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STATE OF ALASKA

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DEPARTMENT OF FISH AND GAME

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July 30, 2007

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Dr. Pat Livingston, Chair
Scientific and Statistical Committee
North Pacific Fishery Management Council
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Dear Ms. Madsen and Dr. Livingston:

The State of Alaska has a profound interest in understanding and promoting the recovery of Steller sea lions (SSL). We welcome this opportunity to comment on the Steller Sea Lion Recovery Plan as revised by the National Marine Fisheries Service (NMFS or agency). The Revised Recovery Plan significantly diverges from the draft developed by the Recovery Team. These changes are the focus of our enclosed comments, which we ask the Council to consider in making their recommendations to the agency on further revisions to the Plan. Please note that two attachments are included and should be considered as part of these comments[1]; they constitute preliminary draft versions of comments that we will be forwarding to NMFS in the near future.

This state has both a constitutional mandate and a long history of supporting sustainable management of fish and wildlife resources. We also are committed to strengthening the health of the state's coastal communities, which are dependent on the long term vitality of our marine resources. The state, in conjunction with NMFS and the North Pacific Fishery Management Council, has taken precautionary measures to protect Steller sea lions. However, we believe access to our marine resources has been overly diminished because of continued uncertainty surrounding impediments to recovery of Steller sea lions. Reducing that uncertainty based on sound science will require the development and implementation of a focused recovery plan. We feel the Revised Recovery Plan does not provide that focus.

The state appreciates the efforts of NMFS in its development of a Revised Steller Sea Lion Recovery Plan. Nevertheless, we are concerned by the agency's apparent departure from

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[1] Attachments include (1) an expansion of points introduced below and (2) a one-page table titled *Comparative Demographic Recovery Criteria of WDPS Steller Sea Lion and Other ESA Species compiled from the "Review and Comparison of Recovery Criteria in the 2006 Draft Revised Steller Sea Lion Recovery Plan" (Loughlin, 2007).* The first attachment is a supporting document referenced by page number in the comments that follow.

objectivity in its weight-of-evidence approach, especially in regards to the issues of nutritional stress and killer whale predation. We offer several recommendations which we hope will improve the plan. In addition to the recommendations that follow, the state believes that the Revised Recovery Plan would benefit from the insight and objectivity of a small team of recognized experts from outside the agency, if necessary, to evaluate public comments and draft the final plan.

Specific recommendations for the Plan include:

- Produce a sharpened focus on impediments to recovery rather than causes of the decline (pp. 1-2).
- Provide a more objective assessment in determining threats to recovery of the species (p. 3).
- Reduce the reliance on overarching models, while prioritizing discrete field studies on predator/prey relationships (pp. 4-5).
- Remove delisting criteria from the Recovery Plan document and develop at the time the species is proposed for downlisting (p. 7).
- Re-evaluate the western distinct population segment recovery criteria so that they are more consistent with other ESA listed species recovery criteria (pp. 8-10).
- Develop adaptive management experiments to determine effective and appropriate mitigation measures (pp. 11-12 and 19).
- Assign a higher priority to Critical Habitat re-designation based on available science (pp. 13-14).
- Recognize that current fisheries management strategies do account for the food-web needs of SSL and other consumers in the ecosystem (pp. 14-16).
- Improve coordination and integration of scientific research methods, findings, and access to existing data on the population between agencies, universities, and researchers (pp. 16-22).

Please consult enclosed comments as supporting documentation for these recommendations. (pp. refers to Attachment 1)

As noted by the Steller Sea Lion Recovery Team members, there is no consensus among the scientific community regarding causes of the SSL decline and slow recovery at current population levels. The state would like to see a more balanced representation, one that describes various hypotheses which affect recovery in a manner that allows for scientific research to be more focused, one that allows fishery management to proceed efficiently, and one that provides a recovery plan with protection for both SSLs and coastal communities.

Sincerely,

Denby S. Lloyd
Commissioner

Enclosures

Attachment 1
Draft comments on the May 2007 Revised Recovery Plan to be submitted to the National Marine Fisheries Service (due August 20, 2007)

The State has reviewed the May 2007 Draft Revised Steller Sea Lion Recovery Plan and offers here several recommendations which it hopes will improve the Recovery Plan so that both Steller sea lions (SSLs) and the residents of Alaska may benefit. *However, because of our concerns with the biased treatment of issues in this Recovery Plan, the State believes the Recovery Plan would benefit from the insight and objectivity of a small team of recognized experts outside the agency to evaluate the comments and draft the final Recovery Plan. To achieve a scientifically defensible and objective plan, the State requests that this Recovery Plan be re-written.* This action is necessary because the current process is confounded by having individual NMFS staff members who conduct research, write papers describing that research, then cite those papers as justification of their hypothesis as they help draft the Recovery Plan, review others' comments on the Recovery Plan and use justification of their own work to dismiss others' comments. The same staff is equally involved in drafting and justifying the Biological Opinion. This is not good public process.

Our specific comments are as follows:

<u>1. Sharpen the focus on impediments to recovery rather than causes of the decline</u>

There still remains much uncertainty about the causes of the steep decline of the WDPS population of Steller sea lions, and the State appreciates that further understanding of the causes of the decline may not be forthcoming; thus, focus should be placed on understanding current impediments to recovery. As recognized by the Recovery Team, a convergence of events including widespread shooting of Steller sea lions, high incidental takes, subsistence takes, killer whale predation, ocean regime shift and commercial fishing may have acted together to cause the steep declines in the 1980s. Overall, during the 1990s the rate of population decline lessened, but seems to be increasing since 2000. While it is useful to recount the likely causes associated with the decline, recognized experts cannot resolve the competing hypotheses that either describe the causes of the decline or those associated with slow recovery. Reverting to the Recovery Team conclusion (above) rather than engaging in a lengthy debate about the causes of the decline and dismissing or degrading some hypotheses to elevate the drafters' preferred hypotheses is not consistent with good public policy. Further, it distracts the focus from the current threats to recovery, which may be factors quite different than those causing the decline.

For example, in <u>Section III. Factors Potentially Influencing the Western Population</u> the focus should be a discussion of the potential threats to recovery of the species. Instead, the narrative focuses on a narrow view of the decline. This section is sometimes argumentative and unbalanced as it selectively dismisses some hypotheses based on their inability to solely account for the cause of the decline. This logic is then applied to the assessment of threats to recovery. For instance, on page 89, the Recovery Plan identifies

20% as the natural mortality rate of Steller sea lions. It then applies the estimated killer whale predation rate within one small region to the entire population. The determination is made that killer whale predation is a small percentage of the Steller sea lion mortality *before* their decline and concludes that killer whale predation *alone* was not the cause of the decline; and therefore, the Recovery Plan finds killer whale predation is not a *Potentially High* threat to recovery.

The selective elimination of some competing hypotheses that are still strongly supported by some members of the scientific community is troubling in that it results in a default hypothesis that appears to be the drafters' preferred choice. By eliminating other hypotheses (e.g., killer whales, shooting, subsistence, climate change, trawl bycatch) as the sole cause of the decline, the drafters determine, by default, that the cause must be fishing. The logic then concludes that any changes in fishing regulations from the status quo will "appreciably diminish" the chance for recovery of sea lions. Logically this is an incorrect conclusion.

Considering the current lack of scientific consensus, the Recovery Plan should focus on the cumulative impacts as they exist today. This approach provides a focus for further research and management that adapts to likely threats. If food availability is a viable hypothesis, then it should be dealt with evenly. Whether nutritional stress results from a changing climate and resulting changed ecosystem, or from localized depletion from fishing that impacts the segment of the stock at risk, the uncertainty should be fairly and fully evaluated. Likewise, the potential impact of killer whale predation needs to be examined based on available empirical and modeling information, including the concept of a predator pit that sea lions are having trouble climbing out of.

To properly refocus on the *threats to recovery* rather than the *causes of the decline*, the State recommends that the next revision of the Recovery Plan include the following:

- It is legitimate that the agency cites continued uncertainty about future reproduction rates at some rookeries (Holmes et al., *in press*) but it is not legitimate to use this single modeling exercise to contradict the overall positive trend of this species. Even if population trends decrease in some areas, it remains unknown whether reduced reproduction and natality rates occur elsewhere. If they do occur elsewhere, whether they are caused by nutritional stress due to environmental variability or to competition for prey. Alternatively, determining natality from pup to non-pup ratios assumes missing pups were lost to bottom-up mechanisms rather than other factors (discussed further in Item 2, bottom of page 5). To what extent these types of mortality occur throughout the range of the WDPS of SSL is unknown, but it is an alternative that should be considered when looking for missing pups.

- An example of how to sharpen the focus on current threats would be the inclusion of a Threats Assessment Table that evaluates threats to reproduction and natality using the same format as was used in Table IV-1 on page 120. For instance, toxic substances, heavy metals, diseases (such as Chlamydia), parasitism and killer whale predation of pups at rookeries are all recognized as possible threats to recovery associated with the reproductive rates of adult females and survivability of pups; but may not be significant threats to the entire population. Such an assessment will help focus and balance the development of recovery criteria, and an appropriate implementation plan that could, for example, assist in securing handling permits of adult females.

2. The Recovery Plan would benefit from a more objective assessment in determining threats to recovery of the species and the current health of the stock.

The NMFS Recovery Plan does not adequately consider aspects of nutrition, health of the stock, the current impact of killer whale predation or carrying capacity.

Health of the WDPS

The Revised Recovery Plan does an inadequate job of describing the current positive status of the WDPS. Specifically, the survey data since 2000 indicates the population has stabilized with an average increasing trend of 3% annually (Fritz and Stinchcomb, 2005), and that the body condition and survivability of adult females and pups (Rea et al., 1998a & 2003; Davis et al.,1996; Adams, 2000) and juveniles (Fadley et al., 2005) demonstrate no signs of nutritional stress. Further, researchers found no difference in Steller sea lion milk composition (Davis et al., 1996; Adams, 2000), and no difference in maternal attendance patterns or foraging trip duration (Brandon, 2000; Milette and Trites, 2003; Andrews et al., 2002) between eastern and western DPS of Steller sea lions. All these studies suggest that adult females at rookeries did not have difficulty finding prey during the summer. Futhermore, no apparent difference was observed between average winter attendance cycles of females from declining western DPS haul-out populations (Marmot Island and Cape St. Elias) and increasing eastern DPS haul-out populations (Timbered Island) (Trites et al., 2006b).

A side-by-side comparison of the 2006 and 2007 Recovery Plan documents indicate changes that appear to reflect a selective bias in the later document. The changes between the documents cannot be attributed to NMFS responding to the 2006 comments by reviewers, because most all of these were set aside to be addressed in the next BiOp. An example of this apparent bias in the May 2006 Draft Recovery Plan (page 215), "The general conclusion from these physiological studies comparing the eastern and western DPS during the 1990s has been that nutritional stress was not evident in adult females or pups." However, in the most recent version (May 2007, Page 40), this statement has been modified by drafters with the insertion of the word "*acute*" in front of nutritional stress. This slight addition changed the meaning, potentially implying that evidence for "*chronic*" nutritional stress *does* exist despite the strong weight of evidence that it does not. The concern over this significant change is that it provides a spring board in support of a modeling exercise based on the demographics of Marmot Island (Holmes et al., *in review*). This modeling exercise anticipates a down-turn in future reproduction rates, extrapolates it to the entire WDPS population, and links the anticipated down-turn to lingering chronic nutritional stress based on other modeling exercises (Holmes and York 2003; Fay, 2004).

In describing environmental variability as a cause for nutritional stress, the drafters selectively dismiss many of the diet studies that would lend support to environmental causes of nutritional stress. This action implies that competition for prey with fisheries is the only plausible threat to recovery of the WDPS population of Steller sea lions. In doing so, this undermines their own *Potentially High* rating for environmental variability as a threat to recovery as presented in the May 2007 Revised Recovery Plan.

The agency drafters give this approach more weight than actual field tests and studies cited above to justify conclusions that nutritional stress, caused by competition for prey, is the greatest threat to recovery. This approach dismisses the conclusions of the National Research Council (2003), the nation's most prestigious science panel, which concluded that top-down predation rather than bottom-up nutritional stress was the more likely cause of the decline. It also contradicts the weight-of-evidence approach used by the Steller Sea Lion Recovery Team. Unable to find consensus because of continued uncertainty, the team identified both approaches as *Potentially High* threats to Steller sea lion recovery, recognizing that there might be multiple causes. In its assessment of evidence on nutritional stress and the elimination of killer whale predation as a *Potentially High* threat, the May 2007 revised draft seems to departure from a reasonable weight-of-evidence approach.

