably would not be important to the spawning and breeding of forage species. Alternative 4 would have a minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 4 probably would not be important to the feeding ecology of forage species. Alternative 4 would have a minimal effect on the feeding of forage species.

Growth to Maturity (Ø) – The areas closed by Alternative 4 probably would not be important to the feeding ecology of forage species. Alternative 4 would have a 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 would not be impacted by measures implemented under Alternative 4. In addition, the bycatch of salmon would not change, as the closures would not affect the pollock fishery, which takes most 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 would be 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; 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 would be expected under Alternative 4; thus, this alternative would 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 would 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 cause 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 Alternative 4 would not result in any substantial change in stock biomass.

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 would 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 probably would 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 probably would have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas in the EBS would overlap with opilio crab EFH areas of concentration. The trawl closure areas might 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 would probably reduce crab bycatch and unobserved mortality by limiting 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 probably would not have 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 would be expected under Alternative 4.

Spawning/Breeding (Ø) – None of the closure areas designated under Alternative 4 would overlap with scallop populations. Therefore, Alternative 4 would probably 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 would overlap with scallop populations, and fishing effort is not projected to increase in areas with scallops. Thus, Alternative 4 would probably have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in scallop dredge effort would be expected under Alternative 4; 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 Appendix C.

4.3.5.3.1 Effects on Passive Use Values (E+)

Under Alternative 4, NPT fishing activities targeting slope rockfish in 11 designated areas of the GOA would be eliminated; use of NPT gear would be 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 would yield 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 km^2 of GOA shelf and slope edge habitat, NPT fishing for all species over an average of 47,986 km^2 of EBS habitat, and 22,883 km^2 of AI habitat, totaling 81,097 km^2. This would affect 3.6 percent of the current 279,874 km^2 of GOA shelf and slope edge habitat, 6.0 percent of the current 798,870 km^2 of EBS habitat, and 19.7 percent of the current 105,243 km^2 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 be 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 is unknown.

4.3.5.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)

Depending on the EBS rotational areas closed, Alternative 4 would place $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 place revenue between $1.82 million and $4.40 million 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 place 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 greatest amount of revenue at risk would occur in the flathead sole fishery, where $1.23 million to $1.34 million of revenue would be at risk, equaling 8.5 to 23.1 percent of the $14.46 million 2001 status quo revenue, depending on the rotational area affected. In the EBS, substantially all of the revenue at risk would occur in the catcher-processor fleet component.

In the EBS, Alternative 4 would impose 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 place 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 accrue mainly in the catcher-processor fleet component. 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. There might be additional revenue placed at risk in the EBS under Alternative 4 due to the requirement to use bobbins and disks on trawl sweeps for all NPT gear fished in open areas; however, the additional adverse economic impact is unknown.

It is not possible to estimate the amount of revenue at risk under Alternative 4 that could be recovered by redeployment of fishing effort to adjacent areas or to alternative fishing gears without a thorough understanding of the fishing strategies that fishermen would actually use 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 employed in open areas. The use of bobbins and disks might 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; however, the additional adverse economic impact is unknown.

GOA Region

Within the GOA, the greatest amount of revenue at risk would be 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 total $230,000, or 28.9 percent of the 2001 total status quo revenue of $790,000. There would be 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 be affected by the EFH fishing impact minimization measures under Alternative 4 would be the NPT slope rockfish fishery. The total revenue at risk in this fishery would be $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 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 $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 revenue at risk only in the CG, whereas the catcher-processor fleet would have revenue at risk mainly in the CG ($620,000, or 10.9 percent of the status quo), but also in the WG ($230,000, or 28.9 percent of the $790,000 2001 status quo gross revenue), and almost all of the $22,711 revenue at risk in the EG.

The 11 designated EFH fishing impact minimization measure areas described under Alternative 4 would be 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 be very small compared with the status quo revenue, had Alternative 4 been in place in 2001. Therefore, the revenue at risk might be 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 be greater 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 be 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 be placed at risk under Alternative 4, or 1.4 percent of the $56.70 million 2001 status quo revenue in the affected fisheries. In the AI, Alternative 4 would place revenue at risk in NPT fisheries for Atka mackerel, flatfish, Pacific cod, and rockfish. The greatest revenue at risk in the AI would be in the NPT rockfish fishery, where $460,000, or 8.6 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 place $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 account 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 occur mainly in the catcher-processor fleet component, might be mitigated by redeploying NPT fishing effort to adjacent areas not affected by the EFH fishing impact minimization measures.

In the AI, Alternative 4 would place a relatively small amount of the 2001 status quo revenue at risk and might not result in significant increases in operating costs of either the catcher-vessel or catcher-processor fleet components. Similarly, Alternative 4 might 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. However, there might be 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 be possible under Alternative 4, particularly for the smaller catcher-vessel fleet component that might have to expend additional fishing effort to recover displaced catch, which could lengthen fishing trips and result in diminished product quality. Product quality might not be affected in the catcher-processor fleet component, since these vessels would process the catch on board the vessel, although the product mix could be adversely impacted (e.g., if the average size of fish declined).

Operating Costs (E-)

Operating cost impacts under Alternative 4 in the GOA might 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 might increase due to the redeployment of fishing effort necessary to mitigate the losses imposed by Alternative 4; in 2001 these would be 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 might have a 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 probably would 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 were closed. They could also experience 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 place 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 might 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 place a relatively small amount of the status quo revenue at risk and might 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 be likely to occur because, although some or all of the revenue at risk might be recovered by redeployment of fishing effort, there would likely be some operational cost increases for the fleet components. These operational cost increases due to Alternative 4 EFH fishing impact minimization measures might result in a measurable increase in the price to consumers of species caught in fisheries directly or indirectly affected by redeployment of fishing effort. The ability of NPT operators to pass their increased costs along to consumers would depend on the demand elasticity associated with the various product forms and markets supplied by these operations. With the currently available data and market models, it is impossible to empirically estimate the expected size and sign of the economic factors potentially influencing consumer price, gross revenues, and net receipts attributable to adoption of this alternative. There might also be 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 might 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 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 be restricted from fishing some areas closer to their home ports during some time periods, depending on the EFH fishing impact minimization measure area affected by the rotational closures to NPT gear. When more southerly areas were closed, vessels fishing NPT gear would have to travel farther north and farther from ports of call, possibly adversely impacting safety.

Alternative 4 might 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.

Impacts to Related Fisheries (Ø)
There might not be significant impacts on related fisheries from Alternative 4 in the GOA because NPT fishing effort for slope rockfish would likely be redeployed into adjacent areas where NPT fishing for slope rockfish already occurs. There might be impacts on related fisheries in the EBS and 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.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs might increase under Alternative 4, although it is not possible to estimate by what amount. Additional on-water enforcement (including boarding and inspection) might be required to ensure 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 for all vessels targeting slope rockfish with NPT gear in the GOA and all vessels using NPT gear in the EBS and AI to ensure 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 be significant at the community level under Alternative 4, although a number of individual operations might experience adverse impacts. The only fisheries directly affected by this alternative would be groundfish fisheries. Unlike Alternatives 2 and 3, however, groundfish fisheries in addition to the targeted rockfish fishery would be affected by this alternative. Further, this alternative would have impacts on GOA, EBS, and AI fisheries, but the only gear group directly affected for both catcher vessels and catcher-processors would be non-pelagic trawl. Using 2001 fleet data, 43 vessels (both catcher vessels and catcher-processors) would be 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 be affected by this alternative, depending on specific closure configurations.

For the GOA, impacts to catcher vessels, catcher-processors, and processors would be identical to those that would be seen under Alternative 2. As a result, as in Alternative 2, no significant impacts to dependent communities in the GOA would occur 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 be 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 be Pacific cod and pollock. The revenue at risk under any of the rotational area closure scenarios would represent 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 be for Pacific cod, and the potential revenue at risk would represent 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). 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 be likely for any area.

Catcher-Processors

In 2001, 24 catcher-processors would have 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 be 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 be 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 be made up by fishing in other areas with very little increase in effort. For catcher-processors in the AI, there would also be a range of potentially affected groundfish species, but fewer than seen in the EBS. The revenue that would be at risk would represent 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 occur in either the EBS or AI, no significant impacts to dependent communities related to catcher-processors would be likely.

Shoreside Processors

For shoreside processors, no substantial impacts would be likely to occur under this alternative because catcher vessel harvest levels would probably remain constant, and no substantial change that would affect inshore delivery patterns in the fishery would be expected (although there may be 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 process some groundfish from vessels with what would be at-risk revenues under this alternative (Sand Point, King Cove, Homer, and Seward), while Akutan would have one or two entities, depending on closure configurations. The total first wholesale revenue at risk for catch delivered inshore for processing would represent 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 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 occur for any dependent community as a result of changes associated with processors under this alternative.

Multi-Sector Impacts
Multiple sector impacts are unlikely to be 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 be insignificant, due to the low volumes at risk and the assumption that overall delivery patterns would be unlikely to change under this alternative. Some additional Alaska resident crew positions on vessels owned elsewhere might have some compensation at risk, but the overall potential for employment and wage or crew share compensation loss would be small. Transient vessels, owned outside of Alaska, typically also make expenditures in ports of landing, which in this case would be concentrated in Kodiak (and, perhaps, Dutch Harbor). Given the assumption that general landing patterns would remain consistent, however, any vessel expenditure associated impacts are would likely be 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 Alternative 4 would be simpler to manage and enforce than the proposal for the GOA, which would be identical to the Alternative 2 proposal that would prohibit bottom-trawl gear only in the rockfish fisheries in 11 restricted areas.

The alternative states 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 were 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 would be clear-cut, and, while additional responsibilities would be created, enforcement of the restriction would be relatively straightforward. However, if the intention were 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 would become 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 of 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 that would be 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, as well as those raised in Alternative 2. That discussion is, in general, reiterated here.

Catch accounting from inside and outside the restricted area would be 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: reports from the industry and reports 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 of 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. Under current procedures, however, 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 would be the same as those in Alternative 2. The effects considered in Alternative 2 are reiterated here, as the same issues are relevant.

This alternative would increase 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 of the restricted area would be 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.

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. Consequently, the regulatory conditions outside of 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 of the restricted area at any time when catch is aggregated and reported. These conditions could have the effect of a de facto expansion of the closed area.

A VMS 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 (50 CFR 679.50(c)(1)(x)). 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, 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 have to be established.

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 were not previously pursued. If an alternate target flatfish fishery were developed, regulations to deal with that activity might have to be developed similar to ways 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 crowd 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 under the authority of current regulations.

The requirement to have disks/bobbins on trawl sweeps and footropes in the EBS would result in 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 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; 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; refer to Section 4.3.3.4 for the evaluation of this alternative on GOA state-managed crab and invertebrate species.

Alternative 4 would set up rotating closures in the EBS for bottom trawl groundfish. This area would encompass 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. Alternative 4 would have no measurable effect on herring stocks.

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 limited, 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 would 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 would be 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, limited, 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 indicated that 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 would likely increase bottom trawling in other areas. The percentages of each displaced bottom trawl fishery would be limited, 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. Fewer ESUs have been reported to occur in the EBS as documented by CWT returns, however, and most salmon ESUs have been taken in the pollock pelagic trawl fishery. Since Alternative 4 would address bottom trawl fishery changes, the limited 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 limited 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 those described for Alternative 2. That section indicated that 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 would 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 is a potential for a trawl vessel to interact with 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 they could encounter groundfish fishing activities in this area if the fisheries occurred 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 along some segments of the EBS coast, such as the Kuskokwim Shoals in winter. It also is present throughout the AI. These birds do not forage or otherwise use most of the marine waters of the EEZ as habitat;

thus, the altered fishing effort patterns under Alternative 4 would not likely result in adverse impacts on this species.

Other Seabirds (Ø) – Alternative 4 might 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 due to 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 a 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 might 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 probably would have no effect on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, increases in the catch of higher trophic levels, or increases in the risk of exotic species introductions. No significant changes would be expected in species composition in the ecosystem due to Alternative 4, although catches of EBS other flatfish and AI rockfish might be somewhat reduced from the status quo. Similarly, the trophic level of the catch would not be much different from the status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators would be 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 would 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 might help to maintain (or even enhance) productive fish habitat and would, thereby, help sustain fish populations that rely on these areas. This alternative would provide 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. The exact spawning locations of these species is unknown, however, so the effects of the alternative on this aspect of diversity remain unknown. Overall, Alternative 4 would 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 the 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 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 (E+) – Alternative 5A would provide substantially improved protections to coral through trawl closures in both the GOA and AI.

GOA – Alternative 5A would institute 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 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 5A would add 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. This represents 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 habitat. 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 ten areas mostly enclose slope habitat. LEI values were substantially reduced for soft bottom bio- (-47 percent) and nonliving (-24 percent) structure and for 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 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 BS. The rotating closure area has been moderately fished recently, while the full closure area would exclude 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 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 would be 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. 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 Alaska 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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 probably not impact walleye pollock fishing mortality because they would be 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. These closures would probably not 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA 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 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 Final PSEIS (NMFS 2004), 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 would be 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 would be closed under Alternative 5A. In the EBS, the proposed closed areas would 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 would likely 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA 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 and AI, additional proportions of walleye pollock habitat would be closed under Alternative 5A. In the EBS, the proposed closed areas 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.

4.3.6.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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. 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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. 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to bottom trawling. 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 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 would lie outside areas where intensive bottom trawling and sablefish concentrations overlap. Thus, the effects of Alternative 5A for the EBS would differ little from the status quo.

The closure areas in the AI would 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 would differ little from the status quo.

Stock Biomass (Ø) – Alternative 5A would close the GOA to slope rockfish bottom trawling and additionally would close 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 could still occur under Alternative 5A unless the classification scheme for directed fishing were 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 would be relatively small in the central GOA, so that the increase in concentration would be small. The closed areas would be relatively larger in West Yakutat and especially in the western GOA, so the increase in concentration would be up to one third higher in the western GOA. However the trawl fishery is small relative to the longline fishery, which would remain 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.

<u>Spawning/Breeding (Ø)</u> – 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 modify 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 would most likely decrease substantially under Alternative 5A compared to the status quo.

<u>Feeding (Ø)</u> – 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 would improve habitat (minor improvements would be 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 would be projected to decrease substantially compared to the status quo.

