Chapter 4 Environmental Consequences

This section forms the scientific and analytic basis for the issue comparisons across alternatives. As a starting point, each alternative under consideration is perceived as having the potential to significantly affect one or more components of the human environment. Significance is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring). Further tests of intensity include: (1) the potential for jeopardizing the sustainability of any target or non-target species; (2) substantial damage to ocean and coastal habitats and or essential fish habitat; (3) impacts on public health or safety; (4) impacts on endangered or threatened species, marine mammals, or critical habitat of these species; (5) cumulative adverse effects; (6) impacts on biodiversity and ecosystem function; (7) significant social or economic impacts; and (8) degree of controversy (NAO 216-6, Section 6.02).

Differences between direct and indirect effects are primarily linked to the time and place of impact. Direct effects are caused by the action and occur at the same time and place. Indirect effects occur later in time and/or further removed in distance from the direct effects (40 CFR 1508.27). For example, the direct effects of an alternative which lowers the harvest level of a targeted fishery could include a beneficial impact to the targeted stock of fish, a neutral impact on the ecosystem, and an adverse impact on net revenues to fishermen, while the indirect effects of that same alternative could include beneficial impacts on the ability of Steller sea lions to forage for prey, neutral impacts on incidental levels of prohibited species catch, and adverse impacts in the form of multiplier effects reducing employment and tax revenues to coastal fishing communities.

The terms “effects” and “impacts” were used interchangeably by analysts preparing these analyses. The CEQ regulations for implementing the procedural provisions of NEPA, also state “Effects and impacts as used in these regulations are synonymous.” (40 CFR §1508.8). The terms “positive” and “beneficial”, or “negative” and “adverse” are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

Though the intent of the alternative fishery management schemes being proposed is to mitigate potential impacts of the federally managed groundfish fisheries off Alaska on Steller sea lions, the effects of the alternatives must be evaluated for all resources, species, and issues that may directly or indirectly interact with this fisheries within the action area. The direction of intensity, therefore, applies to the particular resource, species, or issue being evaluated (as opposed to always applying to Steller sea lions).

Each section below contains an explanation of the criteria used to establish significance and a determination of significance, insignificance or unknown for each resource, species, or issue being treated. The criteria for significance and determinations of significance are summarized in a table in each section, or when the same criteria were used to evaluate subsequent species, the reader is referred back to the appropriate table. The following ratings for significance are used; significant (beneficial or adverse), conditionally significant (beneficial or adverse), insignificant, and unknown. Definitions of the criteria used for these rankings are included in each section. Where sufficient information is available, the discussions and rating criteria used

are quantitative in nature. In other instances, where less information on the direct and indirect effects of the alternative are available, the discussions and rating criteria used are qualitative in nature.

Although the significance ratings utilized are the same for each resource, species, or issue bing treated, the basic "perspective" or "reference point" differs. Table 4.0-1 summarizes the reference points for the topics addressed in this analysis. The first three reference points relate to the biological environment, while the later two are associated with the human environment. Social and economic consequences are not listed because the significance ratings were not similarly applied; rather, direct indicators of changes from current economic conditions were used. For each application listed in Table 4.0-1, one to five specific questions were addressed in the analysis. In each case, the questions were fundamentally tied to the respective reference point. The generic definitions for the assigned ratings are as follows:

S+ Significant beneficial effect in relation to the reference point; this determination is based on ample information and data and the judgement of the NMFS analysts who addressed the topic.

S- Significant adverse effect in relation to the reference point and based on ample information and data and the judgement of the NMFS analysts who addressed the topic.

CS+ Conditionally significant beneficial effect in relation to the reference point; this determination is lacking in quantitative data and information, however, the judgement of the NMFS analysts who addressed the topic is that the alternative will cause an improvement in the reference point condition.

CS- Conditionally significant adverse effect in relation to the reference point; it is based on insufficient data and information, however, professional judgement is that the alternative will cause a decline in the reference point condition.

I Insignificant effect in relation to the reference point; this determination is based upon information and data, along with the judgement of NMFS analysts, which suggests that the effects are small and within the "normal variability" surrounding the reference point.

U Unknown effect in relation to the reference point; this determination is characterized by the absence on information and data. In instances where the information available is not adequate to assess the significance of the impacts on the resource, species, or issue, no significance determination was made, rather the particular resource, species, or issue was rated as unknown.

NA Not Applicable. In instances where the full spectrum of significant negative, conditionally significant negative, insignificant, conditionally significant positive, and significant positive are not logically described, the undescribable situation is noted "not applicable." An example of an undescribable situation is evaluating the impact vector of incidental take on marine mammals. In this example, a continuum of significant adverse to insignificant is describable (though with less precision than perhaps desired by decision makers), however, within the area known to be insignificant the point of no impact from the vector of incidental take is

reached, therefore, the situations of conditionally significant beneficial, and significant beneficial do not apply.

In this analysis, and the often referenced Draft Programmatic SEIS (NMFS 2001a), NMFS uses the term "conditionally significant" to allow informed decision making to proceed in spite of incomplete or unavailable information. When information is incomplete or unavailable to quantify an impact's significance (beneficial or adverse), or if the point at which an effect becomes significant is not supported by scientific data, the qualifier "conditionally" is applied. The qualifier implies that significance is assumed, based on the credible scientific information and professional judgement that are available, but more complete information is needed for certainty. In other words, we may believe that an impact has a significant adverse or a significant beneficial effect, but we do not have a high level of certainty about that finding. This approach provides a heightened sense of where information is lacking, and may guide research efforts in the future. An interesting point to make about this approach is that if an impact is rated as insignificant, there is a high level of confidence that the impact is truly insignificant, or it would have been moved to the "conditional significance" category.

Table 4.0-1 Reference points for significance determinations

Reference Point	Application
Current population trajectory or harvest rate of subject species	(1) Marine mammals (2) Target commercial fish species (3) Incidental catch of non-specified species (4) Forage species (5) Prohibited species bycatch (6) ESA list Pacific salmon (7) Seabirds
Current size and quality of marine benthic habitat and other essential fish habitat	Marine benthic habitat and other essential fish habitat
Application of principles of ecosystem management	Ecosystem
Current management and enforcement activities	(1) State of Alaska managed fisheries (2) Management complexity and enforcement
Current rates of fishing accidents	Human safety and private property (vessels)

4.1 Effects on Marine Mammals

The Draft Programmatic SEIS (NMFS 2001a) examined effects of groundfish fishery management alternatives by focusing analyses around four core questions, modified from Lowry (1982):

1. Is the alternative management regime consistent with efforts to avoid direct interactions with marine mammals (incidental take and entanglement in marine debris)?

2. Does the alternative management regime result in fisheries harvests on prey species of particular importance to marine mammals, at levels that could compromise foraging success (harvest of prey species)?

3. Does the alternative management regime result in temporal or spatial concentration of fishing effort in areas used for foraging by marine mammals (spatial and temporal concentration of removals with some likelihood of localized depletion)?