Killer Whale Predation

When the National Marine Fisheries Service took possession of the Steller Sea Lion Recovery Plan from the Recovery Team they significantly rewrote the section on killer whale predation (pages 82-90 and 114), and concluded that killer whale predation should be downgraded from a *Potentially High* threat to a *Medium* threat. We are told this change was made based on public comment and new research. However, no support of reducing the threat of killer whale predation is found in the agency's response to public comments. Recent research does not seem to support such a critical shift in thinking. Rather, there is still significant scientific support for an alternative hypothesis.

The Recovery Plan does not present an objective description of research on killer whale predation. Instead, the drafters' presentation discredits work that supports predation as a significant impediment to recovery. The narrative seems combative in pitting recent work done by Maniscalco et al. (2007), "Assessing Killer Whale Predation on Steller Sea Lions from Field Observations in Kenai Fjords," against the published work of Williams et al. (2004), "Killer Appetites: Assessing the Role of Predators in Ecological Communities."

Maniscalco et al. (2007) report on predation of transient killer whales in the Kenai Fjords and on Chiswell Island; the work of Williams et al. (2004) was based on data collected from the Aleutian Islands. The methods used in the two papers differ considerably, as do the regions and populations of killer whales. Nonetheless, the narrative in this section of the NMFS Recovery Plan seems to apply findings in the Mansicalco paper to findings in the Williams paper, and determines Williams is incorrect. In doing so, it specifically ignores strong admonition in the Maniscalco et al. (2007) paper stating, "Caution should be emphasized if comparing these results to other times and areas because the activity budgets and feeding rates of these killer whales may vary during times when not observed in our region. Furthermore, the specialization in predation behavior by this group of transient whales should not be extrapolated across transient populations, nor would it be appropriate to extrapolate their effect on Steller sea lion populations to other regions because of differing behaviors between transient groups."

The drafters of the May 2007 Recovery Plan ignore these cautionary caveats. Instead, they seem to apply the resting and foraging times of Kenai Fjord and Chiswell Island killer whales studied in the Maniscalco paper to the Williams energetic model and claim the Williams work to be incorrect. They state that the Williams paper predicts 170 transient whales would have been required to cause the SSL decline in that region; when in fact the Williams paper estimates fewer than 40 could have caused the decline. The plan also fails to recognize that recent killer whale survey data on the BSAI indicates a dramatic increase in the estimated number of transient killer whales in that region from 170 used in the Williams et al paper to an updated estimate of 314 transient killer whales which should heighten rather than diminish concerns about killer whale predation. Based on this misapplication and estimation error, the May 2007 Recovery Plan dismisses killer whale predation as the single cause of the decline and uses this reasoning to reduce its potential threat to recovery.

Interestingly, the authors of this section ignore another paper written by Maniscalco et al. (2005) on "Reproductive Performance and Pup Mortality in Steller Sea Lions." This paper also uses breeding, birth and pup mortality observed from the remote video camera at Chiswell Island. Based on video camera observations, pup mortality in three of four years was over 20%. In one year 10 of 12 mortality events were due to killer whale predation. In another study, also generated from observations at Chiswell Island, Matkin et al., (2005) estimated that annual killer whale predation in the Kenai Fjords region was 8.5%, which "is not insubstantial and may impact recovery." These observations of predation events, though not cited in the Recovery Plan, seem to support the agency's own conclusion on page 114 that killer whale predation "is perhaps the largest single source of Steller sea lion mortality." Based on this conclusion, it is puzzling that the Recovery Plan downgrades the threat of killer whale predation from *Potentially High* to *Medium*.

It is important to note that the observed reproductive performance rate at Chiswell Island as reported in this paper (Maniscalco et al., 2005) is 82.5%, well above the 64% reproductive rate predicted in the Holmes et al. (*in press*) natality study done at Marmot Island. However, just as the reproductive performance results from Chiswell Island should not be extrapolated to test a modeling effort on Marmot Island; neither should the killer whale predation events and caloric usage based on foraging time be extrapolated from Chiswell Island to the Aleutian Islands. *Similarly, the reproductive rates at Marmot Island as predicted by Holmes et al. (in press) should not be extrapolated to the rest of* *the WDPS Steller sea lion population without field research (see page 17 for further discussion).*

Holmes et al. (*in press*) assumes there are natality problems (low pup/non-pup counts) because pups are missing during some years when the high resolution photography used in aerial surveys is examined. The constant video monitoring and field observations at Chiswell do not corroborate these findings. Instead, they show that storm waves and killer whale predation mortality often occur within the first months. This is because first time mothers take less optimal places on rookeries, where waves wash pups away. Also, mothers that have both pups and last year's still-nursing juveniles are less attentive to their pups and may lose them to storm waves or killer whale predation (Dr. Atkinson, June SSLMC meeting). It may be possible that similar dynamics could have caused the reduced pup population observed during the single aerial fly-over and reported at the Holmes et al. rookeries. Photography will only show that the pups are not there; not that they were eaten by killer whales or washed away. *Field observation and video studies are needed on these larger rookeries to validate the Holmes hypothesis.*

Lastly, the Council and SSC requested the literature that describes density dependent/density independent effects of predation be considered in respect to killer whales depressing recovery response at low SSL population levels. This evaluation is not presented in the revised killer whale section and should be included as an important factor in determining the potential threat of killer whale predation on the recovery of Steller sea lions in the WDPS.

In sum, there is little evidence to support a downgrading of the threat assessment of killer whale predation from *Potentially High* to *Medium*. Such a downgrading is premature and does not show support for important research that would likely reduce uncertainty. Further, it disproportionately inflates the impact of other speculative threats to recovery of this species.

<u>Carrying Capacity and Recovery Criteria</u>

During a June 2007 discussion regarding the Holmes et al. natality hypothesis with the Steller sea lion mitigation committee (SSLMC), Dr. Demaster described his concern with carrying capacity. To paraphrase, Demaster stated that something in the environment is causing an increasing mortality and changing vital rates. He speculated that Steller sea lions are acting like a population above carrying capacity. The fact that NMFS has recognized limited carrying capacity as an actual possibility affecting Steller sea lions means they also understand, under that alternative, there is the possibility that the current population level may be close to equilibrium.

A delisting criterion requiring approximately 107,000 animals as a specific goal in the Recovery Plan is fine if the carrying capacity remains the same for this species as it was in the early 1970s. The problem is there has been a large shift in the ecosystem since that time. The removal of 2,784,400 metric tons of Pacific Ocean Perch and other red rockfish (1960-1977 [Balsiger et al., 1984]) in conjunction with the depleted state of humpback whales, would have released significant forage into the ecosystem when climates were cold and conducive to SSL production (Maschner, 2007). The 1977 regime shift from cold to warm climate also greatly changed the ecosystem and caused a dramatic increase in pollock and cod stocks. Many large whales that feed on herring and other forage needed by Steller sea lions for a balanced diet have started to rebuild and compete for food. Lastly, since the 1960s, the North Pacific Ocean has also become a fished ecosystem. Societal needs for a healthy fishery resource may, in conjunction with the return of humpback whales and expanding gadid and flatfish populations (particularly Arrowtooth flounder in the Gulf of Alaska and now in the Bering Sea) compete directly with Steller sea lions and this may have lowered the carrying capacity for Stellers. The Endangered Species Act (ESA) was enacted to prevent species from going extinct, not to try to maintain populations at levels beyond carrying capacity. Since we do not know for certain what the current carrying capacity is for SSL, setting a 30-year target at 107,000 animals could be an unreasonable benchmark until the science can provide clearer insight.

A need for rebuilding within the available carrying capacity was considered in developing a recovery plan for the Rocky Mountain gray wolf. Rather than choosing a number within the range of historically high levels of the population, the U.S. Fish and Wildlife Service addressed ESA rebuilding and establishment of Critical Habitat for the gray wolf, recognizing their habitat had been modified by man. This was a societal decision: one that recognized a reduction in carrying capacity, yet set forth a recovery plan that assures the wolf population will not go extinct.

As found in a U.S. Fish and Wildlife Service (2007) publication on the grey wolf ESA listing:

> Question 3: "Does this mean the U.S. Fish & Wildlife Service will require wolf packs to be maintained throughout all the states of Montana, Idaho, and Wyoming?"
>
> Answer 3: "The recovery goals only mandate that each state maintain at least 10 breeding pairs and at least 100 wolves per state, within the general area currently occupied by wolf packs. There are many parts of Montana, Idaho and Wyoming where once-historic wolf habitat has been so modified by human use that it can no longer support wolf packs. The state fish and game agencies will regulate human-caused mortality so that in many parts of those states wolf packs will never form. The Service fully recognizes that wolves cannot occupy their entire historic range, and supports limiting wolf distribution to suitable habitat as long as recovery is not threatened." (Source: *http://www.fws.gov/mountain-prairie/species/mammals/wolf/NRMQA.pdf*)

There are too many unknowns and competing hypotheses of the factors affecting Steller sea lions at this time. By the time the species can be downlisted the science should be fully mature to aid in the development of reasonable delisting criteria. Based on concerns raised in this section, the State recommends the following:

- Return the threat assessment of killer whale predation to *Potentially High*

- Include citations of literature that describe density dependent/density independent effects of predation and an evaluation of this issue as it relates to killer whale predation on the current WDPS Steller sea lion population size and its recovery.

- The status and health of the SSL has improved. The Recovery Plan must clearly state and describe the current positive status of the WDPS population trend, the overall good body condition, and survivability based on the volume of work cited in the Recovery Plan. The Recovery Plan should clearly state that the single remaining concern is the reproductive rate of the WDPS. This will help focus research and management for this stock.

- The Recovery Plan should discuss the fact that while the 3% annual increase in the WDPS population is below the 12% default rate for pinnipeds used in the Marine Mammal Protection Act, it is statistically similar to the trend of the EDPS which is recommended for delisting. This may be a carrying capacity issue.

- Be very cautious about extrapolation of localized research to other regional studies.

- Add caveats to the Recovery Criteria that provide for reducing the downlisting requirements if carrying capacity limits becomes the preferred hypothesis.

- Eliminate delisting criteria from the Recovery Plan. These criteria should be developed at the time downlisting is proposed based upon all available science at that time.

<u>3. Re-evaluate the WDPS SSL recovery criteria so that they are more consistent with other ESA listed species recovery criteria.</u>

The Council hired Dr. Tom Loughlin to prepare a report that would compare recovery criteria proposed for the WDPS of Steller sea lions with eleven other ESA listed species. While the report provided detailed recovery criteria requirements for each species in its appendix, it made only generalized comparisons in the text and tables. Dr. Loughlin was asked to compare the use of PVAs, population growth, sub-area requirements and evaluate whether sufficient rationale was used in development of those criteria. A basic *yes* or *no* format was used in making these comparisons. The Recovery Plan would benefit greatly if this information were presented in a single table. ADF&G has developed such a detailed table (Attachment 2) that provides Loughlin report information. The table is used here to make the following observations:

- The population of WDPS SSL, including the Russian component, is 60,000 animals. The proposed demographic performance requirements for downlisting this population include: (1) a statistically significant average increase in the U.S.

non-pup population over 15 years (1.5 generations) to increase it from 44,000 to 55,000; (2) increasing trends in 5 of 7 sub-regions (including Russia); (3) no declines in any 2 adjacent sub-areas; and (4) Slow increased population trends.

- The proposed demographic performance requirements for delisting the SSL WDPS include: (1) a 3% average population increase over 30 years (3 generations); (2) increasing trends in 5 of 7 regions (including Russia); (3) no declines in any 2 adjacent sub-areas; and (4) no decline of more than 50% in any single region.

- None of the other listed species required an average population increase over three generations as is required for delisting of the WDPS SSL.

- The highest generational performance rate for other listed species was the Puget Sound killer whale with a current population of only 90 animals. It requires a 2.3% annual average population growth over 1 generation (14 years) for downlisting and a 2.3% annual average increase for 2 generations for delisting. It has no other demographic performance requirements.

- The North Atlantic right whale, with an estimated population of 300 animals, has recovery criteria requiring a 2% annual average population increase for 35 years. There are no other demographic performance requirements for downlisting. The population would no longer be considered threatened when the probability of becoming endangered is less than 10% percent in a minimum of 10 and maximum of 25 years. There are no additional delisting criteria specific to this plan.

- The fin whale population (150,000 animals), must remain *stable* for 1.5 generations or 26 years for downlisting. Or the probability of extinction less than 1% in 100 years in each ocean basin for downlisting.

- The threatened sea otter requires only that its current population of 3,090 animals remain *stable* over a three year period to be delisted. There are no other demographic performance requirements.

- The threatened Rocky Mountain grey wolf plan requires that a population of 300 wolves be reached, including 30 breeding pairs. No time period is identified. There are no other demographic performance requirements. It is currently proposed for delisting.

- Of the ten endangered or threatened species only four plans: the Monk seal (population 1,300), the grizzly bear (1,400), the spectacled eider (1,700 pairs) and the manatee (3,276) include any regional performance requirements.