<u>Growth to Maturity (Ø)</u> – 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 would be 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) might 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 end 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) might 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 the status quo. Alternative 5A 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. Alternative 5A 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 is 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 the status quo. Alternative 5A 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 Atka mackerel fishery. Alternative 5A 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 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 would not be expected to affect the spawning and breeding of Atka mackerel relative to the status quo. Alternative 5A 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. Alternative 5A 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 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 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 the 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 would not be expected to affect the growth to maturity of Atka mackerel relative to the status quo. Alternative 5A 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. Alternative 5A 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 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 would be scheduled for rotating closures, no negative effect would be expected 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to affect the availability of prey for yellowfin sole, since the modeled benthic disturbance for infauna and epifauna prey is 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 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 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 would be 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 included 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 would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be 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 would be 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 would not be 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 probably has not 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 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 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 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 would be 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 would be scheduled for rotating closures, would be no expected 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 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, 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 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 would be 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 it would not be expected to have 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, a negative effect would not be expected 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to 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, 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 would be 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to 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 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 has not 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 would be 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, a negative effect would not be expected 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to 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, 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 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 would be 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 Alternative 5A would have 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 would be no expected changes in harvest practices under this alternative, and fishing is not suspected to have had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to 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, 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 would be 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 might 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 5A would not be expected to 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 has not 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 would be 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 is expected to remain so, resulting in a rating of no effect of fishing on stock biomass. Because Alternatives 5A and 5B would 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 areas 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 would have no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the Final PSEIS (2004), 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 Final PSEIS (2004), 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 be 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 would 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 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 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 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. Under a short duration, an 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 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 criterion, the fishing effects of Alternative 5A on Pacific ocean perch spawning would be 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 are not in areas with high Pacific ocean perch concentrations. They do, however, 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 are considered as a management tool for exploited rockfish 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 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 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.

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 coincided 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 sites 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 would not be 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 would be 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 would be 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) are 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 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 would 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, 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 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, 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 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 would 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 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 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 might 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 might 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 stock's ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The primary sites 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 might 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 would 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, might have some positive effect on the results 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 that eat 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 are 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 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. 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). Therefore, movement of the Pacific ocean perch bottom trawl fishery could result in increased fishing pressure in areas of high northern rockfish concentrations and could increase the risk of overfishing and or localized depletion in these areas under a short-duration, open-access fishery.

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 would not be 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 5A 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 5A.

Growth to Maturity (Ø) – GOA northern rockfish are currently sustaining themselves above MSST. The fishing closures would not be 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 are 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 (Dave Clausen, personal communication). 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.

4.3.6.2.1.20 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 5A 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 would all be 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 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 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 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 they are not retained by any fishing gear, Alternative 5A 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 5A would mostly be 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 might 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 benefit 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 would 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, would be in areas where little to no light dusky rockfish have been observed. In the EBS, the closure areas would be 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 to the rationale 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. 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 are not presently known, these closure areas probably would 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, there would be little to no effect on stock biomass under Alternative 5A, 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 would probably be 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 are 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 sites closed by Alternative 5 would not be 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 a 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 a 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 a 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 would 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 would be 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; 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) would be 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 small relative to the 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 would only overlap substantially with the opilio crab stock (although there would be 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 would 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 might 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 would be expected under Alternative 5A.

Spawning/Breeding (Ø) – None of the closure areas designated under Alternative 5A would overlap with scallop populations. Therefore, Alternative 5A would probably have no substantial effects on spawning and breeding of weathervane scallops.

Feeding (Ø) – None of the closure areas designated under Alternative 5A would overlap with scallop populations, and fishing effort would not probably 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 or in effort redistribution to scallop grounds would be expected under Alternative 5A, so it would probably 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 of Alternative 5A on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.6 of 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 33.3 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 km^2 of GOA shelf and slope edge habitat (11.4 percent of the current 279,874 km^2 of habitat), an average 63,975 km^2 of EBS habitat (8.0 percent of the current 798,870 km^2 of habitat), and 32,235 km^2 of AI habitat (30.6 percent of the current 105,243 km^2 of habitat), for a total of 128,114 km^2, or 10.8 percent of the combined fishable area of 1,183,987 km^2. Alternative 5A would further reduce NPT fishing impacts in the EBS by requiring that disks and bobbins on trawl sweeps and footropes be 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 is unknown.

4.3.6.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)
If Alternative 5A had been implemented for the 2001 fishing season, it would place $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 would include the following closures and management measures: a closure of NPT fishing in 33.3 percent of five areas, with each area rotating on a 5-year basis. These EFH fishing impact minimization measures would place 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 occur mainly in the catcher-processor fleet component.

Alternative 5A would place 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 occur 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 be at risk in the EBS NPT Pacific cod fishery would range 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 accrue to the catcher-processor fleet component. A total of $2.63 million to $5.61 million of revenue would be 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 mitigated by fishing with NPT gear in adjacent areas not affected by EFH fishing impact minimization measures. However, the additional revenue could be 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 be 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 equal $810,000, or 13.0 percent of the 2001 total status quo revenue of $6.25 million. There would be $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 affect a number of NPT fisheries, but primarily fisheries targeting rockfish and Pacific cod. The total revenue at risk in the NPT rockfish fishery would be $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 be $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 be 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 be $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 be the 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 be the 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 would be discreet and 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 be mitigated by a redeployment of fishing effort. However, Alternative 5A would place 31.8 percent of the status quo revenue at risk in the EG, an amount that would likely be difficult to make up elsewhere. Amendment 58 to the GOA FMP, which took effect in 1998, prohibits trawling in the EG east of long. 140º W. This would leave a very limited area within the EG where the revenue at risk for the NPT fisheries could be mitigated. There would likely be 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, most of the NPT commercial catch of the slope rockfish complex occurs deeper than 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 as 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 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 5A, while the revenue at risk might be 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 be 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 be followed by the different fleet components.

Larger catcher vessels and catcher-processors in the GOA have the option of changing to PTR gear to target 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 might have 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 might not be affected in the catcher-processor fleet component, since these vessels would process the catch onboard 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 result 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 account 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 be 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 place 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 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.

<u>Operating Costs (E-)</u>
Operating cost impacts under Alternative 5A might 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 might be lower than the CPUE of NPT gear in the depth range of 200 m and greater where these species are normally fished. This might 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 to target 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 were closed and possibly due to increased fishing effort needed 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. If Alternative 5A been in place in 2001, there would undoubtedly be 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 might 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 place a relatively small amount, 3.0 percent, of the status quo revenue at risk and might 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 might occur because, although some or all of the revenue at risk might 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 might 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. How much, if any, of this cost could be passed along to consumers would depend on a number of factors, such as the price and availability of close substitutes, own and cross price elasticities, etc. There might also be attributable costs imposed on consumers from changes in availability of supply, product mix, and/or quality. Empirical analyses with which to assess these economic and market factors are not presently available.

Safety (Ø)
Alternative 5A might 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 were closed, vessels fishing NPT gear would have to travel farther north and farther from ports of call, possibly increasing safety impacts.

Alternative 5A might 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 might 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 (when 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, owing to crowding externalities, gear conflicts, grounds per presumption, etc.

There might be impacts on related fisheries from Alternative 5A 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 might be operating.

Impact on Management and Enforcement Costs (E-)
Management and enforcement costs might increase under Alternative 5A, although it is not possible to estimate by what amount. Additional on-water enforcement could be required to ensure 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 NPT gear in the GOA, EBS, and AI to ensure 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 might be 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 might occur in other communities (especially Kodiak), but these impacts are unlikely to be 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 be groundfish fisheries. Similar to Alternative 4 (but unlike Alternatives 2 and 3), groundfish species in addition to rockfish would be affected by this alternative. Like Alternative 4, this alternative would impact 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 be non-pelagic trawl. Using 2001 fleet data, 82 to 89 vessels (catcher vessels and catcher-processors combined) would be 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 be 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 be 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 both large and small vessels with revenue at risk. All but two of the Aleutians East Borough, resident-owned vessels with revenues that would be at risk are under 60 feet, while none of the Kodiak vessels is 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 be confined to the CG area. Under Alternative 5A, catcher vessels would have at-risk catch in the EG, the CG, and the WG. At-risk harvest would not be 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 be only 7.30 percent for all affected catcher vessels. Total status quo harvest in the EG would be \$310,000, and the WG would be \$2.24 million, compared to \$9.76 million in the CG. At-risk revenue would be about \$900,000. Fisheries with greater than negligible (0.1 percent in this case) at-risk amounts in the GOA would include 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 represent 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 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, be 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 be affected by this alternative would have 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 3.3 percent of their revenue at risk, about three-fourths of which would be Pacific cod and one-fourth pollock. Affected Kodiak boats would have only 2 percent of their revenue at risk under this alternative, primarily from Pacific cod.

The amount of revenue at risk that would likely be lost under actual conditions would, however, vary considerably by community. The smaller catcher boats of King Cove and Sand Point would place 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 depend 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 be 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 might 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 be 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 some at-risk revenue would be made up with minimal costs by altering fishing areas or approaches, it is not likely that these operations would experience significant impacts under this alternative.

For catcher vessels operating in the EBS and AI, the only species that would be affected is Pacific cod. For both the EBS and AI, revenue at risk under this alternative would be 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 be likely to occur.

Catcher-Processors

Based on 2001 data, ownership of catcher-processors with revenue that would be 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 be 17.6 percent under this alternative, and this would not be evenly distributed among the various areas within the GOA. Revenue at risk in the EG would be relatively modest in terms of total value ($180,000 out of a 2001 status quo revenue for affected vessels of $450,000), but this would be relatively large in percentage terms (39.3 percent). For the CG, revenue at risk would be 18.9 percent of the total ($2.07 million out of $10.93 million), while the analogous figure for the WG would be 11.3 percent ($450,000 out of $4 million). The GOA total revenue associated with a number of species would potentially be at risk, but only a few species would experience greater than negligible (0.3 percent in this case) amounts. These would be 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 be 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 experience 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 with a revenue at risk greater than 1 percent would include 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 a relatively low overall value to the catcher-processor sector. As a result, relatively large percentage declines might have minimal impacts on the sector (and associated communities). Of all of the species with at-risk revenues greater than 1 percent of total value, the only species with 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 experience revenue at risk associated with a number of different groundfish species. While a number of these species would have a relatively high percentage of revenue at risk, the overall value at risk would be comparatively low. Revenue of $10,000 or greater would be at risk for only five species: Atka mackerel ($200,000 at risk, which is 0.5 percent of the status quo revenue of affected vessels), Greenland turbot ($190,000, 51.0 percent of the 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 the 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 be borne by affected Washington area catcher-processors (80 percent) and that this would represent 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 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 be 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 not be significant. In the case of Washington communities, while individual Washington-owned entities might experience adverse impacts under this alternative, it is assumed that community-level impacts would not be significant under this alternative due to the scale of the local economy in those communities.

Shoreside Processors

For shoreside processors, no substantial impacts would be likely under this alternative for EBS and AI fisheries because catcher-vessel harvest levels would likely remain constant, and no substantial change in the fishery would occur. 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 some groundfish from vessels with revenues that would be 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 represent 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 be 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 be likely for any other dependent communities.

Multi-Sector Impacts

Multi-sector impacts might be 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 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 some revenue at risk under this alternative. Revenue at risk for King Cove and Sand Point catcher vessels would be a higher percentage of total overall ex-vessel revenues (at 5.4 and 3.3 percent, respectively) than would be the case in Kodiak (about 2 percent), and these vessels would represent 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 might experience social impacts from this alternative that would be significant at the community level. Individual Kodiak entities might experience adverse impacts under this alternative, but impacts at the community level would be 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, might have some compensation at risk. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which in this case would be concentrated in Kodiak (and, perhaps, Dutch Harbor). Given the assumption that overall delivery patterns for the community would be unlikely to change, any vessel-expenditure-associated impacts would likely be 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 would result 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. NMFS' 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 VMS could be used to verify vessel activity data, as NMFS currently does 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 touched 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 fished 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 could 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 have 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 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 that is 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 because pelagic gear would still be allowed in the closed areas, so 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), its addition as a requirement to monitor areas designated through the EFH process would not be a large additional burden for 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 would 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 would 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 would be 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 would minimize 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 would likely result in very small changes in the specific locations and how frequently vessels with trawl third-wire gear might 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 might take seabirds as bycatch, primarily seabird species that dive for their prey (shearwaters and alcids such as murres and puffins). Albatross also might 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. As noted above, however, 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 would 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, so they 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 might increase groundfish trawl fishing levels in some areas of the GOA and BSAI, with some potential concentration of fishing activities in the AI area. This 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, as 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 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 might 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, increased catch of higher trophic levels, or increased 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 might be somewhat reduced from the status quo. Similarly, trophic level of the catch would not be much different from the status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators would be 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 would remain open to trawling, the areas closed to bottom trawling would 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 might 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 would have positive effects on diversity.

4.3.7 Effects of Alternative 5B Options 1, 2, and 3

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 the 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 would not be 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 occur 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 would be 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 would afford 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 occur 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 ten areas enclose slope habitat. LEI values would be substantially reduced for soft bottom bio- (-47 percent) and nonliving (-24 percent) structure and for 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 occur 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 would 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 occur due to bottom trawling, and areas where coral gardens have been delineated in the HAPC process. Total proposed closures would account for 47 percent of the shallow habitat type and 69 percent of the deep habitat. Because the primary fishing grounds would 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 would be 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 Alaska 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.

<u>Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U)</u> – As was determined in the Final PSEIS (NMFS 2004), 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 almost 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 would be 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 Final PSEIS (NMFS 2004), 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 would 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 almost 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 would 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 Final PSEIS (NMFS 2004), 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.

<u>Feeding (Ø)</u> – As was determined in the Final PSEIS (NMFS 2004), 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.

<u>Growth to Maturity (Ø)</u> – As was determined in the Final PSEIS (NMFS 2004), 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, and 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 not expected to impact the stock biomass of Atka mackerel relative to the 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 be likely to impact the stock biomass relative to the 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 the 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 the 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 the 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 the 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 the 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 the 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 the 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 probably has not 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 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, 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 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 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 includes 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, nor a 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 would not be 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 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 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 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 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 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 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 would be 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 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 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 is 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. Adults 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 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 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 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, there would probably be no effect from fishing 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 probably would be no effect from fishing on 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 Final PSEIS (2004), 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 Final PSEIS (2004), 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.

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 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). If the slope were closed to bottom trawling, Pacific ocean perch fishing effort might move onto the shelf and into the gullies. Consequently, movement of the Pacific ocean perch bottom trawling fishery could result in increased fishing pressure in these areas. 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 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). Because shortraker and rougheye are only taken as bycatch, are taken by both trawl and longline fisheries, and 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. Because it is unknown if a reduction in bottom trawl effort in such small areas would improve benthic habitat, and 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 the effects 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 (Dave Clausen, personal communication). 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 to the rationale 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. 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 are not presently known, these closure areas most likely 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 are 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 would have no effect 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 would 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 would have no effect 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 would simply pass over the crabs without touching them, 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 would have no substantial effect 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 would have no effect 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. Alternative 5B would 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 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 33.3 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 km^2 of GOA shelf and slope edge habitat (11.4 percent of the current 279,874 km^2 of habitat) and an average 63,975 km^2 of EBS habitat (8.0 percent of the current 798,870 km^2 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 km^2 of AI habitat, or 77.9 percent of the current fishable area of 105,243 km^2 in the AI. Overall, Alternative 5B would affect 177,903 km^2, or 15.0 percent of the combined fishable area of 1,183,987 km^2 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 the status quo Alternative 1 is unknown.