4. Does the alternative management regime modify marine mammal or forage behavior to the extent that population level impacts could occur (disturbance)?

Those four questions, and the associated rating criteria established (Tables 4.1-1 and 4.1-6), were modified for use in this analysis from the process used in the Draft Programmatic SEIS (NMFS 2001a). The main departure from how they were used in the Draft Programmatic SEIS analysis was it evaluated alternatives with respect to consistency with a policy of marine mammal protection, whereas, in this analysis each suite of specific fishery management measures is evaluated independently against a criteria for significance established for each of the four above questions. Additionally two management tools used in the Draft Programmatic SEIS are not relevant to discussions of effects on marine mammal populations: vessel monitoring requirements and experimental design. As the experimental designs being proposed are directed at gaining answers to questions about Steller sea lions, however, discussion was added (Section 4.1.1.6) evaluating the potential each alternative has for experiments designed to monitor Steller sea lion population recovery in response to the fishery management measures being manipulated, or to evaluate the localized effects of commercial fishing on Steller sea lions.

In cases where absolute quantitative criteria for significance could not be established, the fishery management measures in effect in 1998 were used as a benchmark upon which to compare these five alternatives with respect to effects on marine mammals, as expressed by the above questions. That is, once it was determined how much of an effect could be expected, as delineated by the above questions, other alternatives were evaluated relative to the performance of the 1998 benchmark.

This analysis is comprised of three tiers:

a. The effects on each of seven marine mammal species or species groups are discussed separately (Steller sea lions, ESA listed great whales, other cetaceans, northern fur seals, harbor seals, other pinnipeds, sea otters).
b. Each alternative is addressed for each species or species group.
c. Each question (type of effect) is addressed for each alternative within each species or species group.

4.1.1 Effects on Steller Sea Lions

Direct and indirect interactions between Steller sea lions and groundfish fisheries occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important sea lion prey, and due to temporal and spatial overlap in sea lion foraging and commercial fishing activities. Of the groundfish species targeted for harvest, pollock, Atka mackerel, and Pacific cod rank foremost among important sea lion diet items (Sinclair and Zeppelin, submitted) and similar sizes are targeted by sea lions and fisheries. Thus subsequent analyses focus on effects of fisheries targeting those species. A metric was established (Table

4.1-4) for Steller sea lions to assess intensity of effects (harvest of prey species and spatial/temporal concentration, Question 3) and associated percent increase to populations, and new population trends for Steller sea lions. Significance ratings for each question are summarized in Table 4.1-5.

4.1.1.1 Effects of Alternative 1 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The estimated mean annual mortality from the 1995-1999 groundfish fisheries is 8.4 sea lions (Angliss *et al.*, 2001). Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[1]. The estimated annual incidental take level of Steller sea lions under Alternative 1 in all areas combined is 13 Steller sea lions (with a confidence interval [CI] = 10 - 16 Steller sea lions; Table 4.1-2). Incidental bycatch frequencies, which are typically low, are summarized in Figure 4.1-4; they also reflect locations where fishing effort was highest. In the Aleutian Islands and GOA, incidental takes are often within critical habitat, though in the Bering Sea such bycatch is farther off shore and along the continental shelf. Otherwise there seems to be no apparent "hot spot" of incidental catch disproportionate with fishing effort. It is, therefore, appropriate to estimate catch ratios based on estimated TAC. Noting, however, that if these take rates differ between observed and unobserved vessels then these take estimates would be biased accordingly. These rates also reflect a prohibition of trawling within 10 or 20 nm of 37 rookeries which likely reduces the potential for incidental take, particularly during the breeding season when females are on feeding trips within the critical habitat area. For Alternative 1, it is likely that the same amount of fishing effort will occur, regardless of the number of seasons (two in this alternative).

Entanglement of Steller sea lions in derelict fishing gear or other materials seems to occur at frequencies that do not have significant effects upon the population. From a sample of rookeries and haul-out sites in the Aleutian Islands, of 15,957 adults observed, Loughlin *et al.* (1986) found only 11 (0.07%) entangled in marine debris, some of which was derelict fishing gear. Observations of sea lions at Marmot Island for several months during the same year observed 2 of 2,200 adults (0.09%) entangled in marine debris. During 1993-1997, only one fishery-related stranding was reported from the range of the western stock, a sea lion observed in August 1997 with troll gear in its mouth and down its throat (Angliss *et al.*, in press). Entanglement of sea lions in derelict fishing gear or other marine debris does not appear to represent a significant threat to the population. In conclusion, incidental take and entanglement in marine debris under Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 1 is 1,831,297 mt (Table 4.1-3). TAC removals at those levels for pollock and Pacific cod, in concert with time and space considerations, were thought to be having a negative effects on Steller sea lions (NMFS 1998b). This

[1]Dan Ito, "Personal Communication," National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115.

component is given a conditionally significant negative rating because many of the analyses were primarily based on qualitative interpretations rather than studies containing quantitative conclusions. Further, based upon sea lion population trends during 1990-2000, it is assumed that the suite of fisheries management measures that would be in place under Alternative 1 will not result in a stable Steller sea lion population. Only to the extent that insufficient data are available to conclude significant negative effects remain, Alternative 1 is determined to be conditionally significant negative with respect to the harvest of prey species. Definitive information on intensity of effects is lacking, but plausible pathways have been described (NMFS, 2000a).

Groundfish fisheries also incidentally take other target fish and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of these species removed under Alternative 1 is estimated to be less than 3% of the total catch in the Gulf of Alaska, and much lower than 3% of the total catch in the Bering Sea (NMFS unpublished observer program data)[2].

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Applicable to all fisheries, Alternative 1 contains closures within 10 nm of 37 rookeries to all trawling year-round, with some extending to 20 nm on a seasonal basis. Specifically, Alternative 1 contains the following:

The walleye pollock fishery in the BSAI has two seasons, January 20-April 15 (45% of TAC) and September 1-November 1 (55% of TAC). There are eastern BS and AI area apportionments of the TAC. GOA TAC is split into three seasons and the TAC is split 25%, 35%, and 45%, accordingly. Pollock trawling is closed in the CVOA June 10-December 31. The Pacific cod BSAI fishery is apportioned into three seasons and two gear types (trawl – January 20-December 31; and fixed – January 1 - December 31 in three seasons). The Pacific cod TAC is set BSAI-wide. In the GOA, fixed gear opens January 1 and trawl January 20; fishing occurs until the end of the year for both. The Atka mackerel fishery is in two seasons, January to April 15, and September 1 to November 1 with 50% of the TAC apportioned in each season. Atka mackerel harvest is limited to 40% of TAC inside Steller sea lion critical habitat. The combined TAC of all these groundfish in the Bering Sea results in a bimodal peak of average removal rates during February through April, and September to November (Figure 4.1-5). Daily average removal rates were calculated by dividing the allocated TAC by length of season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries. Actual daily fisheries removal rates may be higher or lower than this value. Compared to removals in the Bering Sea for all other alternatives, Alternative 1 has relatively lower average daily removal rates during the late spring and summer, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). Similar patterns are seen in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8). In the GOA projected average daily removal rates of pollock and cod are highest in mid summer (Figure 4.1-9 and 4.1-10).