- The Hawaiian Monk seal (population of 1,300 animals) is required to reach a population of 2,900 animals, have a population of more than 100 animals in five of the six regions, and that the Main Hawaiian Islands population is above 500 animals. Also, population growth must not be negative in 2 areas.

- The Yellowstone grizzly bear criteria require that 16 of 18 segments be occupied by females with young from a running six year sum and that the total population include a minimum of 15 females with cubs over a running six year average.

- The threatened spectacled eider population in the Yukon-Kuskokwim Delta, North Slope and Arctic Russia regions is estimated to be 1,700 breeding pairs. This population will be considered recovered when each of those three populations is considered *stable or increasing* for ten years and there are a minimum of 6,000 pairs OR there are 10,000 pairs for 3 years OR 25,000 pairs in 1 year.

Despite a population of 45,000 animals (60,000 if the Russian population is included), the demographic performance requirements proposed for downlisting and delisting of the WDPS SSL are, by contrast to these other listed species, both singularly and cumulatively more demanding than any of the other species included in the Loughlin report. This includes endangered species with populations less than 1,000 animals and one population, the Puget Sound killer whale, with less than 100 animals that requires an annual average population increase of 2.3% over two generations for delisting of the species. Justification for the complex recovery criteria developed for this SSL population is not provided in the Recovery Plan. *The State requests development of recovery criteria more consistent with those provided for other protected populations.*

Though recovery criteria for other species seem to include one or two demographic goals, including the EDPS with a single demographic goal, the WDPS has several. In a peculiar breach of consistency, the agency drafters respond quite differently to comments on the sub-regional demographic performance criteria of EDPS and WDPS. Specifically, in its response to comments, the agency disagrees with comments that the EDPS should not be delisted because it has not been divided into sub-regions as has the WDPS and that populations in California remain at high risk of extinction. The agency responded that the Steller sea lions breeding and residing in southern California did not represent "a significant portion of the range of the eastern DPS… largely because they live at the southern extent of the eastern DPS range and populations often fluctuate most at ends of their ranges. Also, there is evidence that the eastern DPS has moved northward. Splitting the eastern DPS into sub-areas would not alter the fact that populations in all other areas besides California have either increased steadily or been stable for an extended period of time." Yet in response to a comment on the necessity of the demographic criteria for WDPS that prohibits delisting if a decline of more than 50% occurs in any single sub-area occurs, the agency responds, "This criterion prevents loss of a significant portion of the range of the WDPS, which is a requirement of the ESA."

While the EDPS is not divided into any sub-regions, the WDPS is divided into seven sub-regions. The western Aleutian Island sub-region, for example, has only three rookeries. If the population of those three rookeries which does not seem to represent "*a significant* *portion of the range*" as required by the ESA, were to decline more than 50%, the current criteria would prohibit delisting even if the overall population achieved an annual average population increase of 3% or more for three generations and even though it has been documented that the WDPS is moving eastward as the EDPS seems to be moving northward.

Based on the demographic performance criteria for other species and to the EDPS, the WDPS criteria, by comparison, seem unreasonably conservative, and almost punitive. *The State believes that the demographic performance requirements seem designed to prohibit downlisting and delisting even after the species is well recovered by any other standard.*

Additionally, the State is requesting that NMFS use the existing status review and the new information from research to rewrite the criteria so that they are more on par and consistent with other listed ESA species (Attachment 2). The recovery criteria are what will be used until they are changed after the next status review – so we recommend bringing some consistency to these criteria now.

<u>Recommended Changes in Recovery Criteria</u>

- Based on the conspicuous disparities in recovery criteria, the agency should revisit the demographic performance requirements of the recovery criteria and develop a more consistent approach in line with the current population level of the WDPS of Steller sea lion. No more than one or two demographic requirements should be included.

- Either the Russian population should be included in the total number of animals (60,000 as compared to 45,000 in the U.S.) or Russia should be excluded from all recovery criteria including the use of two adjacent areas as a population performance requirement. No other ESA delisting criteria include an international segment of an ESA population that requires foreign action without an international agreement or treaty to assure such protection. While whale species and the spectacled eider populations overlap into international and foreign waters, protection of those species in regions outside the U.S. are agreed to and enforced with international treaties and agreements. No such agreements exist to enforce protection of Steller sea lions in Russian waters, and thus a number of the Recovery Criteria might not be met which would stop downlisting or delisting due to activities in Russia. Without a formal international conservation agreement, responsibility for the Russian portion of the WDPS should be eliminated from the next revision of the Recovery Plan.

- The requirement that the overall population demonstrate a "statistically significant" growth in population to be downlisted is an unacceptable benchmark because it lacks a clear definition. Some level of population growth needs to be specified in the Recovery Plan. Other recovery plans include criteria such as "stable or increasing," or "zero or above." In its response to comments, the agency says it will address the issue of defining a "statistically significant" population at the time of downlisting. This subjective and unnecessarily ill-defined approach is counter to the ESA requirement that criteria be clear and objective. In compliance with that ESA requirement, the State recommends that, like other recovery plan criteria identified in the Loughlin report, the agency use "zero or above" or "stable or increasing" instead of "statistically significant" in describing required population growth for downlisting.

- The State believes that downlisting/delisting criteria should be revised on par with other ESA listed species recovery criteria.

4. Re-evaluate recovery actions that require an adaptive management experimental design and maintenance of current mitigation measures.

The Recovery Plan designates the design and implementation of an adaptive management plan (Task 2.6.8) with a 2a priority rating which identifies it as "(2) An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant impact short of extinction and (a) Actions that should either be taken first, or are of primary importance." While the State is pleased that this task has not been given a Priority 1 rating, a 2a Priority rating is not a meaningful improvement. This is still too high for an action that is seemingly impossible to accomplish without incurring great costs and potentially disenfranchising fishing participants and coastal communities. Its purpose and scope also remains ill defined, requiring "*design and implementation of an adaptive management program to distinguish between the effects of fisheries, climate change, and predation of the western Steller sea lion.*" This description is too similar to the 2001 "red/green" area assignment and is unreasonable in scope: one that would seem to be in conflict with the requirement that *current* mitigation measures be maintained. Lastly, at such a high priority it would likely garner research funds better spent elsewhere. Although the agency has been largely unresponsive to this public comment, the contradiction remains.

The failure of a population to recover is generally because it fails to reproduce at a rate that exceeds general mortality in the population. Since 2000, surveys show that population levels are increasing overall and vital rates of adults and juveniles indicate good body condition and survivability. However, recent modeling efforts using the Marmot Island population near Kodiak, raise concern that lower reproduction and natality rates may occur in the future and threaten the current positive population trend. It is unknown whether nutritional stress, pup mortality from killer whale predation, storm surges, or a combination of effects may impede reproductive and natality rates. It also remains unknown whether competition for prey or environmental variability is the cause of nutritional stress. For this reason, NMFS and others have recommended that an adaptive management experimental design be developed to test the hypothesis that competition for prey with commercial fisheries is the cause of nutritional stress. However, the scale of the experiment, the requirements to survey and monitor opened and closed sites and the disruption to fisheries make this proposed action extremely costly and potentially impossible given the requirement that current fishery mitigation regulations (50 CFR 679) remain in place until the species is recovered. Further, its focus on the entire population seems misdirected and the likelihood of unequivocal results seems slim.

Instead of a large-scale experimental design, the agency should modify this proposal so that it relies on a more localized design and requires that *appropriate* rather than *current* mitigations be maintained until the species is recovered. In this way, the Recovery Plan can best *adapt* to increased scientific information and test the competition for prey with fisheries hypothesis without unduly disenfranchising fishermen and fishing communities dependent on those fisheries. More importantly, it can appropriately focus on the segment of the SSL population considered most at risk.

As generalist, multiple-central-place foragers known to target prey (at least in part) during dense seasonal prey aggregations, SSL likely have several foraging options that are not captured by the fixed, year-round Critical Habitat definition required by ESA. Recovery tasks in the Recovery Plan should investigate whether declines in local prey abundance or changes in prey distribution will cause negative impacts on SSL survival, considering that SSL are able to successfully move to new haulouts by 2 months of age where similar prey at higher density or other prey types are available.

While Critical Habitat must remain fixed, mitigation measures should consider the type of usage made of critical habitat by SSL. Relative vulnerability of SSL to indirect or direct disturbance during different phases of at-sea activity should be assessed if possible (*i.e.*, does human disturbance within SSL travel routes to offshore foraging grounds have similar impact on SSL foraging as disturbance within the foraging grounds?).

To insure that the recovery actions are science driven, cost-effective and well focused on results, the State recommends the following:

- The recovery action that requires maintaining current mitigation measures for all segments of the population, when pregnant females and newborn pups are the population of concern, does not seem well grounded in a science-driven process requiring adaptive response to the best scientific information available. *Specifically, the recovery criteria requirement to keep in place current fishery mitigation regulations at 50 CFR part 679 should be modified to accommodate adaptive management and mitigation measures based on the best available science.* To better promote the protection of adult females and new born pups, for instance, mitigation measures might be redesigned to protect rookeries where reproduction or natality rates are in decline. Or if field studies indicate a specific fishery is not negatively affecting prey fields, mitigation measures should be adjusted appropriately. Under current regulations, appropriate adjustments or discrete experimental designs in areas that are currently closed are prohibited from occurring.

<u>5. Heightened Priority should be given to redesignation of Critical Habitat.</u>

The term Critical Habitat is defined in the ESA (16 U.S.C. 153) to mean: "*Those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection.*" The ESA also states, "*Except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species.*"

Critical Habitat was designated in 1993 as a precautionary measure in face of the precipitous decline of SSL by unknown factors. Foraging areas were determined based on platform-of-opportunity sightings by observers aboard fishing vessels, incidental catch data of Steller sea lions by fishing vessels and early foraging studies. It is not surprising that, based on the platform-of-opportunity information available at the time, critical habitat overlapped with fishing grounds.

Critical Habitat designations for SSL in the WDPS (excluding the several 'marine foraging areas') are circular buffers of identical fixed radius around major terrestrial rookeries and haulouts. These were based on limited studies of SSL foraging. Circular critical habitat relies on the assumption that SSL have an equal probability of foraging in any direction from the haulout, and that SSL foraging radius is similar across their range. These are not realistic assumptions, although we acknowledge they followed the precautionary principle and use best-available data at the time they were designated. Efforts proposed by the Recovery Plan to determine preferred SSL foraging habitat features and nearshore activity should be used to reshape these critical habitats.

Significant new information is now available about life history patterns and timing of rookery and haul-out use, vulnerable segments of the population and foraging activities based on telemetry tracking of animals and other studies. However, the agency dismisses high priority given to redesignation of Critical Habitat in its response to comments and assigns it a Priority 3, the lowest priority level in the implementation plan. This posture is puzzling considering the agency's heightened interest in adverse modification to Critical Habitat that may impede recovery of the species, rather than just avoidance of jeopardy. Further, the Recovery Plan and response to comments often refers to testing the "efficacy" of mitigation measures in reducing fishing in Critical Habitat. *Of what relevance could such a test have if it is measuring fishery impacts in areas not critical to the survival and recovery of the species?*

In view of the above, the State recommends that redesignation of Critical Habitat, currently given the lowest priority level of 3, should be given a higher priority of 2a and be undertaken as soon as possible.

<u>6. Revise comments and research priorities in the Recovery Plan that unnecessarily undermines the exceptional management of fisheries in waters off the coast of Alaska.</u>

The State of Alaska has been a strong advocate for precautionary management of both state and federal fisheries off its coast. Fisheries in Alaska are widely recognized as among the best managed fisheries in the world. Nonetheless, the Steller Sea Lion Recovery Plan on pages 102 and 103 and the agency's response to comments seem to question current management strategies, implying ecosystem overfishing (Recovery Action 2.6.7). Specifically, it seems to question maximum sustainable yield (MSY) harvest strategy and the current ecosystem approach to calculating prey for Steller sea lions as part of the natural mortality calculations made in determining allowable harvest levels of groundfish species. It also ignores other important ecosystem approaches to management including the optimum yield (OY) caps, harvest control rules, bycatch caps and prohibition of targeting on forage fish that all contribute to a precautionary management approach that leaves more fish in the ocean than recommended as Allowable Biological Catch limits.

The agency's sustainable fisheries staff have investigated and incorporated ecosystem considerations and specific analysis of food web relationships in a multi-species population analysis of the Eastern Bering Sea (Livingston et al., 2000), comparison of ecosystem food web models (Aydin et al., 2002), inclusion of predation mortality in GOA stock assessments (Hollowed et al., 2000) as well as inclusion of ecosystem indicators in annual stock assessment documents. Finally, it is well recognized that a fixed OY cap and other mechanisms cited above are unique and highly precautionary mechanisms that further limit overall removals from the ocean. In short, management of North Pacific fisheries is on the leading edge of ecosystem management, including food-web relations and this should be properly acknowledged rather than undermined in the Recovery Plan.