4.3.7.3.2 Effects on the Fishing Fleet

<u>Gross Revenue Effects (E-)</u>
Alternative 5B would place $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 place 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 reduce 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 place 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 be 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 occur 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 reduce 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 would impose EFH fishing impact minimization measures in the GOA, EBS, and AI. Within the GOA, the largest amount of revenue at risk would be 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 be $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 affect 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 equal $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 be $380,000, or 4.9 percent of the status quo revenue of $7.66 million.

In the GOA, the catcher-processor fleet would have 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

$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 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 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. Alternative 5B would place 31.8 percent of the status quo revenue at risk in the EG. That large a revenue at risk would be difficult to fully make up. Amendment 58 to the GOA FMP, which took effect in 1998, prohibits trawling in the EG east of long. 140º 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 be placed at risk, or 12.0 percent of the $55.81 million of the 2001 status quo revenue in the AI fisheries affected by this rule. In the AI, under Alternative 5B, Option 1, there would be 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 be 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. Because 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 total $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 place 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 $3.61 million, or 8.8 percent of the status quo revenue of $41.01 million would be placed at risk. The TAC reduction requirement under Alternative 5B, Option 1, would reduce 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 be 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 place $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 reduce 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 be 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 be recovered due to the TAC reduction. Some or all of the remaining $350,000 revenue at risk in the rockfish NPT fishery could potentially be recovered by redeploying fishing effort to adjacent open areas or switching to PTR gear.

In the AI, the catcher-processor NPT fleet would account 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 $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 under Alternative 5B, Option 1, would reduce 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 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 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 1, revenue would be 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 be placed at risk, or 5.4 percent of the $55.81 million of the status quo revenue in the fisheries affected under this rule. In the AI, there would be 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 be 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 would total $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 place 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 $1.59 million, or 3.9 percent of the status quo revenue of $41.01 million, would be 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 place $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 be 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 be recovered, due to the TAC reduction. Some or all of the remaining $90,000 revenue at risk in the rockfish NPT fishery could potentially be recovered by redeploying fishing effort to adjacent open areas or switching to PTR gear.

In the AI, the catcher-processor NPT fleet would account 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 $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 be placed at risk, or 2.2 percent of the $55.81 million of the 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 place 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 $0.62 million, or 1.5 percent of the status quo revenue of $41.01 million, would be placed at risk. In addition to the impacts on the Atka mackerel fishery, Alternative 5B, Option 3, would place $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 be 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 account 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 $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.

<u>Operating Costs (E-)</u>

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 increase 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 mean that 11.8 to 29.3 percent of the status quo revenue would be 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 segment of the fleet composed of catcher vessels currently required to carry 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. It is not possible to empirically estimate these impacts, given available data and market analyses.

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 those targeting 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. These costs are treated in the RIR in Appendix C.

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 be 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 occur in other communities (especially Kodiak), but these impacts are unlikely to be 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).

Only groundfish, in addition to rockfish, fisheries would be directly affected by any of the Alternative 5B options, similar to Alternative 4 (but unlike Alternatives 2 and 3). Like Alternative 4, this alternative would have 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 be non-pelagic trawl. Using 2001 fleet data, 93 vessels (catcher vessels plus catcher-processors) would be 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, be 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 be 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 be the same as those seen under Alternative 5A. As noted under that alternative, significant impacts associated with local catcher fleets could accrue 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 be the same as those seen under Alternative 5A (not significant).

For catcher vessels operating in the AI, the only affected fishery would be Pacific cod under any of the options, but the amount of revenue at risk would vary 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 be primarily concentrated in Pacific Northwest communities, and any impacts seen in Alaska would be concentrated in Kodiak. No significant community level impacts associated with this catcher fleet would be 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 Alternative 5B, Option 2, the revenue at risk under this alternative ($50,000) would be 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 Alternative 5B, Option 2, would be the same vessels as those with revenue at risk under Alternative 5B, Option 1; therefore, effects on communities would be similar to those seen under Alternative 5B, Option 1 (but of a lower intensity, due to less revenue at risk). Impacts would be concentrated primarily in Pacific Northwest communities and Kodiak, and no significant community level impacts associated with this catcher fleet would be 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 experience increased costs and/or decreased harvests).

Under Alternative 5B, Option 3, the revenue at risk under this alternative ($30,000) would be 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 Alternative 5B, Option 3, would be the same vessels as those with revenue at risk under Alternative 5B, Option 1; therefore, effects on communities would be similar to those seen under Option 1 (but of a lower intensity due to less revenue at risk). Impacts would be primarily concentrated in Pacific Northwest communities and Kodiak, and no significant community level impacts associated with this catcher fleet would be 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 experience 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 be 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 be the same as those seen under Alternative 5A.

For the AI, affected catcher-processors under Alternative 5B, Option 1, would experience 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 experience revenue at risk associated with a number of different groundfish species. While fisheries for some of these species would have 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 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 be 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 be significant, although some individual entities may experience adverse impacts due to increased costs and/or decreased harvests. While individual Washington-owned entities may experience adverse impacts under Alternative 5B, Option 1, it is assumed that community level impacts would not be significant due to the scale of the local economy in those communities.

Under Alternative 5B, Option 2, affected catcher-processors in the AI would experience 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 be associated with the same groundfish species as under Alternative 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 Alternative 5B, Option 1, would be less than $10,000. For the other three species, revenue at risk would be less than seen under Alternative 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 Alternative 5B, Option 2, would be the same vessels as those with revenue at risk under Alternative 5B, Option 1; therefore, effects on communities would be similar to those seen under Alternative 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 be 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 experience 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 be 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 experience 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 be associated the same groundfish species as under Alternative 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 Alternative 5B, Option 1, would be less than $10,000. For the other three species, revenue at risk would be less than that seen under Alternative 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 Alternative 5B, Option 2, would be the same vessels as those with revenue at risk under Alternative 5B, Option 1; therefore, effects on communities would be similar to those seen under Alternative 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 be 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 be significant, although some vessels may experience increased costs and/or decreased harvests. While individual Washington-owned entities may experience adverse impacts under Alternative 5B, Option 3, it is assumed that community level impacts would not be 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 are concentrated in Kodiak (with nine entities). Akutan has two entities, and a number of other communities each has a single processor that processed 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 represent 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 be 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 be 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 some of this catch would likely be 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 be likely for Unalaska/Dutch Harbor, although some individual entities may experience a loss of processing volume and/or revenues. No significant community impacts would be 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 be the same as under Alternative 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 Alternative 5B, Option 2, than under Alternative 5B, Option 1. It is assumed that most of AI Pacific cod catch at-risk under this option would be 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 be likely for Unalaska/Dutch Harbor, although some individual entities may experience a loss of processing volume and/or revenues. No significant community impacts would be 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 be the same as under Alternative 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 Alternative 5B, Option 2, than under Alternative 5B, Option 1. It is assumed that most of AI Pacific cod catch at-risk under this option would be 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 be likely for Unalaska/Dutch Harbor, although some individual entities may experience a loss of processing volume and/or revenues. No significant community impacts would be likely for any other dependent communities.

Multi-Sector Impacts

Multiple sector impacts may be 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 some revenue that would be 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 some revenue that would be at risk under this alternative. Alaska fleet related community impacts would be 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 experience social impacts from this alternative that would be significant at the community level. Individual Kodiak entities may experience 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 be unlikely to change for Kodiak-based shoreside processors under this alternative. Kodiak may experience 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 some compensation at risk. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which, in this case, would be 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 be minor.

Multiple sector community impacts under Alternative 5B, Option 2, would be the same as those identified under Alternative 5B, Option 1, because the same fleets and processors would be affected, and most multiple sector impacts to communities would be driven largely by GOA impacts that would not differ between the options under this alternative. As under Alternative 5B, Option 1, these impacts may be 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 be concentrated in Kodiak, but it is not likely that they would be 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 be the same as those identified under Alternative 5B, Option 1, because the same fleets and processors would be affected, and most multiple sector impacts to communities would be driven largely by GOA impacts that would not differ between the options under this alternative. As under Alternative 5B, Option 1, these impacts may be 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 be concentrated in Kodiak, but it is not likely that they would be 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 establish 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; vessels 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 effects 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.

<u>ESA-listed Seabirds (Ø)</u> – 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; because no documented take of this species has been reported for these fisheries, however, 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.

<u>Other Seabirds (Ø)</u> – 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 in 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 the status quo, and little change would be 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 would 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 5C

4.3.8.1 Effects of Alternative 5C on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type would differ from status quo for Alternative 5C. LEIs for both status quo and Alternative 5C 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.

Effects on Benthic Biodiversity (E+) – Alternative 5C would provide moderate increases in protection of coral in the GOA and very large increases in the AI. However, fishing effort would not be uniform within the proposed open areas in Alternative 5C and could shift to areas that are not fished regularly under current conditions, resulting in some new impacts to living substrates.

GOA – Alternative 5C would institute closures to all bottom trawling in ten areas of the GOA slope habitat. LEI values would be slightly reduced for coral. 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.

AI – Alternative 5C would close all Aleutian areas outside of recently productive fishing grounds, as well as six coral garden sites located off Semisopochnoi Island, Bobrof Island, Cape Moffet, Great Sitkin Island, Ulak Island, and Adak Canyon. Total closures would account for 39 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 5C would be expected to result in positive effects on epibenthic structure forming organisms, mainly through reduced effects on ten sites on the GOA slope.

GOA – Alternative 2 would institute closures to rockfish trawling in ten areas of the GOA. All of these areas enclose mostly 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.

AI – Alternative 5C would close all Aleutian areas outside of recently productive fishing grounds, as well as six coral garden sites located off Semisopochnoi Island, Bobrof Island, Cape Moffet, Great Sitkin Island, Ulak Island, and Adak Canyon. The total proposed closure would account for 39 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.

An additional feature of Alternative 5C would be fishery monitoring measures at existing levels of observer coverage plus a requirement for VMS on all fishing vessels in the AI, as well as VMS on all fishing vessels with bottom-contact gear in the GOA.

4.3.8.2 Effects of Alternative 5C 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 Alaska 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 AI, WCGOA, and SeGOA pollock stocks.

Stock Biomass (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the revised Final PSEIS (NMFS 2004), 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 Alternative 5C would be the inclusion of additional areas closed to bottom trawling. Because the additional closures in the GOA would fall almost entirely outside of walleye pollock habitat, they would not be expected to impact walleye pollock fishing mortality in the GOA.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the Final PSEIS (NMFS 2004), the existing spatial-temporal concentration of the catch does not appear to have led to changes in the genetic structure of the WCGOA walleye pollock stocks that would 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 5C would be the inclusion of additional areas closed to bottom trawling. 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.

Spawning/Breeding (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the Final PSEIS (NMFS 2004), nothing in the current fishery management regime jeopardizes the ability 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 5C would be the inclusion of additional areas closed to bottom trawling. 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.

Feeding (EBS U, WCGOA Ø, SeGOA U, AI U) – As was determined in the Final PSEIS (NMFS 2004), nothing in the current fishery management regime jeopardizes the ability 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 almost entirely outside of walleye pollock habitat, they would not be expected to impact the feeding success of adult walleye pollock in the GOA. 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 5C, 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 Final PSEIS (NMFS 2004), nothing in the current fishery management regime jeopardizes the ability of 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.

4.3.8.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the Final PSEIS (NMFS 2004), 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 5C would be the inclusion of additional areas closed to bottom trawling. 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. 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 Final PSEIS (NMFS 2004), 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 would 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 5C would be the inclusion of additional areas closed to bottom trawling. 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. Even if some decrease in spatial concentration of the BSAI catch were realized under Alternative 5C, 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 Final PSEIS (NMFS 2004), 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 5C would be the inclusion of additional areas closed to bottom trawling. 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 5C appear to encompass only a small proportion of the known Pacific cod spawning grounds, and it is unclear whether the other elements of Alternative 5C 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 5C, 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 Final PSEIS (NMFS 2004), 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 5C would be the inclusion of additional areas closed to bottom trawling. 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 5C are small, and it is unclear whether the other elements of Alternative 5C 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 5C, 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 Final PSEIS (NMFS 2004), 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 5C would be the inclusion of additional areas closed to bottom trawling. In the BSAI, the additional proportions of

Pacific cod EFH that would be closed under Alternative 5C are small, and it is unclear whether the other elements of Alternative 5C 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 5C, 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.

4.3.8.2.1.3 Sablefish (BSAI and GOA)

The effects of Alternative 5C for sablefish would be the same as the effects of Alternative 5B. The additional measures for the AI added by Alternative 5C would not affect any areas where sablefish are caught, and the sablefish catch would not reduced by these additional measures.

4.3.8.2.1.4 Atka Mackerel (BSAI and GOA)

Stock Biomass (Ø) – The Alternative 5C options would probably not impact the stock biomass of Atka mackerel relative to the status quo. Relative to the status quo, the major change under Alternative 5C would be the inclusion of additional areas closed to bottom trawling. Because these areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5C would probably not impact the stock biomass relative to status quo. Alternative 5C 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 is 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 the status quo. Relative to the status quo, the major change under Alternative 5C would be the inclusion of additional areas closed to bottom trawling. Because these areas would not overlap with the Atka mackerel fishery, Alternative 5C would not be likely to impact the spatial concentration of the catch relative to status quo. Alternative 5C 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 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 5C would not be expected to affect the spawning and breeding of Atka mackerel relative to the status quo. Relative to the status quo, the major change under Alternative 5C would be the inclusion of additional areas closed to bottom trawling. Because these areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5C would not be likely to impact the spawning and breeding of Atka mackerel relative to the status quo. Alternative 5C 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 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. In addition, the closed areas in the GOA for Alternative 5C would be mostly directed at the Pacific ocean perch bottom trawl fishery. Euphausiids are also the major food for Pacific ocean perch. In theory, therefore, 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 the 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 generally less than 200 m.

Alternative 5C would not be expected to affect the growth to maturity of Atka mackerel relative to the status quo. Relative to the status quo, the major change under Alternative 5C would be the inclusion of additional areas closed to bottom trawling. Because these areas would not overlap with the major fishing grounds for Atka mackerel, Alternative 5C would not be likely to impact the growth to maturity of Atka mackerel relative to the status quo. Alternative 5C 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 is no effect.