Sinclair and Zeppelin (submitted) showed that regions based on diet similarity closely paralleled the metapopulation clusters defined by York *et al.* (1996), in that Sinclair and Zeppelin's region 1 represents the eastern and central Gulf of Alaska as defined by York *et al.* (1996). Region 2 represents the western GOA in the York *et al.*(1996) scheme, region 3 represents the eastern Aleutian Islands, and region 4 the central

[2]Ibid.

and western Aleutian Islands. Because these two analyses result in similar clustering, population projections relevant to York *et al.* (1996) using those regions/areas (e.g., Figure 3.1-9) can be used in the context of comparing diet differences, fisheries allocations, and population trajectories. For this reason, the present analysis was based on Steller sea lion metapopulations rather than on the 13 monitoring areas proposed in NMFS (2000a) *per se*.

In addition, Loughlin and York (2001) provided an accounting of losses to the Steller sea lion population stratified by metapopulation areas using sources of known mortality, including subsistence harvest, incidental take in fisheries, illegal shooting, research, and predation by killer whales and sharks. Some portion of the remaining unknown mortality from the Loughlin and York (2001) study may be attributable to removal of prey by commercial fisheries. For example, in 2001, losses from a stable population would have been 4,710, with and additional 1,715 losses accounting for the decline. This totals 6,425 sea lions lost to the population. Of the 1,715 losses, 55%-75% could not be attributed to a specific cause. The following discussion incorporates analyses from Sinclair and Zeppelin (submitted), York *et al.* (1996), and Loughlin and York (2001) to assess the effect of the five alternatives on these losses that were not attributable to a specific source.

Effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging. Benefits to sea lions are likely linked to the extent that an alternative reduces removals of key prey species within sea lion foraging areas, and during critical time periods such as April-June, when energy requirements of late-term pregnant females are greatest and pups from the prior year may begin weaning, and May-August, when females are tied to rookeries while nursing pups.

The proportion of pollock, Pacific cod, and Atka mackerel in the Steller sea lion diet varies by area and season (Figure 4.1-11, Figure 4.1-12). A recent study that examined sea lion scat (Sinclair and Zeppelin, submitted) showed that sea lion diet can be classified into four sea lion regional clusters (Figure 3.1-9). In region 1 (Prince William Sound to the Semidi Islands) pollock comprised 64% of the frequency of occurrence (FO) in summer (May-September) and 56% FO in winter (December-April) of the Steller sea lions diet. For region 2 (Shumagin Islands to the Sanak Islands) pollock comprised 80% FO in summer and 86% FO in winter. In region 3, (Sanak Islands to Ogchul Island) pollock comprised 54% FO in summer and 59% FO in winter. And in region 4 (all islands west of Umnak Island), pollock comprised 10% FO in summer and 3% FO in winter. Sinclair and Zeppelin (submitted) found that Pacific cod in region 1 during summer was 5% FO in summer and 31% FO in winter. In region 2, Pacific cod was 11% FO in summer and 36% FO in winter. For region 3, cod was 6% FO in summer and 20% FO in winter, and for region 4, cod was 7% FO in summer and 17% FO in winter. For Atka mackerel, Sinclair and Zeppelin (submitted), found no occurrence in summer and 2% FO in winter in region 1. For region 2, Atka mackerel occurrence was 2% FO in summer and 4% FO in winter; region 3 had 26% FO in summer and 25% FO in winter. And for region 4, Atka mackerel was 93% FO in summer and 65% FO in winter.

Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 1 will not result in a stable population (Table 4.1-4). Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-4). Overall, the effects of Alternative 1 are conditionally significant negative (Table 4.1-5) according to the criteria set for significance in Table 4.1-1.

Indirect Effects - Disturbance Effects (Question 4)

This and all other alternatives contain measures that avoid important forms of disturbance to Steller sea lions at rookeries during the breeding season. In particular, the prohibition of vessel entry within 3 nm of 37 rookeries avoids intentional and unintentional disturbance of hauled-out sea lions, including new born pups, or those animals aggregated near shore. More than 3,250 km^2 around 37 sites is offered for protection under this alternative.

Vessel traffic, nets moving through the water column, or underwater sound production may all represent perturbations, which could affect foraging behavior, but few data exist to determine their relevance to Steller sea lions. We note especially, that the influence of trawl activities on Steller sea lion foraging success cannot be addressed directly with existing data. Foraging could potentially be affected not only by interactions between vessel and sea lion, but also by changes in fish schooling behavior, distributions, or densities in response to harvesting activities. In other words, disturbance to the prey base may be as relevant a consideration as disturbance to the predator itself.

For the purposes of this analysis, we recognize that some level of prey disturbance may occur as a fisheries effect. The impact on marine mammals using those schools for prey is a function of both the amount of fishing activity and its concentration in space and time, neither of which may be extreme enough under Alternative 1 to represent population level concerns. To the extent that fishery management measures under Alternative 1 do impose limits on fishing activities inside critical habitat, we assume at least some protection is provided from these disturbance effects. These protections occur as byproducts of other actions which either reduce fishing effort or create buffer zones to limit impacts on foraging. Also, they occur directly in the case of the 3-nm, no-entry zones around rookeries. Whether the residual levels of disturbance represent significant effects on Steller sea lions can not be determined from data currently available.

Anecdotal evidence, however, suggests that fisheries-related disturbance events are unlikely to be of consequence to the Steller sea lion population as a whole. For instance, vessel traffic and underwater sound production have long been features of the Bering Sea and Gulf of Alaska, at least over much of the twentieth century. Such circumstances have prevailed before, as well as after, the decline of Steller sea lions, suggesting no obvious causal link. Steller sea lions also appear to be tolerant of at least some anthropogenic effects, as noted by their attraction to fish processing facilities and gillnets, as well as their distributions in proximity to ports. Further, the eastern stock of Steller sea lions is increasing, despite anthropogenic activities throughout their range on the west coast of North America and particularly in southeast Alaska. Overall, these circumstances suggest that disturbance effects are likely to be insignificant to Steller sea lions at the population response level. Thus, the effect of Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.2 Effects of Alternative 2 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 2 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear

type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[3]. Takes of Steller sea lions currently are rare events in all Alaska groundfish fisheries, with no apparent pattern to their temporal or spatial distribution (Figure 4.1-4). For example, the total number of animals killed is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this Alternative, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

Under Alternative 2, TACs for pollock, Pacific cod, and Atka mackerel are reduced; thus, proportional reductions in incidental take could be expected. However, the apportionment of the TAC reductions did not result in the reduction of the expected incidental catch of Steller sea lions (Table 4.1-2). Similarly, reduced fishing activity inside critical habitat, where Steller sea lions may be expected to spend a greater percentage of their foraging and transit time, could further lower incidental take. The overall effect of any such reductions on population trends, however, would be indistinguishable.