Based on the agency's own participation in the management of what is widely recognized as the best managed fisheries in the world, it seems inappropriate that the drafters from the same agency undermine those efforts in this Recovery Plan by failing to acknowledge these precautionary measures and implying that current harvest strategies are inadequate. This is a further example of the Recovery Plan casting its net too far. In view of the above, the State recommends the following:

- *The paragraphs questioning current MSY management of the federal fisheries in the North Pacific on pages 102 and 103 should be modified to acknowledge current management efforts to protect food-web relationships.*

- *Lower priority should be given to Recovery Action 2.6.7, now tagged as a Priority 2b, which seeks to overhaul how prey needs are incorporated into stock assessment models and harvest strategies.* There are currently no overfished groundfish stocks in the North Pacific and, because of the OY cap and other mechanisms, significant amounts of harvestable biomass are left in the water for consumption by others. Further, since there is not yet strong evidence of nutritional stress, this sort of research seems premature, especially when funding is limited.

7. Prioritize the development of a focused implementation plan with research objectives that are likely to reduce uncertainty surrounding the threats to recovery.

Coastal communities and fishing participants have shouldered costly mitigation measures as a result of continued uncertainty about the cause of the decline and threats to recovery of the WDPS of Steller sea lions. The federal government has shouldered approximately $120 million in research money to reduce that uncertainty. The Revised Recovery Plan has developed an implementation schedule with an estimated price tag of $430 million. Significant funds will be used to conduct research aimed at reducing this uncertainty over threats to recovery of the WDPS. However, research funds are limited and a very disciplined approach should be taken to develop a meaningful implementation program that is well-targeted to understanding and mitigating the threats to recovery of the species. A focused, cost-conscious and results-oriented approach should be exercised in its development.

While it seems necessary and appropriate to design a research plan that seeks to reduce uncertainty, those experiments should be focused, well controlled, able to produce meaningful results and adapt to new information in a timely fashion. The State recommends the following:

- *NMFS should reconsider the ranking of only one task (estimate trends for pups and non-pups via aerial surveys) as a top priority activity. We encourage NMFS to elevate Task 1.5 (Develop an implementation plan) to Priority 1.* With significant volumes of new data available it is important to mobilize a team of experts to integrate new insights into the planning and implementation of a focused, cost effective, results-oriented research plan. The team should include experts outside the agency and be conducted as part of a transparent process, perhaps through the North Pacific Research Board. We also consider Task 1.2.1 (Continue to estimate vital rates through branding/resight program) to be critical to resolve uncertainty over the threats to recovery of the WDPS, and recommend elevation of this task to Priority 1. Without an indication of what vital rate is changing to create a change in population trajectory, there still remains significant uncertainty on the potential causes of population change that would restrict implementation of appropriate conservation measures. Expanded vital rates research has been limited to a few locations in the WDPS and should be broadened to allow differences between rookeries across the range to be assessed, leading to finer-scale understanding of SSL population responses to management decisions. Further, we also encourage elevation of Task 3.5.1 (Coordinate research efforts to reduce potential for unnecessary or duplicative research) to priority 2a. This is a requirement of all MMPA/ESA research permits. Currently the majority of coordination effort is undertaken by individual researchers, however a designated NMFS research coordinator would greatly facilitate these efforts.

- *NMFS must ensure that new and emerging research and analytical techniques are applied to all aspects of Steller sea lion recovery research.* New technique development and implementation must receive high priority within Tier 2a to find new approaches to close data gaps that currently generate high uncertainty. One area of research to which this is very applicable is in the determination of vital rates such as reproductive rate. Specialized mark-recapture techniques recently adapted for vital rates research on Steller sea lions in the EDPS should be applied to the WDPS in a broad fashion where sufficient numbers of branded adult females are available to assess reproductive rates at multiple rookery locations. Although this technique for the direct assessment of rates of reproduction is currently being utilized at some locations in the WDPS, support should be provided for this application to broaden to all sites where sufficient numbers of females are available. This would allow potential differences between rookeries across the range to be assessed and compared/contrasted to model predictions developed from data collected in the Gulf of Alaska (Holmes et al., *in press*). The expansion of this technique may also permit comparisons in rookery usage/rookery fidelity which may provide insight on the plasticity of adult female responses to localized adverse modification of habitat or other threats. Other specific examples would be the development and utilization of new capture techniques that would allow study of older and larger animals, application of improved statistical techniques that address the limitations of foraging behavior data and new laboratory methods for analysis of diet composition such as fatty acid signature analysis, stable isotope analysis and DNA analysis of scats to identify prey remains.

- *The Recovery Plan should consider density dependent effects in all aspects of ecosystem research. We recommend that the implementation plan seek out opportunities to investigate the carrying capacity of the ecosystem to support Steller sea lions, potentially through Task 2.4.3 (Distinguish how natural and anthropogenic factors influence marine ecosystem dynamics and subsequent sea lion population dynamics).* There is a long time series of data available for EDPS population trends, combined with recent intensive focused research in vital rates, foraging ecology, growth and body condition of juvenile Steller sea lions (and to a lesser extent adult females in the 1980s) during a period when this population has been increasing in size and expanding breeding rookery locations. There is preliminary evidence that this population is being impacted by density dependent effects [such as lower growth rates of pups (Fadely et al., 2004) and higher incidence of parasites in pups (Beckmen et al., 2005) compared to WDPS pups]. This may provide research opportunities to investigate the carrying capacity of the ecosystem to support Steller sea lions, and to more fully understand changes to Steller sea lion demographics when the system is at carrying capacity for this species. It should be considered that the carrying capacity for the WDPS may be different than that of the EDPS, leaving one to question whether it is realistic to assume that the WDPS could attain a similar rate of population increase to that recently documented for the EDPS (or conversely if it should be much higher for a marine mammal population that is below its carrying capacity).

Comparative Demographic Recovery Criteria of Western DPS Steller Sea Lion and other ESA Species

Compiled from the "Review and Comparison of Recovery Criteria in the 2006 Draft Revised Steller Sea Lion Recovery Plan" (Loughlin, 2007)

SPECIES	NUMBER - STATUS	DOWNLISTING CRITERIA			DELISTING CRITERIA			
Western distinct population segment of Steller sea lions	60,000 - Endangered	U.S. population shows statistically significant increase for 15 yrs & slow increasing pop trend	Trends in non-pups in at least 5 of 7 subareas, including Russia, are stable or increasing	Any two adjacent regions cannot show a decline	U.S. population of non-pups must show an average annual increase of 3.5% for 3 generations (30 years)	Trends in non-pups in 5 of 7 regions are stable or increasing at 3% annually	The population trend in any two adjacent sub-regions cannot decline significantly	The population in any single sub-region cannot decline more than 50%
Monk seal	1,300 - Endangered	Population to exceed 2,900	5 of 6 sub-population are above 100 and Main Hawaiian Islands population above 500	Population growth not negative in two areas	Delisting criteria not included in report			
Fin whale	150,000 - Endangered	Population to remain stable or increase for 1.5 generation	OR a probability of extinction less than 1% in 100 yrs in each ocean		Probability of extinction less than 10% in 10-25 years			
Puget Sound killer whale	90 - Endangered	2.3% annual population increase for 1 generation	Pod social structure normal		2.3% annual population increase for 2 generations			
North Atlantic right whale	300 - Endangered	2% annual population increase for 35 years	Other threats not limiting growth – no whaling		Delisting criteria not included in report			
Gray whale	20,000 - Delisted				Population increased to pre-exploitation level of 20,000			
Southern sea otter	3,090 - Threatened				Average population exceeds 3,090 for 3 years			
Manatee	3,276 - Endangered	Annual growth rate is zero or above	Females with calf at 40% - & human impacts controlled	4 regions with annual adult survival of 90%	Delisting criteria not included in report			
Yellowstone grizzly bear	1,400 - Delisted				All 6 recovery zone populations must be recovered for delisting	Yellowstone zone requires 15 females with cubs for 6 years and within 10 miles of zone	16 of 18 segments occupied by females with young	
Spectacled eider	1,700 pairs - Threatened				Each of 3 regional populations is increasing for 10 yrs	AND a minimum estimated population at least 6,000 breeding pairs	OR 10,000 pairs for 3 years	OR 25,000 pairs for 1 year
Rocky Mountain gray wolf	30 pairs - Proposed for delisting				Over 300 wolves in three states	30 breeding pairs		

Note: Though not included in the Loughlin report, the demographic recovery criteria for eastern distinct population segment of Steller sea lions is an annual average increase of 3% over 30 years. There are no subarea requirements. The agency is recommending that population for delisting.

NMFS' RESPONSE TO COMMENTS ON DRAFT STELLER SEA LION (SSL) RECOVERY PLAN
Notice of Availability and Request for Comments
(71 FR 29919, May 24, 2006; 71 FR 41206, July 20, 2006)

In May 2006, NMFS released the draft Steller Sea Lion Recovery Plan for public review and comment (71 FR 29919). On July 20, 2006, NMFS extended the customary 60-day comment period until September 1, 2006 (71 FR 41206) to provide additional time for public review and comments. NMFS received comments from 18 individuals and organizations during the 100-day comment period. Comments were provided by the Marine Mammal Commission, the State of Alaska, the North Pacific Fishery Management Council, members of the fishing industry, non-governmental organizations (NGOs), members of academia and other interested parties. NMFS reviewed these comments and incorporated recommendations into the Draft Revised Plan. This document provides the full suite of comments and responses. Comments and responses are organized by topic area. Non-substantive or supportive comments that simply reiterate Plan content are not included here. All citations referenced in this document are included in the "Literature Cited" chapter of the Draft Revised Steller Sea Lion Recovery Plan.

Population Structure

Comment: There were a number of suggestions that NMFS should use a different population structure of Steller sea lions in its management for recovery:

- Despite the current ESA listing, data on DNA and movements support other possible divisions of the population (e.g. Western Aleutians/Russian). More natural divisions focused upon rookeries would focus management priorities.
- The Plan needs to consider smaller geographic boundaries with the western DPS.
- The Plan should base its models and management plans on the SSL as a single meta-population.
- Evidence supports more stock structure within the eastern DPS. The Plan recognizes distinct sub-regions for the western DPS, but makes no distinctions for the eastern DPS. Baker et al. (2005) constructed a neighbor-joining genetic tree which indicates that eastern DPS from rookeries in British Columbia, Oregon and northern California form a lineage distinct from all western stock rookeries, and the longer branch lengths separating these breeding populations indicate substantial isolation over long periods of time. The evidence suggests that the U.S. West Coast subpopulation may in fact constitute a distinct population segment from the more northerly eastern populations, and further research should be required to make this determination prior to delisting of the eastern DPS.

Response: NMFS acknowledges that there are many different ways (e.g., three DPSs, seven metapopulations, 40+ rookeries; recovery units) that the Steller sea lion could be managed. However, recent genetic information from analyses of mitochondrial and nuclear DNA still strongly supports the two DPS structure NMFS currently recognizes. Metapopulations (geographical clusters of rookeries) or individual rookeries could have formed the basis of recovery units (and management actions), but this assumes a level of knowledge regarding movement between units that currently does not exist. The Plan recognizes that not all parts of the western and eastern DPS are recovering or responding in the same way or at the same rates. As part of a status determination or a post-delisting monitoring plan, NMFS will collect information on population status throughout the entire range of each DPS, determine the population's status, and assess whether it meets the criteria for a change in listing status.

The stock structure currently recognized by NMFS (eastern and western DPSs separated at 144°W) is based on analyses of mitochondrial DNA (mtDNA), a marker passed on to offspring only by the mother. Bickham *et al.* (1996; 1998) and Ream (2002) reported that there was a distinct break in the distribution of mtDNA haplotypes between sea lion pups sampled on rookeries in the western part of the range (Russia to the eastern Gulf of Alaska) and eastern locations (Southeast Alaska and Oregon), indicating restricted gene flow between these two populations.

Results of subsequent genetic samples taken throughout the Steller sea lion range, including additional samples from rookeries in Asia, generally confirm the strong east/west population delineation, but also indicate that there is additional structure within the western DPS (Trujillo *et al.* 2004, Baker *et al.* 2005, NMFS unpublished data). Baker *et al.* (2005) hypothesize that a third population may exist just west of the Commander Islands in Russia. However, they point out that this potential division is not nearly as robust as the previous split between the eastern and western DPSs. Additional research points to a genetic break at Samalga Pass in the Aleutian Islands within the western DPS (O'Correy-Crow *et al.* 2006). Recent research suggests that the boundary between the western and eastern populations may be blurring (Pitcher *et al.* submitted 2006, NMFS unpublished). Of the two most recently established rookeries in the eastern DPS, about 70% of the pups born on Graves Rock and about 45% of the pups born at White Sisters were from western DPS females (Gelatt et al. *in press*). This has potential long term implications regarding the management of these populations, but it is also possible that we are witnessing in real-time a very infrequent event in which female sea lions from one population cross over to breed in another.