4.3.8.2.1.5 Arrowtooth Flounder (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5C 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 5C 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 5C would probably not cause a negative effect on the future genetic diversity of the stock.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5C 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 5C 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.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5C 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 5C, there would be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.6 Rock Sole (BSAI)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5C would have no effect on BSAI 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 5C would have little effect on BSAI rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Since most of the BSAI rock sole harvest does not occur in the designated bottom trawl closure areas 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 5C would have no effect on BSAI 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 5C 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 5C 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 5C, there would be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.7 Flathead Sole (BSAI and GOA)

Stock Biomass (Ø) – Relative to the status quo, Alternative 5C would have no effect on GOA and BSAI 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 5C would have little effect on GOA and BSAI flathead sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Bottom trawl surveys conducted during the 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 BSAI flathead sole harvest has not occurred in the designated bottom trawl closure areas that would closed in 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 5C would have no effect on GOA and BSAI 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 5C 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.

Growth to Maturity (Ø) – Relative to the status quo, Alternative 5C 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 5C, there would be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.8 Rex Sole (GOA)

Stock Biomass (U) – Because the value of MSST is unknown for GOA rex sole, the effect of Alternative 5C on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (U) – Relative to the status quo, Alternative 5C might have some effect on the GOA rex sole harvest due to the areas closed below 200 m. Trawl surveys indicate that more than half of the summertime biomass is 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 5C 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 5C 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. Adults 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 5C 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 5C, there probably would be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.9 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 5C on stock biomass is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – Relative to the status quo, Alternative 5C would have little effect on GOA rock sole and other shallow water flatfish, since they primarily inhabit water less than 200 m deep.

Spawning/Breeding (Ø) – Relative to the status quo, Alternative 5C would have no effect on GOA rock 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 5C 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 5C 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 5C, there would probably be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.10 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.

<u>Stock Biomass (U)</u> – Because the value of MSST is unknown for GOA deep water flatfish, the effect of Alternative 5C on stock biomass is unknown.

<u>Spatial/Temporal Concentration of the Catch (U)</u> – Relative to the status quo, Alternative 5C might have some effect on the GOA Dover sole harvest due to the ten closed areas between 200 to 1,000 m. Trawl surveys indicate that nearly half of the summertime biomass is at depths less than 200 m, so the harvest could be taken entirely in the shallow areas. The effect this would have on the genetic diversity of the stock is unknown.

<u>Spawning/Breeding (Ø)</u> – Relative to the status quo, Alternative 5C 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.

<u>Feeding (Ø)</u> – Relative to the status quo, Alternative 5C 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.

<u>Growth to Maturity (Ø)</u> – Relative to the status quo, Alternative 5C 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 5C, there probably would be no effect from fishing on survival and growth to maturity.

4.3.8.2.1.11 Pacific Ocean Perch (BSAI)

<u>Stock Biomass (Ø)</u> – 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 Alternative 5C would place additional habitat protections in the BSAI area, the stock biomass would be expected to remain above the MSST, and the effect of fishing on stock biomass would also be rated as no effect.

<u>Spatial/Temporal Concentration of the Catch (Ø)</u> – The primary locations for Pacific ocean perch harvest in the AI occur where few Pacific ocean perch would be caught under Alternative 5C; 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 5C 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 Final PSEIS (NMFS 2004), 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 Alternative 5C 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 Alternative 5C would have no effect on these pelagic prey items.

Growth to Maturity (Ø) – As was discussed under Alternative 1, model projections conducted for the Final PSEIS (NMFS 2004), 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 Alternative 5C would probably be similar to that under Alternative 1; thus, fishing would probably have no substantial effect on the survival of fish to maturity.

4.3.8.2.1.12 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – The ten areas in the GOA that Alternative 5C would close to all groundfish bottom trawling would 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.

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 5C 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. The fishing closures would probably not increase total fishing mortality. Consequently, Alternative 5C would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 5C 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 5C.

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.

4.3.8.2.1.13 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 stock's ability to maintain itself above the MSST is unknown.

Spatial/Temporal Concentration of the Catch (Ø) – The spatial/temporal concentration of the catch under Alternative 5C 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) are also unknown.

4.3.8.2.1.14 Shortraker and Rougheye Rockfish (GOA)

Stock Biomass (Ø) – Alternative 5C would likely have little or no impact on the stock biomass of shortraker/rougheye rockfish compared to the status quo. 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). Because shortraker and rougheye are only taken as bycatch, are taken by both trawl and longline fisheries, and distribution is evenly spread over a wide geographical area, the closures proposed under Alternative 5C 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 5C 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. 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 5C 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. Because it is unknown if a reduction in bottom trawl effort in such small areas would improve benthic habitat, and habitat requirements are mostly unknown for shortraker/rougheye, it is unknown what effects Alternative 5C would have on these species.

4.3.8.2.1.15 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 closures near Semisopochnoi Island and Seguam Pass 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 5C 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 the effects 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 5C 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.

4.3.8.2.1.16 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 would cover a relatively small portion of the slope geographically and 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 5C 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 are not in areas with high northern rockfish concentrations, this portion of Alternative 5C would have a negligible effect on the spatial/temporal concentration of catch.

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 5C 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 5C.

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 5C 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.

4.3.8.2.1.17 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 5C would likely have little or no impact on the stock biomass of light dusky rockfish compared to the status quo. The ten areas in the GOA that the alternative would close to all bottom trawling would 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.

Spatial/Temporal Concentration of the Catch (Ø) – Because the areas closed to fishing generally would not correspond with locations where light dusky rockfish are abundantly caught (the closed areas are all too deep), Alternative 5C 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 5C 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 5C 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 5C would mostly be 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 were selected, 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 5C 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 would all be located in deeper waters (more than 200 m) that are inhabited by relatively few light dusky rockfish, so they would provide little benefit to these fish.

4.3.8.2.1.18 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. Therefore, Alternative 5C 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 to the rationale for stock biomass, Alternative 5C 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. Due to this lack of knowledge, the effects of Alternative 5C 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 are not presently known, these closure areas most likely 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 5C would have little or no effect on growth to maturity of light dusky rockfish.

4.3.8.2.1.19 Shortspine Thornyheads (BSAI)

Stock Biomass (Ø) – The peak abundance for shortspine thornyheads is along the slope from 300 to 1,000 m. The displaced fishery catch of shortspine thornyhead, in these areas, would be minimal (Reuter and Spencer 2001). Under Alternative 5C, therefore, there would be little to no effect on 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 5C 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 5C closures on the habitat of this life stage would probably be 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 are 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). The displaced fishery catch of shortspine thornyhead in these areas would be minimal in the AI (Reuter and Spencer 2001). Therefore, Alternative 5C would have little to no effect on their growth potential as compared to the status quo.

4.3.8.2.1.20 Forage Species (BSAI and GOA)

Stock Biomass (Ø) – The impact of Alternative 5C 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 5C would lead to change in the stock biomass over the status quo.

Spatial/Temporal Concentration of the Catch (Ø) – As stated above, the areas closed by Alternative 5C would not be in areas of significant forage species bycatch. Alternative 5C would have a negligible effect on the spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The areas that would be closed by Alternative 5C are not thought to be important to the spawning and breeding of forage species. Alternative 5C would have a minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas that would be closed by Alternative 5C are not thought to be important to the feeding ecology of forage species. Alternative 5C would have a minimal effect on the feeding of forage species.

Growth to Maturity (Ø) – The areas that would be closed by Alternative 5C are not thought to be important to the feeding ecology of forage species. Alternative 5C would have a 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 would not be impacted by measures proposed under Alternative 5C. 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 would be expected under Alternative 5C.

Spawning/Breeding (Ø) – No changes in the distribution of fisheries in salmon spawning and breeding areas would occur under this alternative; thus, no effects would be expected under Alternative 5C.

Feeding (Ø) – No substantial changes in the catch of these prey species would be expected under Alternative 5C; thus, this alternative would have no effect on feeding of salmon species.

Growth to Maturity (Ø) – No changes in habitat effects or survival would be expected under Alternative 5C; thus, no effects would be anticipated. Bycatch of juvenile salmon has been relatively limited in the fisheries that would be 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.

4.3.8.2.2.2 Crabs

Stock Biomass (Ø) – Alternative 5C would not affect the catch of crabs in the directed fisheries by more than 1 percent, which would not significantly modify the distribution and intensity of fishing effort. Thus, stock biomass would not be substantially affected by Alternative 5C.

Spatial/Temporal Concentration (Ø) – While some crab fishing does occur in the six coral garden sites located off Semisopochnoi Island, Bobrof Island, Cape Moffet, Great Sitkin Island, Ulak Island, and

Adak Canyon, Alternative 5C would not significantly modify the distribution and intensity of fishing effort in the crab fisheries; thus, no effects would be anticipated.

Spawning/Breeding (Ø) – No effects on spawning and breeding of crabs would be expected under Alternative 5C. For that reason, Alternative 5C would 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 5C would have no effect on feeding of crab species.

Growth to Maturity (E+) – The closure areas in the six coral garden sites located off Semisopochnoi Island, Bobrof Island, Cape Moffet, Great Sitkin Island, Ulak Island, and Adak Canyon would overlap with golden king crab EFH areas of concentration. The closure areas might improve habitat within the closure area by eliminating potential impacts due to crab fishing. However, it is likely that fishing effort would redistribute to nearby adjacent areas also used by these crab, and this redistribution would likely dampen potential habitat benefits or reductions. Overall, positive changes in habitat effects and survival would be expected under Alternative 5C.

4.3.8.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 5C would probably 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 would be expected under Alternative 5C.

Spawning/Breeding (Ø) – None of the closure areas designated under this alternative would overlap with scallop populations. Therefore, Alternative 5C would have no substantial effects on spawning and breeding of weathervane scallops.

Feeding (Ø) – None of the closure areas designated under this alternative would overlap with scallop populations, and fishing effort would probably not increase in areas with scallops. Thus Alternative 5C would have no effect on feeding of scallops.

Growth to Maturity (Ø) – No change in scallop dredge effort would be expected under Alternative 5C, and no changes in effort redistribution to scallop grounds would be anticipated. Alternative 5C would have no effect on growth to maturity.

4.3.8.3 Effects of Alternative 5C on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 5C on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.8 of the Appendix C.

4.3.8.3.1 Effects on Passive Use Values (E+)

Under Alternative 5C, NPT fishing activities for all species in ten designated areas along the intermediate and deep slope (200 to 1,000 m) in the GOA would be eliminated. The use of non-pelagic trawl gear would be prohibited for all species in designated areas of the AI and, in addition, all bottom-contact fishing would be prohibited in six designated coral garden areas. As such, Alternative 5C would contribute additional management measures that would further reduce the impacts of fishing on EFH. 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 5C would yield some incremental increase in passive-use benefits over the status quo Alternative 1.

4.3.8.3.2 Effects on the Fishing Fleet

Alternative 5C would minimize the impact of NPT fishing over 7,157 km^2 of GOA shelf and slope edge habitat (2.6 percent of the current 279,874 km^2 of habitat) and 66,713 km^2 of AI habitat (61.6 percent of the current 108,243 km^2 of habitat) and eliminate all bottom contact fishing gear use in 380 km^2, within six designated AI coral garden areas, for a total of 74,250 km^2, or 19.1 percent of the combined fishable area of 388,117 km^2 in the GOA and AI.

Alternative 5C would reduce the effects of NPT fishing on EFH in the GOA and AI beyond measures currently in place or planned as part of other fishery management actions, and it would provide added protection by eliminating all bottom-contact fishing in six designated AI coral gardens.

<u>Gross Revenue Effects (E-)</u>
Assuming that Alternative 5C had been implemented for the 2001 fishing season, it would place $2.39 million of gross revenue at risk in NPT fisheries in the GOA and AI, or 1.3 percent of the status quo total revenue of $180.41 million throughout the GOA, EBS, and AI.

GOA Region
Within the GOA, the largest impact would be in the WG, with $0.57 million in revenue at risk, equaling 9.1 percent of the $6.25 million 2001 status quo revenue. The revenue at risk in CG would equal $0.56 million, or 2.7 percent of the 2001 total status quo revenue of $20.69 million. There would be $30,000 in revenue at risk in the EG, or 4.6 percent of the $760,000 2001 status quo revenue.

In the GOA, EFH fishing impact minimization measures under Alternative 5C would affect a number of NPT fisheries, but primarily fisheries targeting rockfish, Pacific cod, and rex sole. The total revenue at risk in the NPT rockfish fishery would be $0.52 million, or 5.5 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 be $0.32 million, or 4.2 percent of the 2001 status quo revenue of $7.66 million, and revenue at risk in the NPT fishery for rex sole would be $0.30 million, or 7.3 percent of the status quo revenue of $4.15 million.

In the GOA, the catcher-processor fleet would have the greatest amount of revenue at risk, equaling $0.80 million, or 5.2 percent of the 2001 status quo total revenue of $15.38 million. The catcher-vessel fleet would have $370,000 of ex-vessel revenue at risk, or 3.0 percent of the total ex-vessel revenue of $12.31 million. Under Alternative 5C, the catcher-vessel fleet would have revenue at risk in the EG of $20,000, or 6.1 percent of the 2001 status quo revenue; in the CG, $50,000, or 0.5 percent of the 2001 status quo revenue of $9.76 million; and in the WG, $300,000, or 13.4 percent of the 2001 status quo revenue of $2.24 million. The GOA catcher-processor fleet would have revenue at risk mainly in the CG ($0.51 million, or 4.7 percent of the 2001 status quo revenue of $10.93 million), but also in the WG ($270,000, or 6.7 percent of the $4.0 million 2001 status quo gross revenue) and the EG ($20,000, or 3.5 percent of the $450,000 in 2001 status quo revenue).

The ten closure areas under Alternative 5C in the GOA would be discreet and widely spaced along the outer shelf and slope edge. Within the entire GOA, substantial adjacent NPT fishing area would remain where some, or possibly all, of the revenue at risk might be mitigated by a redeployment of fishing effort. However, Alternative 5C would place 9.1 percent of the status quo revenue at risk in the WG, with 13.4 percent of the catcher vessel revenue at risk in this area. This amount of revenue at risk would likely be difficult to make up elsewhere. Additionally, Amendment 58 to the GOA FMP, which took effect in 1998, prohibits trawling in the EG, east of long. 140º W. This restriction leaves a very limited area within the EG where revenue at risk for the NPT fisheries could be mitigated. Some portion of the WG and EG revenue at risk might not be recovered under Alternative 5C.

Although some slope rockfish are caught with NPT gear at depths shallower than 200 m in the GOA, most of the NPT commercial catch of the slope rockfish complex occurs at depths in excess of 150 m (NMFS 2002d). There is fishing area for slope rockfish in the 150 to 200 m slope edge adjacent to the ten areas (200 to 1,000 m) 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 5C. 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 as incidental catch by HAL gear in the sablefish and halibut fisheries.