With respect to entanglement in marine debris, Alternative 2 does not alter the effects described under Alternative 1. That is, the effect is insignificant. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 2 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 2 is 1,646,297 mt (Table 4.1-3). The amount of the fishery removals of all key prey species is reduced by 10%. Reduced competitive effects, in turn, should avoid impacts on fitness or population recovery. Alternative 2 dampens the effects of harvest of the key prey species with different combinations of management measures, and includes reductions in TACs.

Reductions in TAC range from a low of 2% for eastern Bering Sea pollock to a high of 92% for Aleutian Islands pollock. Some of these reductions may be more important to Steller sea lions than others. For example, while a 92% reduction in Aleutians Islands pollock TAC is a large difference, diet studies indicate that pollock become less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). In addition to lowering TAC, spatial and temporal restrictions are discussed below.

Groundfish fisheries incidentally take some non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The bycatch of these species under Alternative 2, however, is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)[4].

Thus, Alternative 2 provides greater protection from effects of harvesting Steller sea lion prey species than Alternative 1. Further, the reductions in TACs are substantial enough (i.e., more than 20%, for two key

[3]Ibid.

[4]Ibid.

species) to rank them as conditionally significant positive (Table 4.1-5) according to the significance criteria established in Table 4.1-1.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Alternative 2 establishes lower total allowable catch levels (for pollock, Pacific cod, and Atka mackerel), prohibits trawling in critical habitat, and implements measures to spread out catches through the year. Applicable to all fisheries is no trawling for any groundfish species within Steller sea lion critical habitat. Relevant measures to the analysis include:

- Four seasons would be established for pollock, Pacific cod, and Atka mackerel fisheries with equal seasonal TAC apportionment: January 20 - March 15 (25%), April 1 - June 1 (25%), June 15 - August 15 (25%), September 1 - Dec 31 (25%). Two week stand-downs would be established between seasons with no rollover of TAC allowed.

Applicable to pollock fisheries:
- The Aleutian Islands would be closed to directed pollock fishing.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS pollock TAC, 74.5% of ABC; GOA pollock TAC, 44.8% of ABC.
- Separate TACs would be established for Bering Sea pollock east and west of 170° W longitude, and GOA pollock TACS would be established by management area (e.g., 610, 620, 630) and for Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the pollock fisheries as follows: BS pollock, 5,000 mt; GOA pollock, 1,000 mt.

Applicable to the Pacific cod fisheries:
- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS cod TAC, 71.8% of ABC; AI cod TAC, 71.8% of ABC; GOA cod TAC, 55.0% of ABC.
- Separate TACs would be established for Bering Sea cod east and west of 170° W longitude, separate AI cod TACs would be established by management area (e.g., 541, 542, 543); and GOA cod TACS would be established by management area (e.g., 610, 620, 630) and for the Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the cod fisheries as follows: BS cod, 600 mt; AI cod, 600 mt; GOA cod, 400 mt.
- Foraging area (Seguam, SCA, Shelikof) catch limits would be established at 10% of survey biomass estimate.
- A zonal approach would be implemented for BSAI and GOA Pacific cod fisheries.

Applicable to Atka mackerel fisheries:
- Maximum mackerel TAC would be established at 33% of the maximum ABC.
- Separate TACs would be established for AI management areas (e.g., 541. 542, 543).
- A maximum daily catch limit of 300 mt would be established for the fleet of vessels fishing in the mackerel fishery.

As with Alternative 1, question 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

For the central and eastern GOA metapopulation, a 55% reduction in pollock TAC and 38% reduction in cod TAC would likely benefit sea lion population trends, particularly during the winter when cod is more common in the diet. Closures of critical habitat to trawling could potentially provide a large degree of separation between fisheries removal and foraging which will also benefit sea lions. The same could be said for other metapopulations where the magnitude of TAC reduction is similar. Likewise, the spreading of allowable catch across four seasons with daily catch limits may reduce the likelihood of regional prey competition. However, determining the magnitude of the effect for this alternative on sea lion metapopulations in general is not possible, except that in most cases it is likely to be positive. The fine resolution of management suggested in this alternative exceeds the resolution available on Steller sea lions; thus the effects of Alternative 2 at the metapopulation level, or at finer scales, cannot be determined.

Daily average removal rates were calculated by dividing the allocated TAC by length of season, and summing, as appropriate, for open pollock, Pacific cod, or Atka mackerel fisheries. Actual daily fisheries removal rates may be higher or lower than this value. Projected average daily removal rates of pollock and cod in the Eastern Bering Sea are comparable in magnitude to the other alternatives (Figure 4.1-5, Figure 4.1-6), though with brief closures separating the fishing periods. Curiously, the pollock TAC allocated to the Eastern Bering Sea could not practically be removed because of daily catch limits. Under the management regime of Alternative 2, four seasons of 54 days (Season A), 61 days (B, C), and 121 days (D) were allocated 343,073 mt each, with no TAC rollover allowed between seasons (see Section 2.3.2). Average daily removal rates within each season to meet this TAC are 6353 mt, 5624 mt, 5624 mt and 2835 mt for the A through D seasons, respectively. However, Alternative 2 caps daily pollock removals from the Eastern Bering Sea at 5000 mt per day (Section 2.3.2), so without TAC rollover about 2601 mt would be forgone. This may have been an unintended consequence, because daily limits in the Gulf of Alaska and Aleutian Islands do not seem to result in "lost" TAC. The overall TAC of pollock and Pacific Cod in the Eastern Bering Sea is only reduced by 2% and 18%, respectively (Table 4.1-3). However, the percentage splits in allowed removals east and west of 170? W longitude of 52/48 (A season), 45/55 (B season), and 39/61 C and D seasons), combined with the daily catch limit of 1000 mt/d and no trawling within critical habitat should greatly reconfigure removals from east of 170? W, where most of the pollock were harvested during 1998-2000 (Figure 4.1-15). A similar split is made in pollock and Pacific cod allocations between western and central Gulf of Alaska TACs (see Section 2.3.2). Given the relatively large contribution of pollock in the summer and winter diets of sea lions in the Eastern Aleutian Islands (Figure 3.1-9, Figure 4.1-11, Figure 4.1-12), this could be beneficial to sea lions. Given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread such a benefit could be to the sea lion population in general. Within the western stock of Steller sea lions, the Eastern Aleutian Island metapopulation has exhibited the lowest annual decline rate (-1.75% during 1991-2000) (Loughlin and York 2001).

Because of reduced pollock, Pacific cod, and Atka mackerel TACs in the Gulf of Alaska and Aleutian Islands, average daily removal rates are lower than in the other alternatives (Figure 4.1-7, Figure 4.1-8, Figure 4.1-9, Figure 4.1-10). Also in contrast to other alternatives, Alternative 2 prevents greater removal rates

during critical periods of April-June (late pregnancy and beginning of pup weaning) and May-July (pup lactation period on rookeries). Of all the alternatives, Alternative 2 measures appear to result in the least temporal concentration of fishery removals of key sea lion prey species.