Trujillo *et al.* (2004) examined mtDNA and nuclear DNA (which is contributed by both parents) from the same samples to show that the population separation apparent from the mtDNA work was not clearly defined when males were taken into account. They found no clear separation of populations based on genetics when markers from both parents were included. They concluded that the difference in results may be attributed to a faster population divergence at the mtDNA locus, or it may be because Steller sea lions, like many other mammals, show a greater level of male-mediated gene flow via immigration than in females, e.g. males tend to disperse more than females and do not show the same philopatry for their natal areas as females.

Population Status and Trends

Western DPS Status

Comment: Describe any management measures implemented in Russian waters that affect Steller sea lions.

Response: The Steller sea lion has been listed as an endangered species in Russia since 1994. At the time it was listed in the Russian Red Book, all hunting or harvest of Steller sea lions in Russian waters was also prohibited. This is the only management measure taken specifically to conserve Steller sea lions by Russian authorities.

However, beginning in the 1950s, Russia established marine mammal protection zones in the Commander and Kuril Islands, along the Kamchatka peninsula, and in the Sea of Okhotsk (e.g., Tuleny Island) that also affect Steller sea lions. These zones were enacted primarily for the protection of sea otter and northern fur seal marine habitats, but because of their size (three to 30 miles in radius) and number (around virtually every island in the Kuril and Commander archipelago, for instance), they serve to protect Steller sea lion habitat as well. The zones prohibit vessels from transiting nearshore and prohibit any type of fishing in waters both nearshore and offshore of sea otter or fur seal terrestrial habitat sites. No transit zones range in size (radius) from three to 12 miles, while the no fishing zones extend up to 30 miles offshore (as in the Commander Islands and around Tuleny Island in the Sea of Okhotsk). The marine mammal protections zones around the Commander Islands were enacted in 1958, while those around the Kuril Islands and other parts of eastern Russia were established in the 1970s. All these zones are shown on the Russian navigation charts used by all fishing vessels. In the 1980s, enforcement was rigorous, and resulted in as many as 150 prosecutions per year for violation of the no-fishing zones by vessels. Since 2000, limited fishing has occurred within some of these zones but only with a scientific fishing permit issued by the Russian fishery authorities.

Eastern DPS Status

Comment: Nearly all increases in pup numbers in SE Alaska have occurred in new rookeries. Please explain whether the size of a rookery population in SE Alaska is determined by prey availability or the availability of terrestrial space.

Response: Rookery population size is likely dependent on a combination of factors, including prey availability and terrestrial space, as well as prevalence of diseases and parasites and the abundance and distribution of predators. It is not known which factors currently predominate in determining rookery size in SE Alaska.

Comment: Add a timeline of management measures in British Columbia (e.g., shooting SSL at salmon net pens in late 1990s).

Response: NMFS believes that this information is not needed in the Recovery Plan. The commenter should look for this information in materials published in Canada, specifically the Status Report on Steller sea lions presented to the Committee on the Status of

Endangered Wildlife in Canada (COSEWIC) by P.F. Olesiuk and A. W. Trites, September 2003.

General Trend Analyses

Comment: The trend analyses cited in the Plan are problematic: (a) trend models should use a random coefficients estimator rather than ordinary least squares to be consistent with the PVA assumption that the parameters are stochastic; (b) trend models should use a GLS or MLE estimator designed to address heteroschedasticity since the variance of observation errors associated with these data are not constant; (c) trend models do not allow for density dependence; (d) inclusion and omission of data sets is not explained; (e) the outputs should be rescaled and expressed in terms of the untransformed data; (f) use of a seemingly unrelated regression or other simultaneous equation model to estimate model parameters and to test the statistical significance of differences in the estimated parameters between regions is warranted because the models share a common set of explanatory variables and the allocation of counts to six regions is arbitrary; (g) autoregression and moving average models or polynomial time-trend models can describe trends without imposing the assumption that the trend is constant across observation periods; and (h) the Plan should note that splines were specified rather than fitted and that the same discontinuities were assumed for all regions.

Response: All of the suggested statistical analyses could be performed and would yield interesting information. However, NMFS does not believe they would improve our understanding of the dynamics of the western DPS. Population models, such as Winship and Trites (2006) and Goodman (2006; Appendix 1 of Plan), have considered many of the issues listed above and were used and referenced in the Plan.

Other issues, such as the strength of a density-dependent response, are highly uncertain (Goodman 2006) and have been assumed to exist by some modelers (Winship and Trites 2006) but not by others (Holmes et al 2007; Fay and Punt 2006). NMFS refers the commenter to primary sources such as Sease and Gudmundson (2002) and Fritz and Stinchcomb (2005) for a complete description of the specific data and analyses used in trend models.

Feeding Ecology

Comment: Seasonal availability of herring and capelin when juvenile SSLs are weaning should be described.

Response: Capelin, herring, and eulachon spawn in spring and summer as juvenile sea lions are being weaned and during the late stages of pregnancy for adult females. At this time, these prey species are densely aggregated in highly predictable locations, particularly in bays and estuaries, and the aggregations of fish provide a rich resource for sea lions (e.g., high energy return for energy expended). Feeding has been documented at several locations, so it is highly likely that juvenile and adult sea lions are feeding at most of the known forage fish spawning aggregations throughout Alaska and British Columbia.

Conservation Measures

Comment: The historical review of conservation measures regarding incidental takes is weak. Thousands of sea lions incidentally caught in the roe-stripping fishery in Shelikof Strait in the 1980s are not mentioned. That fishery was eliminated, in part because of the sea lion issue but also because of concerns about wanton waste. NMFS observers are confined to groundfish vessels and a large number of small vessels lack coverage, including salmon and herring vessels. There is a long history of interactions between longline, troll, and other fishing vessels and sea lions since the start of these fisheries in the late 1880s.

Response: While a detailed history of incidental take and the fisheries involved could be added to the Plan, NMFS believes this is unnecessary. The objective of the Recovery Plan is to outline and prescribe actions that will lead to recovery. Historical information is useful to provide context for understanding the current situation; however, the Plan already explains that incidental take was high in the past and that a variety of measures were implemented to reduce it to the point where it is no longer believed to be a threat to recovery. Therefore, NMFS believes the description in the Plan is sufficient.

Comment: Potential beneficial relationships with fisheries should be considered and discussed. Sea lions have been depredating commercial fishing gear since commercial fisheries began in Alaska in the late 1880s. Presumably, there is some energetic benefit to a sea lion that consumes a longlined cod or gillnetted salmon, both in terms of caloric intake and reduced energetic costs from not having to seek and capture a free swimming prey. Fisheries discards may also benefit SSL.

Response: NMFS is aware that some Steller sea lions feed on discards from fishing vessels and onshore fish processing plants, while others consume fish caught on fixed gear, but this is not believed to be a common sea lion foraging practice. While sea lions that forage in this way may expend less energy to obtain food than those that do not, such food resources are unreliable for sea lions and are most likely a source of opportunistic foraging rather than a primary food resource.

None of the satellite-tagged sea lions studied in foraging research have been observed feeding near commercial vessels or within harbors with fish processing plants (e.g., Dutch Harbor, Kodiak) or from fixed gear. It would be very difficult to quantify the number of sea lions that forage in this way, how frequently those individuals do so, or the total proportion of their diets (both in mass and caloric intake) comprised of fisheries-caught food.

Factors Potentially Influencing the Populations

Comment: Fisheries incidental take should be reviewed. The estimate for the Prince William Sound gillnet fishery is likely too high, whereas takes in unobserved fisheries may not be adequately accounted for.

Response: Although a detailed history of incidental take, fisheries involved, and how each fishery responded could be added to the Plan, NMFS believes it is not necessary. The Plan describes in detail the fact that incidental take was high in the past and that a variety of measures were taken to reduce it to the point where today, and in the foreseeable future, it is no longer believed to be a threat to recovery. Although the commenter believes that estimates for particular fisheries may not be accurate, the Recovery Team and NMFS used the best available data when the Plan was written. Recovery actions associated with minimizing the threat of incidental take to the recovery of Steller sea lions are in Chapter V.D.3.1. It is very expensive to observe fisheries that are not covered by the Groundfish Observer Program. Given limited resources, NMFS has not been able to implement an additional observer program in Prince William Sound; as such, we must rely on the most recent data as the best available information.

Comment: A significant proportion of sea lions sink immediately after death, thus reducing the probability of recovery on the beach and ability to determine level of entanglement, disease and other health factors.

Response: NMFS agrees with this comment. This is most likely one of the reasons why there have been few stranded sea lions found from which samples could be taken in an attempt to determine cause of death.

Comment: The description of groundfish harvest strategy for the North Pacific is oversimplified and misleading. An $F_{40\%}$ harvest strategy is not exactly an MSY harvest strategy; an $F_{35\%}$ harvest strategy results in harvests somewhat less than those that would result from an F_{msy} strategy. The $F_{35\%}$ is set as overfishing, which is a limit not a target. $F_{40\%}$ results in harvests set to be safely below $F_{35\%}$. Possibly, higher fishing levels have been applied in parts of the Pacific region and BC, where sea lion numbers are increasing.

Response: NMFS believes it is unnecessary for a Recovery Plan to contain detailed descriptions of the harvest strategies or the actual harvest rates of commercial groundfish. This information is more appropriately provided in other widely available resources, including the 2000 Biological Opinion available on the NMFS website (http://www.fakr.noaa.gov/protectedresources/stellers/plb). The Plan cites a review of the harvest strategy by Goodman et al (2002) and contained within the 2000 Biological Opinion, and the reader is referred to these sources as well as other information available within Stock Assessment and Fishery Evaluation reports published by the North Pacific Fisheries Management Council and available on the NMFS-AFSC website (http://www.afsc.noaa.gov/refm/stocks/assessments.htm).

Comment: Humpback and fin whales may be significant competitors for food. The Plan should examine the spatial relationship between their distribution, diet/population trajectory and SSL.

Response: The Plan recognizes this threat, which is discussed as a potential factor causing nutritional stress in Chapter III.B.11.

Comment: The Plan is inconsistent in how it represents the data on nutritional stress. Appendix 2A indicates strong evidence that nutritional stress has not been found in the western DPS, yet the discussion (p.89-92) indicates the data are inconclusive. The discussion in Appendix 2A (*note;* Appendix 2A cites a table that is missing) should be included in the main body of the Plan. The Plan would also be improved by inclusion of a table comparing the various hypotheses with any additional new data.

Response: NMFS agrees with this comment. The section on nutritional stress has been completely rewritten for the May 2007 Draft Revised Plan. Information in the appendices has been incorporated into Chapter III.B.3, and redundancies were removed.

Threats Assessment

Western DPS

Comment: The rankings of impacts appear subjective—a basis for each ranking should be clear in the Plan.

Response: NMFS has now clarified the basis for the threat ranking in the Plan, as well as the process undertaken by both the Team and NMFS to assess threats. A "weight of evidence" approach was used to assess the relative impact of each threat (factor) identified in Section III. This qualitative assessment approach was selected rather than a quantitative approach because of the substantial uncertainty in the understanding of each threat's influence on sea lion population dynamics. Using the extensive expertise of the recovery team, we were able to identify three relative threat levels (High, Medium, and Low), defined as follows:

- High: a threat with substantial impacts to recovery requiring mitigation and/or further research to identify impacts
- Medium: a threat with moderate impacts which if mitigated could increase the likelihood of recovery, but in and of itself has limited impact on population trajectories
- Low: a source of mortality that likely has little impact on population trajectory

Comment: A high ranking for predation by killer whales cannot be defined as a precautionary approach. Rather a precautionary approach would be to focus on fisheries, which is the only area in which precautionary actions may be taken.

Response: After public review and comment, as additional scientific information became available, NMFS concluded that the threat posed by killer whale predation was unlikely to be high, and thus changed the ranking to medium. NMFS agrees that it is not necessarily precautionary to rank a threat as high if it is essentially beyond mitigation. Fisheries are the focus for many recovery actions in the Plan, with an emphasis on gaining greater understanding of the magnitude and mechanisms of competition and determining how to separate fisheries effects from those which would have occurred naturally. In this sense, NMFS believes that the Plan's approach, relative to the threat posed by competition with fisheries, is precautionary.

Comment: It is difficult to fully rule out the possibility of sleeper shark predation on sea lions, because only one study has examined the diets of sharks near rookeries. Hulbert et al (2006) found sleeper sharks to be an ambush predator with geographic overlap with sea lions. Sigler et al (2006) documented harbor seal remains in sleeper shark stomachs, which demonstrate that they are able to consume small pinnipeds. Given this information, it seems premature to fully discount sleeper shark predation on Steller sea lions.