Under Alternative 5C, most, if not all, of the revenue at risk in the GOA might be recovered by redeployment of fishing effort to adjacent areas or by most of the fleet components involved in the fishery switching to PTR gear. The smaller catcher-vessel fleet targeting slope rockfish almost exclusively uses NPT gear and has neither enough horsepower to fish PTR, nor the revenue from participation in this fishery to warrant the investment necessary to use PTR gear. The larger catcher vessels (vessels that also target pollock) and the catcher-processors either already have PTR gear available or, at the very least, have enough horsepower to convert to PTR to target slope rockfish. The revenue at risk might be recovered by vessels fishing near the ten GOA slope closed areas, or by vessels switching from bottom trawl to PTR gear within those areas, but a transfer of catch share and revenue would be likely from the smaller catcher-vessel fleet to the larger catcher-vessel and catcher processor fleet component. 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.

Operational costs for any of the larger catcher vessels and catcher-processors in the GOA that change to PTR gear for targeting slope rockfish might 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 at risk in the NPT fisheries for Pacific cod and rex sole could only be mitigated by vessels moving fishing effort to adjacent areas outside the ten designated EFH protection areas, since these species are not caught with PTR gear. It is likely that most, if not all, of the revenue at risk in these fisheries would be mitigated in the GOA by redeployment of fishing effort to areas not affected by EFH protection measures.

Revenue impacts from changes in product quality would be possible under Alternative 5C, particularly for the smaller catcher-vessel fleet component operating with NPT gear in the GOA. These vessels might have to expend additional fishing effort in an attempt to recover the revenue at risk, which could lengthen fishing trips and result in diminished delivered catch quality. Product quality might not be affected in the catcher-processor fleet component, since these vessels would 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 5C would close designated areas to all species with NPT gear and would place $1.23 million of revenue, or 2.2 percent of the $55.81 million 2001 status quo revenue, at risk in the affected fisheries. The AI revenue at risk impacts under Alternative 5C would occur mainly in the catcher-processor NPT fleet, which would account for substantially all ($1.20 million) of the $1.23 million revenue at risk, or 2.2 percent of the total 2001 status quo revenue of $4.69 million. The AI revenue at risk in the catcher-processor fleet component due to restrictions on NPT fisheries could potentially be 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 5C would place revenue at risk in NPT fisheries for Atka mackerel, Pacific cod, and rockfish. The largest amount of revenue at risk in the AI would be in the NPT Atka mackerel fishery, where $0.62 million, or 1.5 percent of the total status quo revenue value of $41.01 million, would be placed at risk. The impact on the Pacific cod NPT fishery would put $0.35 million at risk, or 3.6 percent of the $9.61 million 2001 status quo value in this fishery. In the AI NPT rockfish fishery, $0.26 million, or 5.1 percent of the status quo revenue of $5.08 million would be placed at risk.

Alternative 5C would prohibit bottom contact fishing in six designated coral garden areas of the AI off Semisopochnoi Island, Bobrof Island, Cape Moffet, Great Siskin Island, Ulak Islan, and Adak Canyon. Bottom contact gear in use in these areas includes NPT, HAL, and POT. Impacted fisheries would include NPT fisheries for groundfish, HAL fisheries for groundfish and halibut, and POT fisheries for king and Tanner crab. Given the relatively small, discreet areas encompassed by the AI coral garden areas, it was difficult to obtain precise estimates of catch and revenue that would be placed at risk by restrictions in these areas. Had Alternative 5C been in place during 2001, groundfish revenue at risk from NPT and HAL fisheries in the coral garden areas would be approximately $235,000, or less than 0.5 percent of the status quo groundfish revenue in the AI. Had Alternative 5C been in place from 1995 through 2003, restrictions on crab pot fisheries would place a combined total of 171,876 pounds of catch at risk, or 0.3 percent of the total harvest of 53.25 million pounds during this period. Ex-vessel revenue at risk in crab fisheries in the coral gardens would total $313,000, or less than 0.1 percent of the status quo revenue of $121.9 million over the 9-year period. Catch and revenue placed at risk in the AI due to the prohibiting of bottom contact gear in the six coral garden areas would likely be mitigated by transferring fishing effort to adjacent areas open to bottom-contact fishing. The IPHC estimated that, had Alternative 5C been in place from 1995 through 2002, a combined total of 1.1 to 1.15 million pounds of halibut catch would be placed at risk, or approximately 4.4 percent of the total harvest in IPHC area 4B in the AI (Tom Kong, IPHC staff, personal communication, March, 10, 2005). Owing to IPHC data confidentiality and availability considerations, no estimate of the associated revenues at risk is provided for halibut.

<u>Operating Costs (E-)</u>
Operating cost impacts under Alternative 5C would probably be greater overall for both the GOA catcher-vessel component and the catcher-processor fleet components in all areas. Redeployment of NPT fishing effort outside the ten EFH protection areas might result in increased fishing effort and associated increased operational costs to mitigate the catch and revenue at risk.

As previously discussed, larger catcher vessels and catcher-processors in the GOA have the option of changing to PTR gear for targeting slope rockfish in the EFH protection areas. However, the smaller catcher vessels, particularly 18.3 m (60 feet) and smaller vessels, do not have enough 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 might increase due to the redeployment of fishing effort necessary to mitigate the 5.2 percent of the status quo revenue at risk for this fleet component.

In the AI, Alternative 5C would place a relatively small amount, 2.2 percent, of the status quo revenue at risk and might not result in any significant increases in operating costs for either the catcher-vessel or catcher-processor fleet components.

The requirement for VMS coverage on all vessels using bottom-contact fishing gear in both the GOA and AI would likely impose a significant cost impact on the entire catcher-vessel fleet in the GOA and on non-trawl, bottom-contact gear vessels in the AI that do not already have VMS equipment. A full discussion of the VMS costs for Alternative 5C is provided in Appendix C, Section C.3.8.

Costs to U.S. Consumers (E-)

Consumers might experience some impact from Alternative 5C because, although some or all of the revenue at risk might be recovered by redeployment of fishing efforts, there would likely be some operational cost increases for the fleet components. This operational cost increase might 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 might also be attributable costs imposed on consumers from changes in availability of supply, product mix, and/or quality.

Safety (Ø)

Alternative 5C would not significantly affect the safety of any of the fleet components in the AI or GOA because fishing effort would likely be redeployed to adjacent fishing areas within similar distance of home ports for the fleet.

Impacts to Related Fisheries (E-)

There might be an impact on related fisheries in the GOA from Alternative 5C because some amount of NPT fishing effort for slope rockfish, Pacific cod and, rex sole would likely be redeployed into adjacent areas not 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 in these areas along the GOA shelf edge could have negative indirect economic impacts on these fisheries.

There might be impacts on related fisheries from Alternative 5C in the AI as vessels using NPT gear could be displaced into adjacent areas where other gear groups such as hook and line and pot vessels might be operating.

Impact on Management and Enforcement Costs (E-)

Management and enforcement costs might increase under Alternative 5C, although it is not possible to estimate by what amount. Additional on-water enforcement could be required to ensure compliance with the EFH fishing impact minimization measures applied in the GOA and AI. VMS equipment on all bottom-contact gear vessels would be required for all vessels in the GOA and AI to ensure compliance with designated area EFH fishing impact minimization measures under Alternative 5C. 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 5C.

4.3.8.3.3 Effects on Communities and Shoreside Industries (Ø)

Overview

Like Alternatives 5A and 5B, impacts of Alternative 5C to dependent communities and shoreside industries might be significant at the community level, at least for a few communities (King Cove and Sand Point). Adverse impacts to individual operations might occur in other communities (especially Kodiak), but these impacts would probably not be significant at the community level, due to the low order of magnitude of the impacts relative to the overall operations of the affected fleet and processing entities (as well as the overall community fishing sectors).

Excluding AI coral garden closures, the only fisheries directly affected by Alternative 5C would be groundfish fisheries. Similar to Alternatives 4, 5A, and 5B (but unlike Alternatives 2 and 3), several species of groundfish in addition to rockfish would be affected by this alternative. Like Alternatives 4, 5A, and 5B, Alternative 5C would have impacts on GOA and AI fisheries, but unlike those alternatives it would not have impacts on EBS fisheries. Like Alternatives 2, 3, 4, 5A, and 5B, the only gear group directly affected for both catcher vessels and catcher-processors would be non-pelagic trawl (with the exception of the coral garden areas of the AI). Using 2001 fleet data, 93 vessels (catcher vessels and catcher-processors combined) would be affected by this alternative: 28 in Alaska, 12 from Oregon, 47 from Washington, and 6 from other states. Using 2001 processor data, 19 shoreside processors in Alaska would potentially be affected by this alternative. When coral garden area impacts are included, this alternative would potentially affect an additional 33 vessels that used longline gear (but these impacts would likely be negligible, as discussed below) and between 5 and 10 primarily Seattle-based crab vessels that used pot gear.

Catcher Vessels

Based on 2001 data, ownership by Alaska residents of catcher vessels harvesting relevant groundfish species with revenue at risk would be concentrated in the Aleutians East Borough with 19 vessels (King Cove with 8 vessels and Sand Point with 11), and Kodiak with 7 vessels. All but two of the Aleutians East Borough resident-owned vessels with revenues that would be at risk are classified as small vessels (i.e., less than 60 feet LOA), while none of the Kodiak vessels was a small vessel. Anchorage and Girdwood accounted for the remaining two Alaska-owned vessels; one of these is a large vessel and one is a small vessel. Ownership in the Pacific Northwest would account for 44 vessels with at-risk revenues under this alternative (32 from Washington, all but 2 of them large vessels, and 12 vessels, all of them large, from Oregon). An additional four vessels (three large and one small) that would be affected by this alternative are owned in other states.

Catcher-vessel-associated community impacts in the GOA, under Alternative 5C, would be similar to those reported under Alternative 5A and 5B. As noted under those alternatives, significant impacts associated with local catcher fleets could accrue to the communities of King Cove and Sand Point. The largest difference in revenue at risk between Alternative 5C and Alternatives 5A and 5B in the GOA would be in the rockfish fishery. Under Alternative 5C, only about $20,000 in rockfish revenue (or about 1.0 percent of the total status quo value of $2.33 million) would be at risk. Under Alternatives 5A and 5B, about $440,000 in rockfish revenue would be at risk (18.8 percent of the status quo value). Among Alaska vessels, the differences in the rockfish revenues at risk would accrue primarily to the Kodiak fleet. Alternative 5C also would have about $60,000 less Pacific cod revenue at risk than was the case under Alternatives 5A and 5B, but this difference would represent only about 0.7 percent of the total status quo GOA Pacific cod revenues of the relevant vessels. No other fishery would have a greater than $10,000 revenue at risk difference between Alternative 5C and Alternatives 5A and 5B, except the pollock fishery (where there would be about $70,000 less GOA pollock revenue at risk under Alternative 5C than under Alternatives 5A and 5B). These differences would not be expected to result in different patterns of GOA community-level impacts between Alternatives 5A, 5B, and 5C. Similar to Alternatives 5A and 5B, no significant community impacts associated with EBS fisheries would be anticipated under Alternative 5C.

For catcher vessels operating in the AI outside of the coral garden areas, the only affected fishery would be Pacific cod. Exclusive of the coral garden areas, the revenue at risk under this alternative ($30,000) would be 2.3 percent of the status quo total ($1.32 million) for affected vessels for the area. Revenue at risk figures given for catcher vessels represent ex-vessel gross receipts, which would tend to understate the cumulative potential loss 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 primarily be concentrated in Pacific Northwest communities, and any impacts seen in Alaska would be concentrated in Kodiak. Excluding coral-garden-related impacts, no significant community level impacts associated with this catcher fleet would be anticipated, due to the modest amount of revenue at risk and the relative size and diversity of the economies of these communities (although some vessels would likely experience increased costs and/or decreased harvests).

The prohibition of bottom-contact fishing in the six coral garden areas in the AI would impose additional revenue at risk impacts on the non-pelagic trawl catcher vessel fleet of approximately $70,000, mainly in the Pacific cod target fishery. This would bring the combined total revenue at risk (from inside and outside the coral gardens areas) to this fleet to approximately $100,000, or about 7.5 percent of the total status quo AI Pacific cod revenue. Based on known fleet characteristics, these impacts would likely be concentrated in Pacific Northwest communities, with impacts associated with Alaska-owned catcher vessels likely concentrated in Kodiak. Given the relatively modest amount of revenue at risk when spread over the entire fleet, community-level impacts would be unlikely, but adverse impacts to individual operations would be possible. Coral garden impacts on the sablefish fleet would be negligible (estimated at less than $1,000). Coral garden area restrictions on longline gear targeting halibut would likely affect about 33 of the 156 vessel catcher vessel fleet and would place up to 4.4 percent of the annual catch from IPHC area 4B at risk (Tom Kong, IPHC staff, personal communication, March, 10, 2005) based on area percentage factors. Current industry practices, however, would suggest that actual impacts would be much lower, given that coral garden areas (and other areas of similar bottom relief) are routinely avoided due to problems caused by inability to retrieve gear efficiently. Coral garden impacts in the AI on crab catcher vessels utilizing pot gear and targeting king and Tanner crab would likely affect 5 to 10 of 17 vessels in the fleet and would place approximately 0.3 percent of the catch and revenue of the crab fishery in AI at risk. The relevant crab vessels would be primarily Seattle-based, and no community-level impacts would be anticipated, given the small amount of revenue at risk, although it is possible that a very few individual vessels could experience adverse impacts.

Catcher-Processors

Based on 2001 data, Alaska ownership of catcher-processors with revenue at risk would be exclusive to Kodiak (three vessels). Ownership in the Pacific Northwest would be 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 Alternative 5C would be the same for the GOA as those seen under Alternatives 5A and 5B, with the exception of the rockfish fishery. Under Alternatives 5A and 5B, about $2.38 million in GOA rockfish revenue would be at risk (about 33.8 percent of the status quo value), but under Alternative 5C the rockfish revenue at risk figure would drop to $50,000 (or about 7.0 percent of the status quo value). Catcher-processors would not experience any EBS fishery related impacts under Alternative 5C.

For the AI, catcher-processors affected by the Alternative 5C non-pelagic trawl closure outside of the coral garden areas would experience revenue at risk of $1.20 million, or approximately 2.2 percent of the $54.49 million status quo revenue. Catcher-processors would experience revenue at risk associated with a number of different groundfish species. While some of these species would account for a relatively high percentage of revenue at risk, the overall value at risk would be comparatively small. Only three targeted species would be associated with revenues at risk greater than $10,000. These would be Atka mackerel ($620,000 at risk, or 1.5 percent of status quo value), Pacific cod ($320,000 at risk, or 3.9 percent of status quo value), and rockfish ($260,000 at risk, or 5.1 percent of status quo value). The catcher-processors harvesting and processing these species are primarily head and gut vessels.