Alternative 2 management measures result in much less spatial and temporal concentration of fisheries removals of key Steller sea lion prey species than do measures under other alternatives, and hence rates a conditionally significant positive using the criteria established for significance (Table 4.1-1). The overall TAC, however, is only 10% less than the other alternatives (Table 4.1-3), and thus the overall effect on the population may not be as intense. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 2 will not result in a stable population, changes to the sea lion population would be within 4% of the current trend, and an overall decline would continue at -1.4% to -2.3% per year (Table 4.1-4).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, to the extent that Alternative 2 reduces fishing activities inside critical habitat and at haul-out sites, the former by extending closed areas and the latter by a reduction in TACs for pollock, Pacific cod, and Atka mackerel, potential disturbance effects may be further reduced or avoided. Thus, the scale of change in fishing activity imposed under Alternative 2 would result in less disturbance. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.1.3 The effects of Alternative 3 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 3 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[5]. Takes of Steller sea lions currently are rare events in all of the Alaskan groundfish fisheries, with no apparent pattern to their temporal or spatial distribution. For example, the total numbers of incidental take is expected to be less than 14 (CI = 11-17) based on allocations of TAC in Alternative 3, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 3 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects

[5]Ibid.

are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 3 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 1 is 1,831,297 mt (Table 4.1-3). Alternative 3 contains a "global control rule" that adjusts TAC relative to surveyed spawning biomass. However, the projected TAC does not differ substantially from that of Alternative 1 (or for that matter Alternatives 4 and 5; Table 4.1-3). The largest (and only) reduction is in GOA pollock which is 18% less than the TAC established in Alternative 1.

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 3 is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)[6].

Alternative 3 contains additional management measures beyond those used under Alternative 1 to manage the harvest within critical habitat. Because GOA TAC is reduced between 5% and 20%, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated insignificant (Table 4.1-5).

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Essential spatial and temporal elements of this approach are to establish large areas of critical habitat where fishing for pollock, Pacific cod, and Atka mackerel is prohibited, and to restrict catch levels in remaining critical habitat areas. Details are as follows:

Applicable to all pollock, Pacific cod and Atka mackerel fisheries:

- Closure areas to directed fishing for pollock, Pacific cod, and Atka mackerel inside specified sites.
- Trawl fishing for pollock, Pacific cod and Atka mackerel prohibited November 1 January 20.
- Fishing for pollock, Pacific cod and Atka mackerel prohibited from November 1 through January 20 inside critical habitat.
- Outside of critical habitat, two evenly spaced seasons for pollock, Pacific cod, and Atka mackerel fisheries in the EBS, GOA, and AI.

Applicable to pollock fisheries:
- A portion of the Aleutian Islands would be open to pollock fishing (Area 12)

Applicable to the Pacific cod fisheries:
- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.

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[6]Ibid.

As with Alternatives 1 and 2, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in Steller sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Alternative 3 reduces spatial concentration by creating large closures within three broad areas, prohibiting fishing within critical habitat during November 1 through January 20, and creates four rather than two seasons within critical habitat which along with catch limits reduce spatial concentration of fisheries removals. Overall average daily removal rates for Eastern Bering Sea pollock and Pacific cod are fairly evenly distributed throughout the year (Figure 4.1-5, Figure 4.1-6). Likewise, Aleutian Island pollock, Atka mackerel and Pacific cod estimated average daily removal rates are even throughout the year (Figure 4.1-7), though relative to removals of all other alternatives is relatively greater during June through September (Figure 4.1-8), a critical period for Steller sea lion lactation. Similarly, GOA Pacific cod and pollock have relatively greater estimated average daily removal rates and similar TAC allocations compared to other alternatives during June through September, though there are removal limits within critical habitat.

Alternative 3 generally spreads fish removals over time and seasons, and thus results in marginally less spatial and temporal concentration of fisheries removals than Alternative 1, and hence rates as insignificant using the criteria established for significance (Table 4.1-1). The overall TAC, however, is similar to all other Alternatives except Alternative 2, which may reduce the benefit to Steller sea lions. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 3 will not result in a stable population. Thus, changes to the Steller sea lion population would be within 2% of the current trend, and an overall decline would likely continue at -1.4% to -5.2% per year (Table 4.1-4). Overall, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated conditionally significant positive (Table 4.1-5).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 3 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a minor reduction in TACs of less than 1% for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 3 results in marginally less disturbance. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.4 The effects of Alternative 4 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for

each fishery area (NMFS, unpublished observer program data)[7]. The total amount of incidental take under Alternative 4 is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this Alternative, or about one sea lion per 140,000 mt of groundfish harvested. The level of incidental take in either the BSAI or the GOA has not increased over the past decade.

With respect to entanglement in marine debris, Alternative 4 does not alter the effects described under Alternative 1. That is, there is no significant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated as insignificant under the criteria established for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 4 is 1,831,299 mt, virtually the same as Alternatives 1, 3, and 5 (Table 4.1-3). Estimated TACs region-wide are the same as under Alternative 1. Alternative 4 contains additional seasonal and gear apportionments to distribute catch relative to Alternative 1.

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 4 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)[8].

Because the TAC is identical to that of Alternative 1, no additional benefits to Steller sea lions accrue. Therefore, this alternative is rated conditionally significant negative (Table 4.1-5) according to the criteria established for determining significance in Table 4.1-1.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

This approach allows for different types of management measures in the three areas (AI, BS, and GOA). Essential measures include fishery specific closed areas around rookeries and haul-out sites, together with seasons and catch apportionments. Specific measures are complex and will not be repeated here, they are fully discussed in Section 2.3.4 Alternative 4.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and Steller sea lion foraging.

Two Eastern Bering Sea pollock and Pacific cod seasons provide fairly uniform estimated average daily removal rates throughout the year, though slightly increased during July-November due to a larger TAC

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[7]Ibid.

[8]Ibid.

apportionment (Figure 4.1-5, Figure 4.1-6). Temporal distribution of average daily removals is similar to Alternatives 3 and 5. In contrast, combined estimated average daily removal rates of Atka mackerel, pollock, and Pacific cod were the largest of all Alternatives in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8), and particularly greater during the critical spring period (Figure 4.1-8). Gulf of Alaska removals are concentrated in four periods, though estimated removal rates are generally lower relative to other alternatives in spring and summer (Figure 4.1-9, Figure 4.1-10).