Response: Sleeper sharks are scavengers with diets substantially comprised of carrion (Smith and Baco 2003; Smith 2005), rather than live, actively hunted prey. In the studies of sleeper shark stomach contents (Hulbert 2001; Hulbert et al. 2003; Wynne 2005), no Steller sea lion remains have been found. Moreover, Steller sea lions have not been identified as a likely prey item through fatty acid analysis (Schaufler et al. 2005). Because there is no definitive evidence that sleeper sharks actively prey on Steller sea lions, this type of predation is not believed to be a threat to recovery.

Comment: The relevance of whether the present climate shifts are outside the range of past climate shifts is not clear. Almost certainly there have been climate shifts in historical, let alone prehistoric times, which rival those of the present. However, the changes in the present have taken place in the context of an altered ecosystem and thus may stress sea lions in ways that were not present before. A quick look at the Aleutian volume of Fisheries Oceanography will provide evidence of major declines in sea lion populations and shifts in populations of fish in the not so distant past.

Response: NMFS agrees that recent changes in the North Pacific Ocean (e.g., 1976-77 regime shift) must be placed into the context of current state of the ecosystem as affected by other anthropogenic sources (e.g., global climate change and effects of fishing). All of these changes could affect Steller sea lion carrying capacity. The Aleutian volume of Fisheries Oceanography did not mention major shifts in abundance of Steller sea lions in the Aleutians prior to the present decline; the paper by Causey et al. describes changes in bird populations as evidenced by the examination of remains in middens. Information on the frequency and distribution of mitochondrial DNA haplotypes indicates that Steller sea lions have not gone through a genetic 'bottleneck' in which haplotypes were lost due to a large reduction in population size. Consequently, large population fluctuations do not appear to be common within the evolutionary history of Steller sea lions. However, environmental change remains as a potentially high threat, due to uncertainty about the nature and magnitude of this stressor on current sea lion population dynamics, as well as how it relates to anthropogenic sources of change.

Comment: It is not accurate to say that fish community structure in the eastern Bering prior to the 1976-77 regime shift is similar to that of today. Community structure is more than just species composition- the proportion of those species also plays an important role. Arrowtooth flounder and other flatfishes increased substantially, pollock increased and then decreased, salmon increased and stayed high, and changes in forage fishes have been observed. So, it is hard to accept this assertion without some supportive analysis.

Response: Bakkala (1993; NOAA Technical Report NMFS 114) provides an excellent summary of the limited fish survey data collected prior to the 1976-77 regime shift in the eastern Bering Sea, upon which to base our knowledge of fish community structure in the 1960s and early 1970s. He concluded that both pollock and Pacific cod had peaks in abundance of approximately the same magnitude both before and after the 1976-77 regime shift. He also found little evidence to suggest that gadids increased to unprecedented levels following the regime shift. Regarding Pacific herring populations (often included in the 'forage fish' complex), Wespestad (1991; PhD. Dissertation, Univ. WA) assessed the entire Eastern Bering Sea population of Pacific herring (both stocks) for the period from1959-1988 using both fishery and survey information. His population reconstruction revealed a total herring biomass of over one million tons in the early to mid-1960s, followed by a steep decline and low population levels throughout the 1970s. This decline, however, preceded the regime shift by approximately 10 years, and may have been the result of heavy fishing pressure. In the early 1980s (after the regime shift), the herring population increased. However, even at its peak in the early 1960s, the abundance of herring was not greater than that of pollock prior to the regime shift. Population sizes of other fish species, particularly flatfish, have changed considerably over the last 40 years, due to natural and anthropogenic factors. However, there is no strong evidence that the eastern Bering Sea was dominated by 'forage' fish prior to the regime shift and by gadids and flatfish after. It is important to remember that pollock, a gadid, is also an important forage fish for other fish, birds and marine mammals in the eastern Bering Sea.

Comment: The 60% reduction in multiple prey species biomass needs to be referenced by geographic area and how well the information from one area can be extrapolated to the next.

Response: The 60% reduction in multiple prey species biomass refers to the harvest policy of $F_{40\%}$, in which fish are harvested at a rate which reduces the average spawning biomass per recruit from 100% (in an unfished equilibrium population) to 40%, hence the 60% reduction. This reduction is not applicable to a specific geographic area, but applies to the ecosystem (e.g., eastern Bering Sea) in which the fish reside and the fishery occurs. This issue will be addressed in more detail in the forthcoming Biological Opinion on the groundfish fisheries in the North Pacific scheduled to be released in draft form in spring 2008.

Comment: Nelson (1887) should be cited in the Summary and Scenarios section as evidence of a historical collapse prior to the onset of commercial fisheries. This entire section should be cited to appropriate literature; otherwise it comes off as being entirely speculative.

Response: The Summary and Scenarios section has been removed and replaced by a section entitled "Synthesis and Discussion of Threats" at the end of Chapter 4. In Chapter III.B.11, more discussion of the observations of early naturalists (including Nelson) regarding species abundance and distribution is included, and indicates that the population sizes of gadid fish and other species likely fluctuated in the past as well.

Recovery Strategy

Adaptive Management (Recovery Strategy and Recovery Action 2.6.8)

Comment: The adaptive management requirement should be removed—it is not a high priority for the recovery of the western DPS.

Response: The Team, NMFS and other review bodies (e.g., NRC 2003) have each recommended the development of an adaptive management program so that managers and scientists can learn more about how natural and anthropogenic factors affect the North Pacific ecosystem and the various species that inhabit it. An adaptive management program will bring all the key management and scientific partners to one table to discuss factors that affect sea lion populations and the design of a program through which we can learn how the system and sea lions respond with and without various forcing factors (e.g., fishing). Currently, the only formal system set up to evaluate this information is the consultation process under ESA section 7, but this only affects federal actions. The development of an adaptive management program will provide another means by which the scientific and management communities can evaluate new information, determine the efficacy of current regulations, and recommend that new actions be taken or regulations be changed.

Development of Recovery Criteria (PVA)

Approaches to the Criteria

1. <u>Weight-of-Evidence</u>

SSC Comments: The Goodman PVA model is used in a decision theory framework to derive recovery criteria that satisfy the ESA for the WDPS of Steller sea lion. This approach, based on the best available science, helped to formulate a structured, defensible, quantitative and biologically relevant basis for evaluating risk. The SSC recommends that the PVA be moved from the Appendix and included in the main documents as a subchapter in the threats assessment section. The SSC endorses the PVA modeling approach as a valuable tool for evaluating risk. Although there are uncertainties in the model, it has helped and will help in the future to structure our thinking about recovery issues, synthesize available data coherently, identify data gaps, and suggest refutable hypotheses and research priorities.

Response: The Plan now includes a substantial explanation of how the Recovery Team used the PVA in guiding their approach to setting the recovery criteria. The utility of the

PVA in directing the thinking of the Team and NMFS is now more clearly explained in the Plan. The description of the PVA, its development and results are included in Section V: "Recovery Plan for the Western Population" rather than the section on threats assessment because it was used by the Recovery Team to evaluate extinction risk and guide the Team as they developed the recovery criteria. Although the detailed description of the PVA remains as an Appendix, there is a thorough description of the model and its utility in the main Plan document.

SSC Comment: The Goodman PVA is just one approach and there is much uncertainty about the correct or best fit model to use. For reference, other models should be explored (i.e. Winship and Trites 2006, Gerber and Van Blaricom, 2001; Fay, 2004; Wolf and Mangel, in press). These models include additional parameters and assumptions, such as density dependence, age and sex structure, lag effects in recruitment and population parameters, and dispersal within a metapopulation structure. It would be useful to compare results of these existing models of SSL population dynamics with the Goodman PVA.

Response: The models cited by the commenter were developed for reasons other than setting of recovery criteria and therefore did not provide the Team with the information needed to develop listing and delisting criteria. However, the Plan describes and cites relevant population models that address the uncertainty inherent in the decline of Steller sea lion populations and had limited applicability to the recovery planning process. These population models were useful, but fell short of meeting the Team's needs because: they were too limited in the scope of their analyses, they focused the analysis of extinction risk on a specific moment in time, or they ignored unusual periods of steep decline in the assumptions. Because the Recovery Team needed to gain a better understanding of the relative effects of threats on Steller sea lion populations and the likelihood of different population trend scenarios, they contracted a biometrician (Dr. Goodman) with extensive experience in modeling populations in the Bering Sea and North Pacific systems to develop a model that specifically addressed the Team's needs.

SSC Comments: As the Recovery Plan is reviewed and updated every 5 years, the PVA should be refined and revised and used as an assessment tool. Therefore, the following weaknesses and desirable improvements that should be addressed in future iterations of the model: The following were issues of concern that warrant further review and/or sensitivity analyses:

a) The PVA assumes distinct time periods of decline and are statistically independent. This is not the case since individual sea lions were alive in consecutive periods. The importance of this assumption is unknown, but it is unlikely that rate changes within each period were unrelated to adjacent periods.

b) The PVA assumes historical population declines were evenly distributed—local versus range-wide effects could have important implications for long-term population viability. Metapopulation structure, regional, or rookery-scale observations, and shorter-time scale observations were dismissed without discussion. Because of constraints imposed by using only five growth rates to model growth rate distribution, further discussion is warranted to explain the basis for the chosen method of binning.

c) The Plan should explicitly describe the data used to select an effective population size threshold of 4783 animals

d) Other input parameters should be examined: (1) 2.5% estimate of fishery prey interaction effect is highly uncertain—one alternative would be to assume no competitive effect at current prey biomass; (2) extraneous mortality (or modeled as stochastic); (3) Constant growth rate within a period and independence between successive periods—there may be autocorrelation in the growth rate between periods; (4) effect of weighting each observed growth rate equally when averaged over very different periods of time (five to 19 years). An alternative is to combine two shorter periods that correspond to a known oceanographic regime; or weight period-specific growth rates by the number of years over which they were averaged; or representing growth rates as a moving average; and (5) the probability that the PVA is correct;

e) Table 4—the rationale for selection of values for biological parameters and values for the fishery competition effect should be more explicit.

Response: The fundamental attributes of a PVA are based on the assumptions used to drive the model. The assumptions used in this particular PVA are similar to those used in other Steller sea lion population models, as explained in Chapters I and V. Chapter V also explains how the PVA served the Team in helping them focus on the factors important in evaluating extinction risk. The following responses are directly related to the points made by the SSC (for example, response "a" corresponds with comment "a" above):

a) This comment refers to the assumptions used in the PVA. NMFS agrees with the SSC's comment. Unfortunately, there is no way to avoid the fact that distinct time periods that occur in sequence are correlated. This is likely the case in any PVA that addresses population change over time. The time periods used in the Plan were based on availability of survey data and represent periods with different population trend.

b) As explained in Chapter V and the Appendix, the PVA had to make assumptions based on the available data. Chapter V explains that individual rookeries or clusters of rookeries displayed different population trends during the greatest period of decline. The Team was asked to put together a plan for each stock; the western and eastern stocks. This required a population-wide perspective for recovery of the species. The team recognized that different areas may ultimately show incongruent trends and as such included recovery criteria that account for these different trends. The PVA included the period of increasing population trend between 2000 and 2004. There has been only a small period of time in the last 50 years where the population has increased.

The population trajectory of previous time periods was modified to reflect mitigation measures currently in place.

c) In Chapter V, the Plan provides background information and an explanation of the basis for the quasi-extinction size of 4,753, which was based on the recommended genetic effective population size of 1,000 individuals necessary to maintain genetic variation. Because Steller sea lions are polygynous, each animal does not contribute equally to the genetic composition of the population. Therefore, a greater number of individuals are necessary to preserve the genetic variation expected from an "ideal" population, in which every animal produces an equal number of offspring.

d) (1) The 2.5% estimate of fishery prey interaction effect is highly uncertain, as are all the estimates for impacts for which the Team and the PVA sub-group had no data upon which to base an estimate. The Team considered a wide range of estimates for this interaction, but settled on 2.5% based on the expert opinion of various Team members. (2) NMFS is unclear what this comment is referring to. The Team did the best job it could at estimating extraneous mortality in each period, but did not try to model it. (3) There may be autocorrelation in the growth rates in successive periods, and there is no real reason to believe that growth rates were constant within a period. These were simplifying assumptions used in the PVA and there are many ways in which more complexity (and uncertainty) could be added to the model. (4) Weighting each modified growth rate by the length of time over which it had been observed in the past is something that could have been added to the PVA. Other alternatives can also be envisioned, such as the one suggested by the commenter. NMFS does not know how changes such as these would have affected the outcome of the PVA. However, the PVA results were not used explicitly to set recovery criteria. (5) Given the assumptions and structure of the model, the results of the PVA speak for themselves regarding the threat of extinction. Many other PVAs with different structures and assumptions could have been developed.

e) The rationale that Goodman used in preparing the PVA is explained in the Appendix. The PVA used a Bayesian framework in order to account for uncertainty especially as it relates to SSL vital rates. The team recognized that in this case the PVA was most useful as a guiding tool in allowing the team to test various outcomes due to different scenarios. The assumptions and results of the PVA are now thoroughly explained in Chapter V and the Appendix, so the Plan addresses these comments.