The coral garden closures to bottom contact gear in the AI would place an additional $164,000 of Pacific cod revenue at risk in the catcher-processor fleet. This would bring the total AI catcher-processor Pacific cod revenue at risk to $484,000 (or about 5.8 percent of the 8.29 million status quo value) under Alternative 5C.

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. Impacts experienced in Alaska would, however, would be 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 be significant, although some individual entities might experience adverse impacts due to increased costs and/or decreased harvests. While individual Washington-owned entities might experience adverse impacts under Alternative 5C, it is assumed that community level impacts would not be significant under this alternative due to the relatively modest percentages of revenues at risk compared to status quo revenues, as well as to the scale of the local economy in those communities.

Shoreside Processors

Following the pattern seen under Alternative 5B, shoreside processors involved in the at-risk harvest (using 2001 data) under Alternative 5C would be concentrated in Kodiak (nine entities). Akutan would have two entities, and a number of other communities would each have a single processor that processed 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 the non-pelagic trawl closure for Alternative 5C, impacts to shoreside processors would be similar to those seen under Alternative 5B. Under Alternative 5B (Option 1), the total first wholesale value at risk for catch delivered inshore for processing would represent approximately 8 percent of the total 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 of the status quo value for all areas combined (about $4.01 million out of $58.84 million), but no breakdown by port of landing is available. Under

Alternative 5C, EBS impacts would be eliminated, GOA impacts would be reduced by about 58.9 percent, and AI impacts would be reduced by about 90.3 percent, assuming that processing first wholesale value at risk would proportionally follow catcher vessel revenue at risk decreases between Alternative 5B and 5C. 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 5B, processor-associated impacts to dependent communities might be 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 would be confidential. Based on 2001 processor location data, it is assumed that most of the AI Pacific cod catch at-risk under this alternative would be processed in Unalaska/Dutch Harbor. In terms of the scale of potential impacts, the $310,000 at risk under Alternative 5B (using 2001 data) would be equivalent to 2 percent of the total Pacific cod value ($15 million) processed in the community in 2000, or about 0.2 percent of the total value ($144 million) for all species processed in the community in 2000, the most recent year for which complete community level data are available. Under Alternative 5C, it is assumed that these impacts would be much smaller, given that the AI catcher-vessel revenue at risk under Alternative 5C would be less than 10 percent of that seen under Alternative 5B. Given that some of this catch would likely be 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 be likely for Unalaska/Dutch Harbor, although some individual entities may experience a loss of processing volume and/or revenues. No significant community level impacts would be anticipated for any other dependent communities.

Shoreside-processing-related community impacts associated with the coral garden areas in the AI would probably be negligible, given (1) the small amount of Pacific cod ex-vessel revenue at risk (approximately $70,000), (2) the negligible sablefish revenue at risk, (3) the assumption that halibut revenue at risk would be easily recovered by fishermen, and (4) the less than 1 percent total catch at risk among the crab catcher vessel fleet. No delivery information is readily available for the specific vessels with revenue at risk, but it is assumed that a large proportion of their catch would be processed at Unalaska/Dutch Harbor. No community level impacts would be expected to result from Alternative 5C related impacts, given the relatively modest amount of revenue at risk and the size of the processing sector in that community.

<u>Multi-Sector Impacts</u>

Multiple sector impacts might be significant at the community level under Alternative 5C, similar to Alternative 5B, Option 1. Among Alaska communities, Kodiak, King Cove, and Sand Point participated in more that one sector with at-risk revenues. Kodiak was home to seven locally owned catcher vessels, three locally owned catcher- processors, and some nine locally operating shoreside processing entities with some revenue at risk. Neither King Cove nor Sand Point was home to locally owned catcher-processors, but both have multiple locally owned catcher vessels (8 and 11 vessels, respectively) and at least one dominant local processor with some revenue at risk under this alternative. Alaska fleet related community impacts would be similar to those seen under Alternative 5B, with revenue at risk for King Cove and Sand Point catcher vessels comprising a higher percentage of total overall ex-vessel revenues than would be the case in Kodiak. These vessels would represent 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 might experience social impacts from this alternative that would be significant at the community level. Other Aleutians East Borough communities that derive benefits from revenues generated through borough raw fish taxes on landings in King Cove and Sand Point might also experience impacts. These impacts to other borough communities would, however, probably not be significant as the overall quota would be unchanged, and no changes would be expected in landing patterns at the regional level. Individual Kodiak entities might experience adverse impacts under this alternative, but impacts at the community level probably would not 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. Kodiak might experience additional catcher-processor related impacts, 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, might have some compensation placed at risk under this alternative. Transient vessels owned outside of Alaska typically also make expenditures in ports of landing, which, in this case, would be concentrated in Kodiak. Given the assumption that overall delivery patterns for the community are unlikely to change, however, any vessel expenditure associated impacts would probably be minor.

4.3.8.3.4 Effects on Regulatory and Enforcement Programs

The management implications of Alternative 5C would be the same as for Alternative 5B, Option 2, in the AI and Alternative 2 in the GOA 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.

Alternative 5C would increase the complexity of management of the fisheries for NPT fisheries in the GOA. To manage the ten areas within which bottom trawling 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. NMFS' 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 would be 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 define catch location. The requirement to record haul retrieval locations might be supplemented to include deployment locations or tracking information, and VMS could be used to verify vessel activity data, as NMFS currently does 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 would constitute being in the area. If a trawl path touched the closed area, but 95 percent of the tow were 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 were to fish 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 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 in which area. Pelagic trawls could also be fished 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 have to be in effect as well.

VMS, which provides an independent observation of vessel location, is already required for vessels in the groundfish fishery that target three commercially important species (i.e., pollock, Pacific cod, and Atka mackerel). 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. A comprehensive explanation and evaluation of the proposed VMS program is contained in Appendix C, under Alternative 5C.

The introduction of closed areas might have the effect of crowding vessels using bottom-trawl gear, and such crowding might increase 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 were reached.

4.3.8.4 Effects of Alternative 5C on Other Fisheries and Fishery Resources

State-managed Groundfish Fisheries (Ø) – The ten GOA slope bottom trawl closure areas in Alternative 5C do not fall within state waters and, therefore, would not directly affect state managed fisheries such as those for Pacific cod, pollock, sablefish, and rockfish. Likewise, state-managed groundfish fisheries do not occur in the areas that would be closed in the AI under this alternative.

State-managed Crab and Invertebrate Fisheries (Ø/E+) – In the central and western GOA, species such as deep water Tanner crab and golden king crab inhabit depths included in the Alternative 5C 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 trawling. Alternative 5C would likely have no effect on state-managed invertebrate species harvested in nearshore waters. The AI closures in Alternative 5C would have no apparent impacts on state-managed fisheries.

Herring Fisheries (Ø) – Herring inhabit and are harvested in nearshore waters in the GOA (Kruse et al. 2000), but herring and herring fisheries would not be affected by Alternative 5C.

Halibut Fisheries (Ø) – Alternative 5C would have no effects or very limited effects on halibut fisheries. If effort in the GOA or AI groundfish trawl fisheries were displaced, halibut bycatch rates and spatial distribution could change slightly, but the effects would be negligible.

4.3.8.5 Effects of Alternative 5C on Protected Species

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

ESA-listed Marine Mammals (E-) – Alternative 5C may result in increased fishery interactions with Steller sea lions because of the moderate level of increased fishing in sea lion habitat. While the effects would not likely 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 population of Steller sea lions would heighten the concern over potential adverse effects on what is possibly a small and declining population unit. Alternative 5C 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 displaced fishing activity, if it occurred in a localized area where whales migrate or feed, could result in a vessel strike or gear entanglement. Thus, if concentrated fishing were to occur in areas frequented by whales or in Steller sea lion foraging habitat, Alternative 5C could result in adverse effects for both whales and sea lions. Such effects for sea lions and whales are not likely, however, because the redistribution of fishing effort under Alternative 5C would be small. Alternative 5C 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 5C would result in a small amount of displaced fishing effort in the GOA and AI 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, impacts on other marine mammals would be minimal. Fishing activities would not likely impact sea otters or harbor seals because the groundfish 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 when seals are in transit to seasonal habitats that are not located in the GOA. In the AI, given the smaller areas that would remain open to bottom trawling, the displaced fisheries would be concentrated in relatively smaller areas. However, the fisheries occur in offshore locations distant from sea otter and harbor seal habitat, and they have minimal overlap with summer foraging habitat for fur seals. Other cetaceans are not currently adversely affected by GOA or AI fisheries, and the modest redistribution of groundfish fishing in the AI would not cause adverse effects to those species. Overall, Alternative 5C would likely have no adverse effects on other marine mammals.

ESA-listed Pacific Salmon and Steelhead (Ø) – Alternative 5C would displace bottom trawl fisheries from closed areas and increase fishing effort slightly in the remaining open areas. Although the effort would likely be similar to the status quo, any concentration of fishing effort could increase bycatch of salmon in the region. ESA-listed species of salmon and steelhead would be comingled with non-ESA-listed stocks and 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 5C, the groundfish fisheries in the AI likely would continue to be prosecuted in a manner that would minimize salmon bycatch, which would continue to minimize the chance of incidental take of an ESA-listed species. Furthermore, CWT data indicate that ESA-listed salmonids are taken primarily in GOA midwater trawl fisheries, with very few taken in the AI. Displaced bottom trawl fishing under Alternative 5C would not measurably affect the prey field for ESA-listed salmonids.

ESA-listed Seabirds (Ø) – In the AI, displaced fishing activity under Alternative 5C would likely concentrate in some remaining open areas, but would not 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; because no documented take of this species has been reported for these fisheries, however, fishing activities under Alternative 5C 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, Alternative 5C would not have adverse effects on ESA-listed seabirds.

Other Seabirds (Ø) – Alternative 5C may increase groundfish trawl fishing levels in some areas of the GOA and AI, with some potential concentration of fishing activities in the AI area. It 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 due to their feeding behavior. An increase in mortality under Alternative 5C 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. 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 5C 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. Overall, however, the effects of Alternative 5C on seabird populations are expected to be negligible.

4.3.8.6 Effects of Alternative 5C on Ecosystems

Predator-Prey Relationships (Ø) – No effect on predator prey relationships is expected for Alternative 5C. No substantial changes would be anticipated in biomass or numbers in prey populations, nor would there be an increase in 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. The trophic level of the catch would not be much different from the status quo, and little change would be 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 regard to the total level of catch biomass removals from groundfish fisheries. No substantial changes in groundfish catch or discarding would be expected.

Diversity (E+) – Bottom trawling would be prohibited in 2,086 nm^2 of the GOA slope and in 279,114 nm^2 of the AI shelf and slope, and all bottom contact fishing would be prohibited in six coral garden sites in the AI. Although much of this effort would be redistributed to adjacent open areas, the closed areas would provide protection for relatively undisturbed habitats. Thus, species level diversity would be provided higher protection relative to the status quo. Fishery closures would help to maintain or enhance productive fish habitat and sustain fish populations that rely on these areas. Structural habitat diversity supported by living substrates would be provided substantial protection. Genetic diversity could increase slightly 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 on this aspect of diversity remain unknown. Overall, Alternative 5C would have positive effects on diversity.

4.3.9 Effects of Alternative 6

4.3.9.1 Effects of Alternative 6 on Habitat

Effects on Prey Species (Ø) – None of the LEIs for prey species by habitat type would differ from the status quo for this alternative. LEIs for both status quo and Alternative 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 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 6 would break Alaska waters into ten regions and would establish closures to all bottom-contact fishing that would comprise approximately 20 percent of each region. When added to existing bottom trawl closures these would close 33 percent of the shallow AI, 26 percent of the deep AI, and 32 percent of the GOA slope habitat. These are substantial areas closed to future fishing that would yield improvements in protection of coral.

Effects on Habitat Complexity (E+) – Alternative 6 would break Alaska waters into ten regions and would establish closures to all bottom-contact fishing that would 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 would be moderate, lowering the original values by 7 to 16 percent. The combination of these reductions would account for a substantial positive effect.

4.3.9.2 Effects of Alternative 6 on Target Species

4.3.9.2.1 Effects on Groundfish

4.3.9.2.1.1 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 Alaska 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 Final PSEIS (NMFS 2004), 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 would be 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 would be minor.

Spatial/Temporal Concentration of the Catch (EBS Ø, WCGOA Ø, SeGOA U, AI U) – As was determined in the Final PSEIS (NMFS 2004), 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 would be 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 would be 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, the Chiniak and Barnabas troughs in the GOA would 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 Final PSEIS (NMFS 2004), 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 would be 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 Final PSEIS (NMFS 2004), 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to all bottom-tending gear. In the EBS and the GOA, the closed areas proposed under Alternative 6 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 of juvenile walleye pollock is unknown. The impact of the no-trawl zones on the feeding success of juvenile pollock is unknown.

4.3.9.2.1.2 Pacific Cod (BSAI and GOA)

Stock Biomass (Ø) – As was determined in the Final PSEIS (NMFS 2004), 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 would be 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 closed in the BSAI under Alternative 6 would be 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 Final PSEIS (NMFS 2004), 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 would be 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 Final PSEIS (NMFS 2004), 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 would be the inclusion of additional areas closed to all bottom-tending gear. However, the additional portions of Pacific cod EFH closed under Alternative 6 would 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 Final PSEIS (NMFS 2004), 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 would be 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 Final PSEIS (NMFS 2004), 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 would be 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.

4.3.9.2.1.3 Sablefish (BSAI and GOA)

Stock Biomass (Ø) – Alternative 6 would close 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 the current level occur 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 probably would not 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 recovered 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 would probably 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 recovered 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 would probably 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 would remain 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 would probably 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 would probably decrease somewhat compared to the status quo.