Alternative 4 also creates a series of area closures or removal limits to spatially spread fish removals. Management Areas 4 and 9 and the Seguam foraging area are closed to fishing for pollock, Pacific cod and Atka mackerel, and within 20 nm of five northern Bering Sea haul-outs (NMFS 2000 Biological Opinion). The closures of these areas is not likely be of great benefit to sea lions, however, as the amount of pollock (Figure 4.1-15) and Pacific cod (Figure 4.1-16) catch, and Atka mackerel effort (Figure 4.1-17) during 1998-2000 in these areas was minimal. Similarly, because pollock are not a key item in Steller sea lion diet west of 170?W longitude (Figure 4.1-11, Figure 4.1-12), prohibiting pollock fishing in the Aleutian Islands may have little benefit to sea lions. Closures to pollock fishing out to 10 or 20 nm around most rookeries and haul-outs in GOA management Areas 1, 2, 3, 4, 5, 6, 10 and 11 could be beneficial to sea lions given the importance of pollock in their diet in those areas (Figure 4.1-11, Figure 4.1-12), particularly during periods of pup rearing when mothers forage from the rookeries. The benefit of these closures outside of the pupping season becomes less clear, given seasonal movements of Steller sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Fisheries allocations are shifted by gear types, seasons, and areas, and represent improvements over Alternative 1 in some areas, the measures under Alternative 4 are rated as insignificant under the criteria established for significance (Table 4.1-1). Additionally, the overall amount of TAC removed is the same as all other alternatives except Alternatives 2 and 5. As with the other alternatives, given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread the effects of these measures are to the Steller sea lion population in general. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 4 will not result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-4).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 4 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a variety of schemes to reduce fisheries impacts on Steller sea lions across the GOA and Aleutian Islands. However, the overall TAC is the same as in Alternative 1 for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 4 results in marginally less disturbance. Although the levels of protection from disturbance effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.5 The Effects of Alternative 5 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)[9]. The total amount of incidental take under Alternative 5 is expected to be less than 14 (CI = 11-17) Steller sea lions (as in Alternative 1) based on allocations of TAC under Alternative 5, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 5 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The TAC of pollock, Pacific cod, and Atka mackerel under Alternative 5 is 1,809,497 mt, virtually the same as Alternatives 1, 3, and 4 (Table 4.1-3). The only reduction in TAC results from a prohibition on fishing for pollock in the Aleutian Islands, as in Alternative 2. The benefit to Steller sea lions from this reduction is equivocal. Diet studies indicate that pollock becomes less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). This alternative limits the amount of catch within critical habitat to be in proportion to estimated fish biomass.

Groundfish fisheries also incidentally take other target and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of bycatch of these species under Alternative 5 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)[10].

Because TAC under Alternative 5 is within 5% of the Alternative 1 TAC, this alternative is rated as conditionally significant negative (Table 4.1-5) according to the criteria set for significance in Table 4.1-1.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Features of this alternative applicable to pollock fisheries include:

- In the Bering Sea pollock fishery: four seasons with harvest limits within sea lion critical habitat foraging areas; and two seasons (40:60% allocation) outside critical habitat.
- In the GOA pollock fishery: fishery distributed over 4 seasons (30%, 15%, 30%, 25%).
- The Aleutian Islands area would be closed to pollock fishing.

Applicable to the Atka mackerel fisheries:

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[9]Ibid.

[10]Ibid.

- Two seasons with TAC apportionments would be established: January 20 - April 15 (50%); September 1 - November 1 (50%).
- Harvest limits would be established in critical habitat: (40% inside critical habitat, and 60% outside)

Applicable to the Pacific cod fisheries:

- In the BSAI cod fishery: separate TACs would be established for the Bering Sea and Aleutian Islands, two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) with harvest limits within critical habitat based on best estimates of biomass. Using these estimates, the Bering Sea TAC limits within CH are 20% in the A season and 3.6% in the B season. In the Aleutian Islands, the TAC limits within CH are 20% in the A season and 48.3% in the B season.
- In the GOA cod fishery: two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) would be established with harvest limits within critical habitat based on best estimates of biomass. Based on these estimates, the TAC limits within CH to start with are 20% in the A season and 31.8% in the B season.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Spatial apportionments under Alternative 5 result in estimated daily average fish removal rates similar to those of Alternatives 3 and 4 for Eastern Bering Sea pollock and Pacific cod (Figure 4.1-5, Figure 4.1-6). Relative to Alternative 1, the removals are evened out over the seasons (Figure 4.1-5). Conversely, they are bimodal with peak removal rates of Atka mackerel Pacific cod, and pollock in spring and autumn from Aleutian Island fishing areas (Figure 4.1-7), though of much lower magnitude (Figure 4.1-8). Compared to other alternatives, estimated daily average removal rates from Aleutian Islands areas are lower during critical spring and summer months than in the other alternatives (Figure 4.1-8). Pacific cod and pollock estimated average daily removal rates in the Gulf of Alaska are most similar to the seasonal distribution of Alternative 4 (Figure 4.1-9), and results in stepwise decreases from winter to summer (Figure 4.1-10).

Alternative 5 also has a series of regional closures and apportionments to reduce spatial fishery concentration. As with other alternatives, an Aleutian Island pollock fishing prohibition may be of marginal benefit to Steller sea lions because pollock are not a key item of Steller sea lion diet west of 170?W longitude (Figure 4.1-11, Figure 4.1-12). Catch limits and multiple seasons within critical habitat reduce the rate at which fish are harvested, though as with the other alternatives, the benefit to Steller sea lions is unclear, given seasonal movements of sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Alternative 5 measures result in marginally less spatial and temporal concentration of fishery removals of key Steller sea lion prey species than do measures under Alternative 1, and is therefore rated insignificant (Table 4.1-5) under the criteria established for significance in Table 4.1-1. TAC levels are similar to those of the other alternatives except for Alternative 2, and hence the ultimate benefit to the sea lion population may not be as great. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 5 will not

result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -5.2% per year (Table 4.1-4).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. Alternative 5 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 10 or 20 nm of 37 rookeries to trawling year-round. It also contains a reduction in TAC of 92% for pollock in the Aleutian Islands (bycatch only), which is an overall reduction of less than 1% for the groundfish TAC for pollock, Pacific cod, and Atka mackerel, resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established in Table 4.1-1, measures which would result in even less disturbance than that which is insignificant are also rated as insignificant (Table 4.1-5).

4.1.1.6 Summary of Effects, Experimental Design Potential, and Re-initiation of Section 7 Consultation for Steller Sea Lions

In conclusion, significance determinations suggests that the effects of the alternatives on Steller sea lion are insignificant for all five alternatives with regard to the questions of incidental take/ entanglement in marine debris and disturbance. On the question for harvest of prey species in the fisheries, Alternatives 1, 4 and 5 were found to be conditionally significant negative, Alternative 2 was found to be conditionally significant positive, and Alternative 4 was found to have insignificant effect. On the question for spatial and temporal concentration of the fisheries, Alternative 1 was found to have a conditionally significant positive effect, Alternatives 2 and 3 were found to have a conditionally significant positive effect. These results are summarized in Table 4.1-5. Alternatives 3 through 5 generally add additional provisions to spread fisheries harvests over time and areas in an attempt to reduce the likelihood of localized depletions on a broad range (from course to fine) of spatial/temporal scales. These alternative management schemes, in particular Alternatives 2 (Low and Slow) and 4 (Area and Fishery Specific Approach), have reached a fine degree of resolution for which harvests are apportioned among areas, seasons, and gear types. Unfortunately, the resolution at which Steller sea lion and other marine mammal foraging behavior is understood is at much courser temporal and spatial scales than the proposed fishery management measures. Much about the effects determinations remain unknown. Thus analyses involving reductions in TAC, or broad scale seasonal or regional allocations could be more readily evaluated within the context of current understanding of marine mammal foraging and life histories than could effects of small scale (within several nautical miles) or patchwork fishery limits or closures. Alternatives which were rated insignificant for one or more elements do contain measures which would be expected to have some beneficial impacts on localized populations of Steller sea lions however these localized impacts are not expected to be sufficient to reverse of the downward trajectory of the endangered western population of Steller sea lion number and hence were deemed insignificant.