Other PVA comments:

Comment: The SSC of the NPFMC recommended that the PVA be taken out of the Appendix and moved into the main body of the Plan, although the NPFMC itself disagreed with that recommendation. The NPFMC recommended that the Goodman

PVA should be kept in an appendix and specifically referred to as an example among other available PVA models.

Response: NMFS and the Team used the PVA as a guide for evaluating some of the threats that may have caused population decline and those that exert some level of extinction risk. The Plan acknowledges that there is considerable uncertainty in our understanding of threats, and the PVA provides one way to quantify the magnitude of this uncertainty. For the Plan, the PVA results were one of many pieces of information used in our 'weight of evidence' approach.

Recovery Criteria

General

Comment: The Plan does not address any actions of planning for the possibility of future SSL declines—explicit planning for this occurrence and rationale for any management response should be included.

Response: This is a recovery plan and as such is intended to outline the requirements for downlisting and delisting. Future declines in the Steller sea lion population, if they occurred, would be addressed, as have past declines, with measures appropriate to any known causes. If the population were to decrease after a period of increase but before it is delisted, the recovery criteria would ensure that the species retains protection under the ESA.

Western DPS

Downlisting WDPS – Biological Criterion 1

Comment: The rationale for the 15-year time period should be expanded and clarification is needed on what 'statistically significant' means.

Response: Chapter V.C explains the rationale for the 15-year time period, which in part reflects the generation time of Steller sea lions as well as a precautionary approach. "Population growth for 15 years would reflect sustained growth by two generations of sea lions during two environmental regimes. Such growth provides assurance the population is recovering and not experiencing the unsustainable conditions of the past 30-40 years." A statistically significant change in population growth is an observed, long-term trend that is unlikely to have occurred by chance. After extensive discussions by the Team, NMFS decided that it will address the issue of defining a statistically significant population increase at the time of downlisting. All of the downlisting factors will be incorporated into the decision, including the population increase. The level of statistical significance will be addressed at that time, relative to these other factors.

Comment: The logic of using the recent history of the eastern DPS as a model for criteria to apply to the western DPS is questionable. A more logical approach to this criterion would be to use the PVA. [The same comment was made regarding the delisting criteria for the WDPS, so both are addressed here.]

Response: The eastern DPS was not considered a model in the sense that the western DPS is expected to perform in the exact same way. However, the eastern DPS lives in a similar, sometimes overlapping environment and is subjected to many of the same factors affecting its survival and reproduction. The eastern DPS has experienced many of the same threats as the western DPS and has displayed a long term population trend that may be representative of Steller sea lions in Alaska. The eastern DPS provides a useful overview of a possible recovery scenario for Steller sea lions. Therefore, NMFS believes that it was appropriate for the Team to review the recent history of the eastern DPS as they developed downlisting and delisting criteria for the western DPS.

A PVA model requires the input of growth rates to run simulations of different scenarios. The recent, three percent rate of increase for the eastern DPS was used in the Goodman-PVA to test the extinction risk for the western DPS, because the Team needed a plausible future population trajectory for which extinction risk could be calculated at time horizons of interest (e.g., 15 and 30 years). The current growth rate of the eastern DPS was used in the PVA because it seemed more appropriate than borrowing a growth rate from another species of pinniped or another mammal species in general. To ignore the information presented by a nearby population of Steller sea lions would not be an adequate use of the best available science. However, if a different, more accurate growth rate value is discovered for the western DPS, then NMFS can re-evaluate the likelihood of extinction based on time and population growth rate at that point.

Downlisting WDPS – Biological Criterion 2

Comment: Vital rates as a down- and de-listing criterion should be eliminated. By using a PVA, if the population risk of extinction is above the threshold, then biological criteria are irrelevant. It is only when the population falls below the threshold that other data are needed to explain why and helps define the threat.

Response: It would be inappropriate for NMFS to ignore vital rates information when downlisting. Although Criterion #2 has been removed from the Draft Revised Plan, all data available to NMFS, including information on vital rates, will be considered when downlisting and delisting decisions are made. The PVA was structured on past population counts and incorporated available information into the model in order to make predictions. The PVA did not have the ability to project changes in vital rates that might affect the model. Ignoring the vital rates information simply because the population numbers reach a certain point would not allow NMFS to answer the first question necessary to downlist or delist – "Why did the population increase?" Without the ability to explain why the population size changed, appropriate monitoring measures could not be put in place and NMFS would be unable to meet the criteria required for downlisting.

Delisting WDPS – Biological Criterion 2

Comment: Vital rates are uncertain, include biases, and may not be a good indicator of population trajectory. For example, under extreme food deprivation, apparent pup growth rate in Antarctic fur seals actually increased due to sampling problems in years of low pup survival (i.e. the covariance of measured growth rate with pup survival). There is heterogeneity among individual responses to nutritional deprivation. Those who are most affected by lack of food are not good competitors and their removal may have comparatively little influence on population dynamics. Current fecundity measures using aerial surveys and mark-recapture introduce biases which are not acknowledged in the Plan. Overall, vital rates may not be a feasible criterion. Vital rates as a down- and de-listing criterion should be eliminated. By using a PVA, if the population risk of extinction is above the threshold, then biological criteria are irrelevant. It is only when the population falls below the threshold that other data are needed to explain why and help define the threat.

Response: The explicit vital rate criterion for downlisting and delisting the western DPS of Steller sea lions was removed. However, all information on the population of western Steller sea lions will be considered by NMFS in its decision to downlist or de-list. This includes rates of survivorship and reproduction. The PVA is based solely on total counts of adults and juveniles (extrapolated to estimate total population size), and does not include information on the age and sex structure of the population. Age-structured modeling and information from mark-recapture studies provides much more detailed information on the demographic reasons behind total population responses and as such, can indicate the effectiveness of mitigation or other recovery efforts.

Delisting WDPS – Biological Criterion 3

Comment: Remove the 50 percent criterion for the sub-region. The significant declines in two adjacent sub-regions should be based on a metapopulation PVA. This criterion should reflect the spatial correlation that is likely to occur between adjacent areas. Also, the Plan should clarify that this criterion applies to the time period in Criterion 1 and is predicated on Criterion 1 being achieved.

Response: NMFS clarified the criteria list to indicate that each biological criterion must be satisfied in order to delist. Thus, the western DPS as a whole must show evidence that threats to its existence have been mitigated or eliminated. This would be demonstrated through population growth at an average rate of three percent per year for approximately three generations, as seen in the eastern DPS. Additionally, NMFS and the Team decided that if two adjacent sub-regions were declining while the western DPS as a whole satisfied criterion 1, then it would not be prudent to delist. If this situation were to occur, it would be likely that NMFS did not fully understand or mitigate the threats to the population. This criterion prevents loss of a significant portion of the range of the western DPS, which is a requirement of the ESA.

WDPS – Listing Factor Criteria: threatened

Comment: This section of the Plan seemingly states for the first time that "modification of the foraging habitat of the western DPS of Steller sea lion, through both natural and anthropogenic sources, likely resulted in decreased survival and reproduction and may currently limit recovery." This indicates that the sea lion's habitat has been modified; citations and supportive information are necessary when making this statement for the first time.

Response: This section is intended to contain only the listing criteria, not the background or the citations supporting them. The commenter is referred to previous sections of the Plan, particularly Chapters III.B and IV.A that describe potential modifications of foraging habitats by natural forces (e.g., oceanographic regime shifts, global climate change) and anthropogenic (e.g., fishing) forces.

Comment: Under Listing Factor C ["**Disease or predation**"] the Plan suggests that disease may present greater risks if population abundance declines further. Why would this be the case? If the animals are less crowded, transmission may decline and disease may pose less of a threat.

Response: NMFS agrees that the probability and rate of disease transmission may decline in a less crowded population. However, it is important to distinguish between the risks to an individual versus the risks to a population. In a smaller population, the proportion of the population infected might be greater, and each death or decline in fecundity caused by disease would have a greater population-level effect. NMFS must monitor for disease and insure that the western DPS is not precluded from recovery because of an outbreak of a new or existing disease whose impact is exacerbated by the current population's smaller size.

Recovery Actions

Comment: Research under each recovery action should be prioritized based upon relevance to the risk assessment, the likelihood of success, and the level of past cost/benefits. Of particular importance is research on population trajectories and their underlying vital rates. Tasks 2.4.2 and 2.4.3 are highly speculative and the costs in the implementation schedule are too low. Task 2.6.8 appears to be the entire purpose of the Plan in one sub-task. Overall, the Plan lacks a credible and cohesive research program. The Plan needs a clear prioritized research plan, together with a recommended public process, under the auspices of the North Pacific Research Board.

Response: Action 1.5 in the Plan calls for the development of an implementation plan that includes a comprehensive ecological and conceptual framework to integrate and further prioritize the numerous recovery actions of the Plan. The implementation plan will synthesize and prioritize the individual actions, and coordinate their implementation in a cohesive strategy outlined in Section V.B. The development of such a plan was beyond the scope of the Team's responsibility, but the Team recognized its importance and highlighted this to NMFS in their draft Plan.

Comment: The Plan should make it clear that the Council and NMFS have broad flexibility to modify existing fishery management measures on a continuing basis as new information becomes available.

Response: Both the North Pacific Fishery Management Council and NMFS have flexibility to modify existing management measures as new information on Steller sea lions and fishery interactions becomes available. All changes must be evaluated under the ESA section 7 provisions, and this Plan calls for maintenance of the existing level of protection at a minimum until it can be shown that less protection will not decrease the rate of recovery of the population.

Comment: Trade measures with Russian/Asian countries that impact SSL should be sought to level the field for US industry and promote international conservation. Collection of data from Russia and Japan on fishery bycatch and directed harvest should be an action item to initiate international agreements.

Response: NMFS has periodic dialogues with Russia regarding fisheries management issues. We recently introduced our concerns about Steller sea lions during discussions with our Russian counterparts. Trade measures with Russian and Asian nations are not addressed in the Recovery Plan because they are outside the scope of this type of document.

Comment: The argument that current measures should be maintained because of a correlation between population stability and fisheries management measures is unfounded. Correlation cannot be equated to causation.

Response: NMFS agrees that correlation between the implementation of new management measures and recent population stability cannot be equated to causation in its argument regarding maintenance of status quo management measures. However, the Plan highlights the considerable uncertainty that remains in our understanding of the relative magnitude of the two factors ranked 'potentially high' as threats to recovery – environmental change and competitive effects of fishing. This alone is reason enough to maintain the current level of fisheries protection until more information can be collected which would indicate that the level of protection could be lessened without reducing the likelihood for or increase the time to recovery.

Comment: No information exists to suggest that the eastern DPS has ever been as abundant as it is now, so the use of 'recovering' is unjustified.

Response: Under the ESA, a species or DPS is 'recovering' until it is determined by NMFS or USFWS to be 'recovered' and removes it from the list of those species requiring protection. NMFS agrees that the eastern DPS of Steller sea lion has shown signs of health (increasing at three percent for nearly 30 years) and that it should be considered for delisting.

Implementation Schedule and Plan

Critical Habitat

Comment: Critical habitat designations should be reviewed and adjusted to better reflect the extensive research conducted over the past 13 years.

Response: It is not an objective of the Plan to redefine critical habitat for the western DPS of Steller sea lion. The Plan does have a recovery action (2.1) calling for NMFS to maintain, and modify as needed, critical habitat designations.

Estimates of Recovery Time and Cost

Comment: There should be a full and proper assessment of the effectiveness of past management actions. Cost-benefit analyses are particularly important given the high level of uncertainty in current data and the potential impact that some measures may have upon the economics of the fishery. Annual and aggregate costs to fisheries of SSL conservation measures should be included.

Response: The efficacy of the current set of management measures and the extent to which they jeopardize the continued existence, adversely modify critical habitat, or significantly affect the recovery of Steller sea lions will be presented in the forthcoming Biological Opinion on the groundfish fisheries in the North Pacific scheduled to be released in draft form in spring 2008. NMFS is aware of some limited analyses that attempted to estimate the costs of certain management actions (e.g., the closure of critical habitat to boats fishing with trawls in fall 2000), but is not aware of any analyses that have estimated the economic impact of the suite of regulations enacted in 2002. These estimates have not been made because there are no data upon which to base these estimates nor are there ways to separate the costs of the Steller sea lion regulations from those resulting from other actions taken at the same time (e.g., regulations to implement the American Fisheries Act). Even when critical habitat was closed in 2000 by order of the federal court, there has never been an instance when a quota (TAC) for a target groundfish species has not been fully harvested because of a regulation whose management objective was to avoid jeopardy to the continued existence of Steller sea lions or adverse modification to its critical habitat because of actions by the groundfish fishery.