4.3.9.2.1.4 Atka Mackerel (BSAI and GOA)

Stock Biomass (Ø) – Alternative 6 would likely have little impact on the stock biomass of Atka mackerel relative to the status quo. The closed areas, although they would cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances would not correspond to the major fishing grounds for Atka mackerel. The possible exception would be the east end of Amchitka Island; however, it is likely that the fishing effort that previously existed in this area would merely shift 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 probably would not have any impact relative to the 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 the status quo. The closed areas, although they would cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances would not correspond to the major fishing grounds for Atka mackerel. The possible exception would be the east end of Amchitka Island. It is likely the fishing effort that previously existed in this area would shift to other areas, most likely the west end of Amchitka Island, where the spatial concentration of the catch would increase. At this time, however, 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 the 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 probably 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 the status quo. The closed areas, although they would cover 20 percent of the bottom habitat in the AI in waters shallower than 1,000 m, in most instances would not correspond to the major fishing grounds for Atka mackerel. The possible exception would be the east end of Amchitka Island; however, the fishing effort that previously existed in this area would probably shift to other areas (e.g., the west end of Amchitka Island) where catches already occur under the status quo. If the east end of Amchitka Island is a spawning ground for Atka mackerel, the closure might provide protection to this habitat and possibly enhance the spawning and breeding in the closed area. There probably is, however, little overlap between the directed fishery and the shallow spawning grounds. Also, any potential enhancement of spawning and breeding in a local area probably would not have population level effects. There is no directed fishery in the GOA, thus the closures in the GOA would probably not have any impact relative to the 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 that they are not retained by any fishing gear. Euphausiids are also the major food for Pacific ocean perch and northern rockfish. In theory, therefore, any reduction in the catch of these species as a result of this alternative might free up some food for Atka mackerel. Alternative 6 probably would not reduce the catch of these two species to any great extent, however, because the closed areas generally would not correspond to major fishing grounds for these fish. Therefore, if this alternative were enacted, food availability for Atka mackerel would likely be unchanged relative to the status quo, and the rating for feeding is no effect.

Growth to Maturity (Ø) – Of all the alternatives, Alternative 6 would have the greatest potential to benefit Atka mackerel in terms of growth to maturity. This alternative would prohibit the use of all bottom tending gear inside a number of closed areas that would encompass 20 percent of the benthic habitat in the GOA and AI less than 1,000 m deep. 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. Although the closed areas would protect 20 percent of the GOA and Aleutian habitat, however, the extent to which this would directly protect habitat important to Atka mackerel is unknown. Also, the closed areas in most instances would not correspond to the major fishing grounds for Atka mackerel. The possible exception would be the east end of Amchitka Island; however, the fishing effort that previously existed in this area would probably shift to other areas (e.g., the west end of Amchitka Island) where catches already occur under the status quo. There is no directed fishery in the GOA; thus, the closures in the GOA probably would not have any impact relative to the status quo for GOA Atka mackerel. Relative to the status quo, any potential benefits probably would not be substantial. Therefore, the rating for growth to maturity is no effect.

4.3.9.2.1.5 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. The effect this redistribution of harvest would have on EBS yellowfin sole is unknown, since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there would probably be no 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 probably would not affect the availability of prey for yellowfin 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 would probably not 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.6 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. The effect this redistribution of harvest would have on EBS Greenland turbot is unknown, 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 probably would not affect the availability of prey for Greenland turbot, since the modeled benthic disturbance for infauna and epifauna prey would not be 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.7 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. The effect this redistribution of harvest would have on GOA arrowtooth flounder is unknown, since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, there would probably not 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 probably would 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 occurs primarily during the 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.8 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 probably would have little effect on EBS rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore, no negative effect is anticipated 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 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 would probably not have a substantial effect on adult feeding. The effect that additional requirement of disks/bobbins on the sweep lines and footrope would have on the availability of benthic prey is unknown.

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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.9 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. What effect this redistribution of harvest would have on GOA and EBS flathead sole is unknown, since these closures would not cause a major reorganization in the spatial/temporal concentration of the catch. Therefore, a negative effect on the future genetic diversity of the stock is not anticipated. 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 probably would not expected to 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, 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.10 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 probably would have little effect on GOA rex sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore, a negative effect on the future genetic diversity of the stock would not be anticipated. 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 probably has not 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 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 has not 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.11 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, a negative effect on the future genetic diversity of the stock would not be anticipated. 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 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 would probably not 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.12 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 probably would have little effect on GOA rock sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore, a negative effect on the future genetic diversity of the stock would not be anticipated. 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 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 would probably not 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 would be no effect from fishing on survival and growth to maturity.

4.3.9.2.1.13 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 would probably have little effect on GOA Dover sole, since there would be only minor changes in the spatial/temporal concentration of the catch. Therefore, a negative effect on the future genetic diversity of the stock would not be anticipated. 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 probably has not had a substantial effect on spawning and breeding.

Feeding (Ø) – Relative to the status quo, Alternative 6 probably would not 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, fishing probably has not 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 would be no effect on survival and growth to maturity.

4.3.9.2.1.14 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 would have 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 on the slope to the southeast of the closure areas, which, thus, would have little effect on the fishery. Similarly, the closure areas in the AI would be located in areas where few Pacific ocean perch are caught and, thus, would have little effect on the spatial/temporal concentration of the catch. The expected pattern of fishing for Pacific ocean perch would be similar to that in Alternative 1; thus, there would be no substantial effects on genetic diversity.

Spawning/Breeding (Ø) – Model projections conducted for the Final PSEIS (2004), 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 would probably be similar to

Alternative 1, and Alternative 6 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 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 Final PSEIS (2004), 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 would probably be similar to that under Alternative 1; thus, fishing would probably have no substantial effect on the survival of fish to maturity.

4.3.9.2.1.15 Pacific Ocean Perch (GOA)

Stock Biomass (Ø) – Alternative 6 would create large-scale closure areas that together would 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 on how the fishery responded 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 would probably 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 on how the fishery responded 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 would probably 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 probably would not increase total fishing mortality. Consequently, this alternative would likely result in GOA Pacific ocean perch sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 6 on Pacific ocean perch spawning would be 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 and 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 would 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 would be geographically large, and they might 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 might 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 coincided with juvenile habitat, then damage to this epifauna by bottom trawls would be reduced in closed areas

4.3.9.2.1.16 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 stock's 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 probably would not have substantial effects on genetic diversity.

Spawning/Breeding (U) – The prohibition of fishing 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 rougheye are caught within the proposed closed areas. Under Alternative 6, therefore, 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 would be so small (0 to 3 percent) that fishing would probably 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) are also unknown.

4.3.9.2.1.17 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 that the 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 would cover 20 percent of the bottom habitat in the GOA over a wide range of depths, in most instances would not correspond to large areas of shortraker/rougheye habitat. It is likely that 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 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 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 would close more than 20 percent of the bottom habitat in the GOA, but this would be over a wide range of depths and, in most instances, would 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 would protect 20 percent of the GOA habitat. However, they would 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 that 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 would not represent 20 percent of shortraker/rougheye habitat, it is unknown what effects Alternative 6 would have on these species.

4.3.9.2.1.18 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 stock's 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, thus, would 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 probably would not 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, might 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) are also unknown.

4.3.9.2.1.19 Northern Rockfish (GOA)

Stock Biomass (Ø) – Alternative 6 would create 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 would coincide with known northern rockfish concentrations. In particular, one closed area would include the "Snakehead," which accounted for 46 percent of northern rockfish catch from 1990 to 1998 (Clausen and Heifetz 2003). Bottom trawl fishing effort for northern rockfish would likely move to open areas, and the stock biomass would likely 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. The closed areas could, however, have an impact on the catch of northern rockfish compared to the status quo, but it would depend upon how the fishery responded to the bottom trawl closure. The alternative would remove the Snakehead from bottom trawling. As noted above, this area accounted for 46 percent of northern rockfish catch from 1990 to 1998 (Clausen and Heifetz 2003). Whether northern rockfish can be captured with other gear, such as pelagic trawls, is unknown. The northern rockfish quota would probably 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 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 would probably not increase total fishing mortality. Consequently, Alternative 6 would likely result in GOA northern rockfish sustaining themselves above MSST. Based on this criterion, the fishing effects of Alternative 6 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.

Closing the areas in the GOA to all groundfish bottom trawling under Alternative 6 would 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 might 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 might 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.

4.3.9.2.1.20 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) – 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 would cover 20 percent of the bottom habitat in the GOA over a wide range of depths, in most instances would 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, would mostly be 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 shift 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 would be 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 that they are not retained by any fishing gear, Alternative 6 probably would have 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. It is doubtful, however, that Alternative 6 would reduce the catch of these two species to any great extent because the closed areas generally would 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 would have the greatest potential to benefit light dusky rockfish in terms of growth to maturity. This alternative would prohibit the use of all bottom-tending gear inside a number of closed areas that would encompass 20 percent of the benthic habitat in the GOA less than 1,000 m deep. 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. Although the closed areas protect 20 percent of the GOA habitat, however, they would 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, would not be included in the closed areas. Because the closed areas would not generally correspond with the preferred habitat locations for light dusky rockfish, this alternative would provide only a modest benefit for growth to maturity of these fish. Compared with the status quo, the benefits would not be substantial.

4.3.9.2.1.21 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 would cover 20 percent of the bottom habitat in the BSAI over a wide range of depths, in most instances would not correspond to areas where light dusky rockfish have been observed in high abundance. Therefore, this alternative would have little to no change from the 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 that they are not retained by any fishing gear, Alternative 6 would probably have 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 would 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 would have the greatest potential to benefit light dusky rockfish in terms of growth to maturity. This alternative would prohibit the use of all bottom-tending gear inside a number of closed areas that would encompass 20 percent of the benthic habitat in the BSAI less than 1,000 m deep. 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. Although the closed areas would protect 20 percent of the BSAI habitat, however, they would not protect 20 percent of the habitat that is important to light dusky rockfish. Regardless, the closure areas would 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 would probably not be significant.

4.3.9.2.1.22 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 would cover 20 percent of the bottom habitat in the BSAI, would only cover a small portion (300 to 1,000 m) of shortspine thornyhead habitat. The area would be less than the area that would be 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 based on NMFS 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 would probably be 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 would extend over the slope, only a small fraction of the area would be 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.

4.3.9.2.1.23 Forage Species (BSAI and GOA)

Stock Biomass (Ø) – The impact of Alternative 6 on forage species would probably be small. The areas closed by this alternative would 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 would not be 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 would probably be important to the spawning and breeding of forage species. Alternative 6 would have a minimal effect on the essential spawning, nursery, or settlement habitat of forage species.

Feeding (Ø) – The areas closed by Alternative 6 would probably not be important to the feeding ecology of forage species. Alternative 6 would have a minimal effect on the feeding of forage species.

Growth to Maturity (Ø) – The areas closed by Alternative 6 would probably not be important to the feeding ecology of forage species. Alternative 6 would have a minimal effect on the growth to maturity of forage species.

4.3.9.2.2 Effects on FMP Salmon, Crabs, and Scallops

4.3.9.2.2.1 Salmon

Stock Biomass (Ø) – The salmon fishery would not be impacted by measures proposed under Alternative 6. The bycatch of salmon might change, as the closures would alter the distribution of the pollock fishery, which takes a majority of the salmon bycatch. However, the pollock fleet would probably 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 anticipated.

Spatial/Temporal Concentration (Ø) – No changes in the distribution and intensity of salmon fishing effort would be 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; thus, no effects would be expected under Alternative 6.

Feeding (Ø) – No substantial changes in the catch of these prey species would be expected under Alternative 6, so this alternative would have no effects on feeding of salmon species.

Growth to Maturity (Ø) – The bycatch of salmon might 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 probably redistribute to adjacent open areas, which likely have similar salmon bycatch rates. Habitat for juvenile salmon would not be affected. Overall, this alternative would have no effect on salmon growth or survival.

4.3.9.2.2.2 Crabs

Stock Biomass (E+) – The catch of crabs in the directed fisheries might be substantially reduced under Alternative 6, if the catch could be made up in the remaining open areas. Some of the closure areas would 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 would 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. Under this alternative slight, reductions would also occur in the bycatch amounts taken in groundfish trawl fisheries (due to the minimum bobbin/roller gear requirements of this alternative). Overall, stock biomass would 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 would have negative effects on spatial/temporal concentration.

Spawning/Breeding (Ø) – The closure areas designated by Alternative 6 would 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 would 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 would have no effects on feeding of crab species.

Growth to Maturity (E+) – The closure areas of Alternative 6 would 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 might 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 would probably 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 6.

4.3.9.2.2.3 Scallops

Stock Biomass (Ø) – Alternative 6 may have slightly positive effects on scallop stock biomass in the Yakutat and Kayak Island areas, as catches would likely be reduced if they could 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 would have no effect on stock biomass.

Spatial/Temporal Concentration (E-) – The distribution and intensity of scallop fishing effort would probably 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 would have a negative effect on spatial/temporal concentration of catch.

Spawning/Breeding (Ø) – The closure areas designated under this alternative would have substantial overlap with scallop populations in the Yakutat and Kayak Island areas. Therefore, Alternative 6 would probably have positive effects on spawning and breeding of weathervane scallops in those areas. On the whole, however, this alternative would have no substantial effect on spawning and breeding of the entire scallop stock.

Feeding (Ø) – The closure areas designated under this alternative would overlap with the Yakutat and Kayak Island scallop populations, and some increases in fishing effort in adjacent areas would be expected. However, fishing effort would probably not increase in other areas with scallops. Thus, this alternative would have no effects on feeding of scallops.

Growth to Maturity (Ø) – No change in overall scallop dredge effort would be 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 would have no effect on growth to maturity.

4.3.9.3 Effects of Alternative 6 on Economic and Socioeconomic Aspects of Federally Managed Fisheries

This section summarizes the effects of Alternative 6 on federally managed fisheries. For additional detail and supporting analysis, refer to Section 3.8 of Appendix C.

4.3.9.3.1 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 Alternative 1 (status quo). Alternative 6 would reduce the impact of bottom-contact fishing over 61,991 km^2 of GOA (17.4 percent of the current 356,199 km^2 of habitat), 136,031 km^2 of EBS habitat (17.0 percent of the current 798,870 km^2 of habitat), and 20,729 km^2 of AI habitat (19.7 percent of the current 105,243 km^2 of habitat), for a total of 218,750 km^2, or 17.4 percent of the total fishable area of 1,260,312 km^2 in the GOA, EBS, and AI.

Alternative 6 would 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.

4.3.9.3.2 Effects on the Fishing Fleet

Gross Revenue Effects (E-)
If Alternative 6 were in place in the 2001 fishing year, it would place $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 be 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 place $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 place $38.34 million at risk, or 34.2 percent of the status quo revenue of $112.16 million. Crab fisheries would place $34.11 million at risk, or 29.4 percent of the total status quo revenue of $116.0 million. Alternative 6 would place $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 directly affect salmon fisheries.

Alternative 6 would impose EFH fishing impact minimization measures in all FMP areas. The largest revenue at risk would occur in the EBS, with $934.36 million, or 19.0 percent of the status quo revenue at risk. The GOA would place revenue of $46.52 million at risk, or 22.0 percent of the status quo revenue of $211.48 million. The AI would place $13.14 million at risk, or 11.8 percent of the total revenue of $111.30 million.