Experimental Design Potential

The management regime proposed in Alternative 3 is similar to that in the NMFS 2000 Biological Opinion (NMFS, 2000a) and the monitoring program suggested therein could be applied to the Alternatives. Because of the reduced level of the sea lion population at present, however, implementation and success of the

monitoring scheme may be difficult to gauge. Prior to the 2000 Biological Opinion experimental design, NMFS planned an experiment to test the efficacy of the no-trawl zones. It may be applicable to all the alternatives (NMFS, 1999c). All Steller sea lion fishery management measures include the presumption that fisheries cause reduced prey availability to sea lions or that by manipulation of the fishery, sea lion population trends will be effected. The efficacy of no-trawl zones experiment (NMFS 1999c) includes two studies addressing the possible effects of fishing on prey abundance and distribution. The first study has begun at Seguam Island and will address Atka mackerel issues, and the second study at Kodiak Island is addressing walleye pollock biology. Both studies are designed to determine whether fisheries result in localized depletion of the target fish, and if so, whether or not Steller sea lions may be compromised because of the depletion of prey. Both studies began in the late 1990s and will require five or more years to complete. Some physiological, behavioral, and ecological variants appropriate to measure to demonstrate food limitation, and by inference, localized depletion, are discussed in the study plan.

Re-initiation of Consultation under Section 7 of the ESA is appropriate for the proposed action

Section 402.16(c) requires re-initiation of consultation on an action "if the identified action is subsequently modified in a manner that caused an effect to the listed species or critical habitat that was not considered in the biological opinion..." The NMFS 2000 Biological Opinion was a comprehensive analysis of the BSAI and GOA groundfish fisheries and for all species listed as endangered or threatened. The proposed action, however, contain modifications to fishery management measures for pollock, Pacific cod and Atka mackerel fisheries to protect Steller sea lion that are different than the specific fishery management measures that were analyzed in the 2000 Biological Opinion. Because the determination of what constitutes differences in management measures that may be important to the determination of jeopardy to the listed Steller sea lion or adverse modification of critical habitat is quite subjective, the agency determined re-initiation of consultation is appropriate.

Section 402.16(b) also requires re-initiation of formal consultation "if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered...". Since the 2000 Biological Opinion, new information about Steller sea lion movements based on telemetry studies and new analysis of Steller sea lion scat samples have become available. An examination of that information as it relates to necessary protection measures is warranted.

NMFS recognized consultation under Section 7 of the ESA was appropriate early in this process. The consultation, limited in scope to Alternative 4, is proceeding in parallel with preparation of this SEIS. The draft Biological Opinion is contained in this SEIS (Appendix A). As such, the draft Biological Opinion undergoes public review with this Draft SEIS and all comments received on it are reproduced and will be responded to in the Final SEIS.

Table 4.1-1 Criteria for determining significance of effects to pinnipeds and sea otters.

Effects	Score					
	S-	CS-	I	CS+	S+	U
Incidental take/ entanglement in marine debris	Take rate increases by >50%	Take rate increases by 25-50%	Level of take below that which would have an effect on population trajectories	NA	NA	Insufficient information available on take rates
Harvest of prey species	TAC removals of one or more key prey species increased by more than 5%	TAC removals of one or more key prey species increased or reduced from 1998 levels by less than 5%	TAC removals of one or more key prey species reduced by 5-20%	TAC removals of one or more key prey species reduced from 1998 levels by more than 20%	TAC removals of all key prey species (pollock, Pacific cod, Atka mackerel) reduced by more than 20%	Insufficient information available on key prey species
Spatial/ temporal concentration of fishery	Much more temporal and spatial concentration in all key areas	Similar temporal and spatial fishery distribution in some, but not all, key areas	Marginally less temporal and spatial concentration than 1998 fisheries	Much less temporal and spatial concentration in some, but not all key areas	Much less temporal and spatial concentration in all key areas	Insufficient information as to what constitutes a key area
Disturbance	Much more disturbance (all closed areas reopened)	Marginally more disturbance (some closed areas reopened)	Similar level of disturbance as that which was occurring in 1998	NA	NA	Insufficient information as to what constitutes disturbance

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown
NA = Not Applicable
TAC = Total Allowable Catch

Percentages used in determining the significance of effects are given as a plausible a point of departure to initiate discussion as opposed to being deemed statistically meaningful per se. Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to Steller sea lion populations. The ideal level is undoubtably zero, however even a reduction to zero is considered to be insignificant to pinniped and sea otter populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. A similar interpretation of significance has been made for disturbance effects on pinnipeds and sea otters. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant, the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to Steller sea lion populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. In establishing criteria for rating the significance to pinniped and sea otter populations of management measures affecting the harvest levels to be established for prey species and the temporal and spatial concentrations of harvest NMFS considered management measures resulting in similar levels of TAC removals and similar temporal and spatial patterns of harvest as in 1998 to be conditional significant negative and that to achieve a rating of insignificant marginal reductions in TAC levels or marginal decreases in the concentration temporal and spatial patterns of the fisheries must be reasonably

expected to occur as a result of the implementation of the management measures contained in the alternative under consideration. To achieve ratings of conditionally significant positive or significantly positive substantial reductions in TAC levels or substantial decreases in the temporal and spatial concentrations to some or all key prey species and to some or all key pinniped or sea otter foraging areas must be reasonably expected to occur as a result of the implementation of the management measures contained in the alternative under consideration.

Table 4.1-2 Estimated incidental take of Steller sea lions and other marine mammals by commercial pollock, Pacific cod, and Atka mackerel fisheries under each alternative.

		1		2		3		4		5	
Fishery and Area	**Species or Group**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**
Eastern Bering Sea Pollock	Steller sea lion	5	3-7	5	3-7	5	3-7	5	3-7	5	3-7
(areas 508 to 530) (Trawl gear only)	All marine mammals	18	15-21	18	15-21	18	15-21	18	15-21	18	15-21
Aleutian Islands Pollock	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(areas 541,542,543) (Trawl gear only)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
GOA Pollock (W&C)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(areas 610,620,630) (All gears)	All marine mammals	3	0-8	1	0-6	2	0-7	3	0-8	3	0-8
Pollock subtotal	Steller sea lion	7	5-9	7	5-9	7	5-9	7	5-9	7	5-9
	All marine mammals	22	16-28	20	14-26	21	15-27	22	16-28	22	16-28
Bering Sea Pacific cod	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
(areas 508 to 530) (All gears)	All marine mammals	3	0-6	2	0-5	3	0-6	3	0-6	3	0-6
Aleutian Islands Pacific cod	Steller sea lion	0	0-1	1	0-2	1	0-2	0	0-1	1	0-2
(areas 541,542,543) (All gears)	All marine mammals	0	0-2	1	0-3	1	0-3	0	0-2	1	0-3
WGOA Pacific cod	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(area 610) (All gears)	All marine mammals	2	0-7	1	0-6	2	0-7	2	0-7	2	0-7
CGOA Pacific cod	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
(areas 620,630) (All gears)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
EGOA Pacific cod	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
(area 640) (All gears)	All marine mammals	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
Pacific cod subtotal	Steller sea lion	2	0-4	3	1-5	3	1-5	2	0-4	3	1-5
	All marine mammals	6	0-12	5	0-11	7	1-13	6	0-12	7	1-13
EBSAI Atka mackerel	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
(Areas 508 to 541) (All gears)	All marine mammals	1	0-4	1	0-4	1	0-4	1	0-4	1	0-4
WAI Atka mackerel	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
(Area 543)	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
CAI Atka mackerel	Steller sea lion	2	1-3	1	0-2	2	1-3	2	1-3	2	1-3
(Area 542)	All marine mammals	2	0-4	1	0-3	2	0-4	2	0-4	2	0-4
Atka mackerel subtotal	Steller sea lion	4	2-6	3	1-5	4	2-6	4	2-6	4	2-6
	All marine mammals	4	0-8	3	0-7	4	0-8	4	0-8	4	0-8
All Fisheries Combined	Steller sea lion	13	10-16	13	10-16	14	11-17	13	10-16	14	11-17
(Areas 508 to 640) (All gears)	All marine mammals	32	23-41	28	19-37	32	23-41	32	23-41	33	24-42
Percentage difference relative to Alternative 1											
All Fisheries Combined	Steller sea lion			0%		8%		0%		8%	
(Areas 508 to 640) (All gears)	All marine mammals			-13%		0%		0%		3%	

Table 4.1-3 Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Eastern Bering Sea pollock	TAC (mt)	1,400,000	1,372,290	1,400,000	1,400,000	1,400,000
	Change from Alt. 1 (mt)		-27,710	0	0	0
	Change from Alt. 1 (%)		-2%	0%	0%	0%
Aleutian Islands pollock	TAC (mt)	23,800	2,000	23,800	23,800	2,000
	Change from Alt. 1 (mt)		-21,800	0	0	-21,800
	Change from Alt. 1 (%)		-92%	0%	0%	-92%
GOA pollock Subtotal	TAC (mt)	99,349	44,509	81,882	99,351	99,349
	Change from Alt. 1 (mt)		-54,840	-17,467	2	0
	Change from Alt. 1 (%)		-55%	-18%	0%	0%
WGOA pollock	TAC (mt)	34,474	15,438	29,440	34,460	34,474
	Change from Alt. 1 (mt)		-19,036	-5,034	-14	0
	Change from Alt. 1 (%)		-55%	-15%	0%	0%
CGOA pollock	TAC (mt)	62,391	27,972	50,420	62,437	62,391
	Change from Alt. 1 (mt)		-34,419	-11,971	46	0
	Change from Alt. 1 (%)		-55%	-19%	0%	0%
EGOA pollock	TAC (mt)	2,484	1,099	2,022	2,454	2,484
	Change from Alt. 1 (mt)		-1,385	-462	-30	0
	Change from Alt. 1 (%)		-56%	-19%	-1%	0%
Pollock subtotal	TAC (mt)	1,523,149	1,418,799	1,505,682	1,523,151	1,501,349
	Change from Alt. 1 (mt)		-104,350	-17,467	2	-21,800
	Change from Alt. 1 (%)		-7%	-1%	0%	-1%
Bering Sea/AI Pacific cod	TAC (mt)	188,000	153,652	188,000	188,000	188,000
	Change from Alt. 1 (mt)		-34,348	0	0	0
	Change from Alt. 1 (%)		-18%	0%	0%	0%
GOA Pacific cod subtotal	TAC (mt)	50,848	31,639	50,848	50,848	50,848
	Change from Alt. 1 (mt)		-19,209	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
WGOA Pacific cod	TAC (mt)	18,300	11,390	18,300	18,300	18,300
	Change from Alt. 1 (mt)		-6,910	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
CGOA Pacific cod	TAC (mt)	28,988	18,034	28,988	28,988	28,988
	Change from Alt. 1 (mt)		-10,954	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
EGOA Pacific cod	TAC (mt)	3,560	2,215	3,560	3,560	3,560
	Change from Alt. 1 (mt)		-1,345	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
Pacific cod subtotal	TAC (mt)	238,848	185,291	238,848	238,848	238,848
	Change from Alt. 1 (mt)		-53,557	0	0	0
	Change from Alt. 1 (%)		-22%	0%	0%	0%

Table 4.1-3 Continued. Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
EBSAI Atka mackerel	TAC (mt)	7,800	4,753	7,800	7,800	7,800
	Change from Alt. 1 (mt)		-3,047	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
WAI Atka mackerel	TAC (mt)	27900	16,993	27900	27900	27900
	Change from Alt. 1 (mt)		-10,907	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
CAI Atka mackerel	TAC (mt)	33600	20,462	33600	33600	33600
	Change from Alt. 1 (mt)		-13,138	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
Atka mackerel subtotal	TAC (mt)	69,300	42,207	69,300	69,300	69,300
	Change from Alt. 1 (mt)		-27,093	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
Combined Total	TAC (mt)	1,831,297	1,646,297	1,813,830	1,831,299	1,809,497
	Change from Alt. 1 (mt)		-185,000	-17,467	2	-21,800
	Change from Alt. 1 (%)		-10%	-1%	0%	-1%

Table 4.1-4 Intensity of effects categories (harvest of prey species and spatial/temporal concentration) and associated percent increase to population, and new population trends for Steller sea lions.

Intensity of Effect[1]	Observed Percent Annual Change to Population	New Annual Population Trend (r, %/yr)[2]
	12	6.2
	11	5.3
	10	4.3
	9	3.4
	8	2.4
	7	1.5
	6	0.5
Much less	5	-0.4
	4	-1.4
Marginally less	3	-2.3
	2	-3.3
	1	-4.2
Same	**0**	**-5.2**
	-1	-6.1
	-2	-7.1
Marginally more	-3	-8.0
	-4	-9.0
Much more	-5	-9.9
	-6	-10.9
	-7	-11.8
	-8	-12.8
	-9	-13.7
	-10	-14.7

[1] Note: Intensity of effect combined for harvest of prey species and spatial/temporal concentration.
[2] Note: base trend is current overall annual decline rate of -5.18%.