Alternative 6 would place $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 the most revenue at risk in the halibut fishery at $38.28 million, or 34.2 percent of the total status quo revenue. Other impacts to the catcher-vessel fleet would include the revenue placed at risk in the crab industry ($31.26 million, or 29.5 percent of the status quo revenue) and the groundfish fisheries ($16.76 million, or 9.3 percent of the status quo revenue). The largest impacts in the catcher-vessel fleet would occur 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 place $150.89 million at risk, or 17.6 percent of the $858.47 million status quo revenue. Catcher-processors harvesting groundfish would have $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 $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 might 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 that would be 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 be placed at risk under Alternative 6 would more than likely be lost. Similar revenue at risk losses may occur 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 place $28.45 million in revenue at risk, or 35.3 percent of the $80.70 million of the status quo revenue in the EBS crab pot fisheries. The Pacific cod hook and line and NPT fisheries would have $23.83 million of revenue at risk, or 17.2 percent of the $138.80 million in status quo revenue. Alternative 6 would place $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 $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 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 $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 $2.29 million of revenue at risk, or 21.5 percent of the status quo revenue of $10.67 million. There would be $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 place $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 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 $9.73 million at risk, or 29.2 percent of the $33.20 million total status quo revenue. The EG would have $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 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 $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 $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 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 be 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 supply a relatively high-value market (e.g., deepskin fillets) might 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.

<u>Operating Costs (E-)</u>
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 would likely 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 aggravate gear conflicts that also cause expensive gear loss or damage. Fishermen might 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 might also be additional costs resulting from learning to fish new gear in new areas.

<u>Costs to United States Consumers (E-)</u>
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 probably 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.

<u>Safety (E-)</u>
Adoption of Alternative 6 would likely 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 might 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 to remain economically viable in the fishery. All of these responses to the Alternative 6 closures would place greater strain on vessels and crew, reducing safety margins for the industry.

Impacts on Related Fisheries (E-)
Alternative 6 might 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 could 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 could cause considerable damage and could 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 might be required to ensure 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.

4.3.9.3.3 Effects on Communities and Shoreside Industries (E-)

Overview
Alternative 6 would be 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 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 experience adverse impacts. Alternative 6 would result 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 be 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 being realized in dependent communities. In addition to these more-or-less straightforward impacts, Alternative 6 would also have a number of differences from the other alternatives under consideration. For this reason, Alternative 6 would result in a different order of magnitude of impacts in some communities, based upon different types of interactive impacts. An extensive treatment of community

[2] At its April 2003 meeting, the 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).

level effects is available in 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 would feature large closure areas, near (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 be 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 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 be closed to bottom gear, meaning future development of a small boat fishery would be effectively precluded as long as the closure remained 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 occur under all of the alternatives, but would probably 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 would serve to 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 would 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, 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, these 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). For a number of communities, the impacts of Alternative 6 would, thus, 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 would also have the potential to generate 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 be 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 would depend on the nature of engagement in the fisheries (and the relative level of dependence on the relevant fisheries), and this would vary 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 would 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 follows the individual sector discussions.

Catcher Vessel Community Impacts Summary

For catcher vessels, there would be 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 would account 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 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 be 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 be the case under Alternative 6, fishery diversification may actually intensify such negative effects.

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 they are from the Pacific Northwest (Seattle or Newport, for example) or from larger Alaska ports (such as Kodiak and Homer). Unlike the groundfish fisheries, there are small local fleets in the EBS that fish 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 they are often major contributors to local government revenue, a number of plants import their labor force and buy most goods and services outside of Alaska.

Under Alternative 6, catcher vessels would be 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 be significant for individual operations and industry sectors, they would not likely be significant on the community level. For Kodiak, however, the catcher fleet would face 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

[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. This 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 to occur under this alternative, rather than for a precise quantification of the exact dollars involved.

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 be affected. Because of the number of such operations in Kodiak, it is likely that there would be 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 would remain open.

Other communities also host vessels that participate in multiple fisheries, so that these communities might also experience effects from multiple fisheries. Most are Alaska communities – Homer, Sitka, and Petersburg. Newport, Oregon, might 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 most likely translate into community-level effects for GOA communities. Kodiak and Homer would be the primary communities where these effects would be likely to occur, but a number of other communities would also be affected. In terms of specific effects, much would depend on the ability of fishermen to catch fish in areas other than where they would 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 that would be 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 some effort to areas that would be closed under Alternative 6. To the extent that such a redistribution would occur, 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 be 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, which participate in these fisheries as a distant-water fleet, would suffer no such disadvantage (assuming that there are other fish to be found), since this extra distance would be a small percentage of their total trip in any event. The local fleets of Sand Point and King Cove have also experienced 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 be 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 would account 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 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 be 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 be 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 be at risk ($980,000 out of $3.37 million).

Overall, community impacts associated with catcher-processors under Alternative 6 would be concentrated in Seattle, with a few exceptions. These exceptions would include the few communities in Alaska with individual catcher-processor ownership and CDQ entities with group ownership interests in catcher-processors.

Although there would probably be adverse impacts to a number of the fishery participants in the catcher-processor sector, impacts to Seattle as a community would potentially be 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 might experience adverse impacts under this alternative, no community-level impacts associated with motherships would be likely to occur.

Catcher-processor-related impacts to Alaska communities under Alternative 6 would accrue to few communities (primarily Kodiak, Petersburg, and Unalaska), but as detailed earlier, community-level impacts associated specifically with catcher-processors would potentially be relatively insignificant. Impacts directly associated with catcher-processors, due to the mobile nature of their operations and their limited numbers, would be much less apparent in engaged communities than would be 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 would represent 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 would be 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 on shoreside processors due to Alternative 6 is less straightforward than for other sectors. Initially, how communities would be affected by shore plants depends on how those shore plants would be 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 potentially be 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 have translated 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, depending upon contractual relationships, demand elasticities, and availability of alternative markets for their catch, they might pass along these costs, in whole or in part, to the processor. Given the relatively large amount of fish and crab involved, some degree of effect, at least in terms of fish tax revenues, would likely occur, 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 would probably be similar in potential effects to those in Unalaska.

The Pribilofs, and especially St. Paul, might 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 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 with revenues at-risk 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 be 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 be affected through the GOA halibut, sablefish, rockfish, pollock, and Pacific cod fisheries. In addition, Kodiak processors (and others in the GOA) 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 that Kodiak processors have depended on in the past would be 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 be at least partly mitigated.

Processors in Sitka, Petersburg, and perhaps other locations could also be affected in similar ways to those in Kodiak, although fewer vessels deliver to them than to Kodiak. Their fleets tend to be more local and, thus, might be less able to find productive alternative fishing areas close to those that would be closed by Alternative 6. These processors would be 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 not available. The loss of such enterprises could be significant for small communities, and small vessels and these processing enterprises/outlets might be quite interdependent in such locations.

Multi-sector Impacts

Individual communities would experience 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 would have little, if any, direct engagement in commercial fisheries might benefit substantially from fishery-related revenues generated in other communities within the borough, or activities outside of city boundaries but still within borough jurisdiction. Other benefits would 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 might derive revenue or income directly or indirectly from fisheries-related activities.

Dependence on the fisheries would also differ from community to community. For example, some fisheries that would be 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 were fish to be found to replace those harvested in the past in areas that would be closed by Alternative 6, rationalized fisheries would give the best chance for each individual vessel to do so, because rationalization would impart 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 affect a number of different fisheries. While often managed more or less independently, these different fisheries are highly interdependent for many fishing enterprises. Thus, impacts to fisheries-dependent communities under Alternative 6 would be interactive and would vary 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 contain 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 be affected by Alternative 6 would 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 experience 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, locally owned catcher-processors, and 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 occur at the community level.

Within the Aleutians East Borough, Sand Point would experience 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 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 experience 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 experience a range of local fleet and processor impacts. While only St. Paul currently has local processing, local St. George catch is now tendered to St. Paul, meaning adverse impacts to St. Paul processors would likely be felt in both communities. St. Paul itself would be 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 be affected by Alternative 6 primarily through its local fleet. Processing would be affected relatively little compared to some other communities. The Kenai Peninsula Borough community of Seward would also feel 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 might involve higher values than those seen for the Aleutians East Borough communities, Homer and Seward would probably be 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 be 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 experience 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 the level of risk associated with Alternative 6 probably would not be significant at the community level, although a degree of uncertainty for processor impacts would remain.

Seattle would experience 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 might experience adverse impacts under this alternative, community-level impacts would not be forecasted for the city.

<u>Small Boat Fleet Impacts from Near-community Closures</u>

As noted earlier, Alternative 6 would feature 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 future effects that may or may not occur, closure areas near communities would create 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 be 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 that would have 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 be affected (meaning that a greater or lesser number of communities could be 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 be closed under Alternative 6 was calculated, as well as the area that would remain open, along with the area that would be closed as a percentage of existing conditions maximum available area. Communities ranged from having much less than 1 percent to more than 98 percent of nearby waters that would be closed under this alternative. Of the communities identified as having at-risk catcher vessel revenues under Alternative 6, St. George would have 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 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 between 33.3 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 would vary 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 have left 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 be 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.

For small-vessel fisheries affected by closure of adjacent waters under Alternative 6, the halibut fishery is clearly the most important. Only a subset of the communities identified as potentially affected would actively participate in this 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 lacked 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 were 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 was 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 long, 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 provided 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 would represent 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 was 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 were included. While these data were from statistical areas near the communities, however, the reported catch for these areas might be (and in some cases surely was) associated with vessels from more distant communities.

The available data suggest that the small-vessel halibut fleet from several potentially affected communities would probably experience only slight effects from Alternative 6. For example, Old Harbor, Pilot Point, and Port Lions would all have 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 be closed, in part, under Alternative 6. While approximately 40 percent of one of these statistical areas and nearly 20 percent of the other would be closed, only the statistical area with the 20 percent closure had reported harvest (about 14,000 pounds). Thus, small-vessel effects in False Pass would appear slight and might be 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 would appear slight and might be recovered in nearby open areas.

Two statistical areas around Mekoryuk would be affected by EFH closures under Alternative 6. One of these would have just under 22 percent of its area closed, and the other would have nearly 60 percent of the area closed within 20 nm of the community. The total harvest in those statistical areas combined would be, however, just over 6,000 pounds. Affected statistical areas around Tooksook Bay and Tunanak also would account for just over 6,000 pounds of total harvest. Thus, based on 2001 data, small-vessel effects in the Mekoryuk, Toksook, and Tunanak area would appear slight and might be recovered in adjacent open areas.

Closure areas around Yakutat would be 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 probably would be 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 be affected by EFH Alternative 6 closures, with a range of 5 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 most of the total landings in the port. EFH Alternative 6 closures might, therefore, have a considerable impact on small-vessel halibut fleet components in the Chignik area, but much of the affected catch would be 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. That would have its own impacts on the community unrelated to the local small vessel fleet.

Port Alexander would have 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, considerable impacts could accrue to the Port Alexander small-vessel halibut fleet.

Similarly, St. Paul and St. George would have 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 be closed. Given that the St. George harvests are spread among these statistical areas, considerable impacts on the St. George small-vessel halibut fleet would be likely under EFH Alternative 6. Similarly, the vast majority of harvest around St. Paul is caught in a statistical area that would have an 85 percent closure.

It is assumed that small-vessel subsistence activity would not be 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 that EFH Alternative 6 closures might have 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 from zero to 24 permits held locally.

4.3.9.3.4 Effects on Regulatory and Enforcement Programs

Closing fishable waters shallower than 1,000 m would create 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 would absolutely restrict vessels from carrying bottom-tending gear in these areas then enforcement would be greatly simplified. For example if bottom-tending gear such as bottom trawls were allowed on board with pelagic gear, as described in the previous sections, then enforcement would become much more complicated. Vessels could be identified as having violated the particular ban with fish caught in the restricted area if they could claim that 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 would 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 require additional attention from management. This could include crowding, increased take of prohibited species or groundfish species at risk of overfishing, and other issues that might arise if effort were 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.

4.3.9.4 Effects of Alternative 6 on Other Fisheries and Fishery Resources

<u>State-managed Groundfish Fisheries (E-)</u>
Alternative 6 would close several strips of seafloor from the shore out to the shelf break to any bottom-contact fishing gear. Because these closures would occur in state waters, the Board of Fisheries could take action to mirror the federal closures in state-managed fisheries, should it choose 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 trawling, 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 would outweigh any potential benefits to the stocks.

State-managed Crab and Invertebrate Fisheries (E-)

Alternative 6 would close an area around the Pribilof Islands in the EBS to all bottom-contact gear. This area would encompass 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 (Bowers, personal communication).

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 it would likely not change under this alternative.

Similarly, under Alternative 6 there would be 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 of Alaska 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 trawling, 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 would outweigh any potential benefits to the stocks.

Herring Fisheries (Ø)

Effects on herring fisheries for Alternative 6 would be 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 trawling, and the other gear groups restricted under this alternative have neither historically resulted in herring bycatch, nor 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 would 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.

4.3.9.5 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 might result in increased fishery interactions with Steller sea lions and the ESA-listed species of whales. Concentrated fishing for Atka mackerel could occur in the western GOA, because of the 100 percent fishery displacement out of the EFH closed areas in the western GOA. There could be similar large displacements in the AI for Atka mackerel and pollock. Such displacements might threaten Steller sea lions through increased chances for injury or mortality from vessel or gear contact where fishing activities were concentrated geographically, or as a result of concentrated removal of prey items important for sea lion nutrition. This alternative might also shift fishing activities in such a manner that concentrated fishing in the AI area could increase the potential for vessel strikes or gear entanglement for some ESA-listed great whale species. Thus, Alternative 6 would 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 would 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. If these fisheries occurred near coastal areas, they might 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 the fisheries would 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 modify 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 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; thus, they 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; 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 that would minimize salmon bycatch. This, 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.

<u>ESA-listed Seabirds (Ø)</u> – 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 might 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.

<u>Other Seabirds (Ø)</u> – Alternative 6 might 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 due to 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 might be more acute for Laysan albatross in the AI where this species may be more abundant.

Alternative 6 would likely have minimal effects 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 might 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.

4.3.9.6 Effects of Alternative 6 on Ecosystems

<u>Predator-Prey Relationships (Ø)</u> – Alternative 6 would probably have no effect on predator prey relationships. No substantial changes would be anticipated in biomass or numbers in prey populations, nor would it 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 due to Alternative 6, although catches of some fish and invertebrate species might be somewhat reduced from the status quo. Similarly, the trophic level of the catch would not be much different from the status quo, and little change in the functional species composition of the groundfish community or in the removal of top predators would be expected.

<u>Energy Flow and Balance (Ø)</u> – Under Alternative 6, the amount and flow of energy flow in the ecosystem would be the same as the status quo with regard 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 gear 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 might increase. Additionally, closure of the areas to bottom-contact gear might preserve representative habitats and ecosystems and enhance productive fish habitat, thereby helping to sustain fish populations that rely on these areas. Thus, structural habitat diversity might 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 would probably have positive effects on diversity.