Other General Comments

Comment: NMFS should revise the Plan to incorporate more flexibility in recovery criteria and management actions and circulate the revision for public review and comment. This is particularly important given the weak rationale for maintaining the current fishery management regime—fisheries measures introduced in the past 5 years are not likely to be responsible for the SSL trend.

Response: Flexibility in recovery criteria is contrary to the ESA requirement to have objective, measurable criteria. The flexibility in the criteria will come in as the Plan is modified in the future, as new data are collected, and as biological conditions are re-evaluated. NMFS has revised the Plan, released it for additional public review, and will seek an additional peer review through the Council of Independent Experts. The efficacy of the current set of management measures and the extent to which they jeopardize the continued existence of Steller sea lions, adversely modify critical habitat, or significantly affect the species recovery will be evaluated in the upcoming Biological Opinion on the groundfish fisheries in the North Pacific, which is scheduled to be released in draft form in spring 2008.

Steller Sea Lion Recovery Plan

Review (July 2007 version)

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Basis of this review

This review was commissioned by the Marine Conservation Alliance. It has been conducted as a peer-review assessment and it is, therefore, a view developed by the author as a practicing scientist in this field. The review should be considered together with the commentary written by the author, again for the Marine Conservation Alliance, about the previous draft version of the Recovery Plan (published in May 2006). Many of the general comments made there, most especially the general issues described in the appendices – (1) A Risk Assessment Framework for the SSL Recovery Plan; (2) Assessment of the effectiveness of past management actions; (3) The "is it food" hypothesis – still stand.

Summary and recommendation

The Revised Recovery Plan (RRP) has presented some important modifications. In some cases these are an improvement (e.g. additional text explaining the construction of the PVA), but some are also important because they could undermine the position of NMFS as a competent body to construct and lead the development of this plan. Issues concerning inconsistency of the analysis of the effects of nutritional stress compared with killer whale predation illustrate a general and worrying lack of objectivity in the underlying approach. In addition, the structure of the RRP does not suggest that NMFS has set clear and transparent policy objectives. If, as I suspect, the objective is to place further restrictions on the fishery then this should be clearly stated and justified against the evidence. In its current form, the plan leaves the strong impression that NMFS is pursuing this policy as an unstated objective, possibly because it does not have evidence properly to back this up but is operating in the "belief" that this is necessary.

Overall, the RRP claims to take a "balance of evidence" approach but in so doing it opens the possibility that NMFS is weighting the assessment to support preconceived notions of underlying mechanisms (especially one that involves the fishery), and this problem has simply been exacerbated by the modifications made to the current version of the RP. Although it may be difficult to accept that over a decade of intensive research has not tended to provide clear evidence supporting particular hypotheses, it would be much more satisfactory for NMFS to admit that the current level of uncertainty is so large that it cannot develop a rationale for distinguishing between several leading hypotheses. In these circumstances, a different approach is required to the management of the SSL. This should be a risk-based approach built around the risk framework developed by the Environmental Protection Agency.

The RRP needs to distinguish policy from the assessment of threats and resulting actions. I suggest that the policy – essentially the objectives for recovery and re-listing - is now articulated reasonably well and with a rationale that can generally be supported by legislation and high-level scientific knowledge (e.g. less than a 1% chance of extinction in 100 years), but this is lost within a mountain of other irrelevant detail. However, the plan still does a very poor job of justifying the choice of recovery criteria. The RRP also fails to grasp and articulate, in an easily digestible form, the complexity of the knowledge base and to communicate this in a manner that is useful for policy implementation. In fact, it appears that this complexity is being used, on occasions, to build quite unjustified scenarios based upon little evidence (e.g. in the case of nutritional stress). Unfortunately, this problem has been exacerbated by the responses to public comment that have patched up the problems rather than provided a root and branch review. More than even in the previous draft, it constructs some elaborate (perhaps fanciful) arguments around very little data that are associated with a high level of uncertainty. The process by which knowledge is mapped into the policy through the assessment of threats is particularly weak and, as a result, the whole structure of the document needs to be re-worked.

The Recovery Plan illustrates two substantial failures in a best practice approach to developing science-led policy. The first is that NMFS, the policy arm, should not also be making the scientific judgements. Somehow the higher level management within NMFS needs to grapple with this problem because it is creating a fundamental conflict of interest at the staffing level that is responsible for drafting the Recovery Plan. Staff that are making scientific judgements cannot also be making policy! The temptation to manipulate the scientific evidence to support a particular policy view is just too great and I fear that the Recovery Plan is seriously infected with this type of issue. Even if it is not infected in this way, it is now seen to be so, and that is just as bad.

The second failure is that the Recovery Plan has been written by stakeholders all of whom have attempted to manipulate the process in one way or another. This results in the worst of all worlds – a plan that has no purpose other than to address the stand-offs between the different stakeholder groups. Worst of all, NMFS scientists are now seen as one of those stakeholder groups because, whether true or not, they are not seen to be assessing evidence appropriately and they are seen to be manipulating evidence to support a particular policy. This represents a major systemic failure in NMFS and it places NMFS staff in an invidious position.

My recommendation is that NMFS should adopt the Environmental Protection Agency's risk assessment/mitigation approach to managing the SSL. This can be supported by, first, providing a clear statement of its policy with respect to recovery of the SSL which should be independent of the Recovery Plan and should not be produced by the NMFS scientists involved. This should be based upon the legal obligations upon NMFS, but it could also review those obligations in the light of new evidence, especially with respect to the justification for establishing distinct population segments. This policy is the reason for the Recovery Plan in the first place. Second, NMFS should establish an independent panel (mainly of scientists many of whom should not be involved in SSL research) to map the current science into the policy and to produce the plan to achieve the objectives.

Overview

I have responded to the RRP in the context of a set of questions generated by me as a way of attempting to articulate the nature of the current problems with the RRP. There are a number of important questions concerning the SSL population that the RRP either does not address or, if it does address them, they are lost within the complex text. There are also questions that relate to specific management measures and options, or the way in which evidence has been used to construct the Recovery Plan.

1. In gross terms, what is happening to the SSL population?

The count data for SSL are probably the most reliable indicator of population status. It is unusual for all the SSL population to be plotted together by combining across all the DPSs but, for reasons articulated below, this is worth doing because I suggest there is little justification for considering that the different population segments are distinct. The overall pattern of SSL abundance suggests rapid decline through the 1980s, stability through the 1990s and a slow but consistent increase through since 2000.

Without getting into the detail of the meta-population structure, and assuming no human impacts have occurred, this suggests a density-dependent pattern of change most likely in response to a change in carrying capacity during the 1980s. Some of the condition indicators from the population support this view.

If one then adds in the knowledge that declines in the 1980s were exacerbated by shooting, this probably explains the apparent rapidity of the decline through that period and the likelihood that the decline may have undershot carrying capacity, at least in some regions. Current increasing trends may represent an increase towards a reduced carrying capacity.

Although this overall view is speculative, the lack of evidence of any significant human factors driving the population dynamics in recent years means that we need to place more weight on the potential that changes have been caused by natural processes.

2. Is the SSL population still declining?

The evidence suggests that the population as a whole is not declining. Some local populations may be in decline but this is to be expected in a population like the SSL that is distributed over a very wide range and where conditions will differ geographically.

But, the observation that birth rate may be low is of concern. It is not absolutely certain that birth rate is a problem but, in the absence of other indicators, the focus of concern may be upon the birth and weaning process either because of teratogenic factors like disease or pollution, or because of a possible tendency for mothers to extend the duration of lactation and trade off new births for investment in current offspring. The latter is certainly a possibility and one can find parallels in other mammals – mainly marsupials - that have to cope with uncertainty in environment productivity. If this was the case then it suggests that mothers are experiencing some level of food shortage through lactation.

The suggestion that lactating mothers could be a focus of management action has to be tempered by two factors;

(1) Our certainty about this being the cause of current population dynamics is fairly low, even if it is the best current model; and
(2) Assuming there is no pathology involved, the responses of mothers is likely to be adaptive, i.e. mothers are trading off new births for investment in current offspring within the norms of the life-history of the species. This means that it is likely to fall within the boundaries of an "evolutionary stable strategy"[1] and is adaptive in the sense that it helps to maintain the population in the long-term. Consequently, it may not be a feature of concern when placed alongside relatively high juvenile and adult survival rates.

A problem faced by managers is that the raw population data placed within models suggests that the current balance of birth and death rates makes the population unsustainable. But the gross evidence from the population trajectory does not support this view. Either the raw input data are wrong, biased or do not represent the population as a whole – which is possible since they apply mainly to the Central Gulf of Alaska – or the data showing the population trajectory are inaccurate. At present, it is probably not possible to distinguish between these alternatives but the most secure data sets for SSL are likely to be the population counts. Even if these are biased, they are likely to be internally consistent unless biases have changed through time. This means that data about population trajectories are likely to be the most robust, and therefore, believable part of the SSL story.

3. Is the SSL population endangered?

The RRP makes the case that, under the conditions of the ESA, the WDPS of the SSL is endangered. However, the RRP does not make a strong case for the separation of the WDPS from the EDPS – in fact it makes no case for this historical separation. My view is that the weak evidence for this separation undermines the fundamental basis of the ESA classification and the classification should be revisited.

Overall, there are about 110,000 SSL. For at least the past 15 years there has been little evidence that the problems that existed in the 1980s are still present and some recent indicators suggest modest rates of increase. The population of 110,000 animals is similar to that of the Canadian and European populations of Atlantic grey seals (*Halicheorus grypus*), it exceeds the population size of the European harbour seal (*Phoca vitulina*), and is of a similar order of magnitude as distinct coastal harbour seal populations in the northern hemisphere. Although smaller than the population of California sea lions, the current SSL population size is of a similar order of magnitude to that of the California sea lion which is not considered to be endangered.

My view is that it is difficult to justify listing the WDPS as an "endangered" population, at least in the same sense as the Hawaiian monk seal, for example. There is strong evidence that several pinniped populations have recovered from population levels that are two orders of magnitude lower than the SSL population.

4. What, in practice, can be done in addition to the conservation measures already in place to promote positive change in the SSL population?

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[1] John Maynard Smith and George R. Price (1973), The logic of animal conflict. *Nature* **246**: 15-18

In its assessment of threats the RRP provides an assessment of the feasibility of mitigation (Table IV-1, p120). Those threats classified as "high" in terms of feasibility for mitigation have received most attention in the past with the introduction of measures to control disturbance, shooting and to reduce the potential impact of fisheries around rookeries.

The "elephant in the room" concerning the RRP, and that is evident from the way in which the evidence has been presented, is that NMFS would like to introduce further controls on the fishery. I would not argue with this as a precautionary measure if it appeared to be proportionate and justified by the evidence. However, as I shall argue in more detail below, it may be neither justified nor proportionate. In summary:

(1) NMFS has already introduced conservation measures that affect the fishery. Insufficient time has been allowed for these to bed in and it remains possible that some of the positive increase we are seeing at present could be the result of some of these conservation measures;
(2) Seen in the context of an appropriate risk assessment/mitigation process it would be normal for the effects of current mitigation to be assessed before moving forward to introduce more mitigation – adding one set of measures on top of another would create a mess.
(3) Indirect effects concerning interactions between SSL and fisheries are likely to be very complex. There is unlikely to be a simplistic connection between the fishery and sea lions (e.g. fish taken by fishermen = fish lost to sea lions) and there is probably just as much chance that well-intentioned manipulation of the fishery will have a negative effect on sea lions.

In summary, since we appear to be witnessing a recovery in the population, I suggest that the most constructive management measure would be to maintain current measures but to review these after each range-wide population survey or if other strong evidence emerges to suggest that they should be revised.

5. *Are the recovery criteria reasonable and achievable?*

The policy description of "1% probability of extinction in 100 years" is a reasonable threshold to apply for ESA listing. However, there is uncertainty about the meaning of "extinction". This arises in two areas:
(i) In current legal terms, since the ESA recognises two distinct population segments, extinction is applied exclusively to each segment. However, I have argued later and in my previous comments that the distinction between population segments is certainly questionable based upon current evidence. If one retains the current segmentation of the population then the PVAs done to date certainly suggest that the WDPS is within the ballpark of the ESA listing criterion. If one considers the population as a single entity (i.e. a single metapopulation) it is highly unlikely that the same ESA listing would apply.
(ii) The PVA in the RRP assumes extinction to have occurred at a population size of 4,743 sea lions. While one would never suggest that a population of this size is in any way desirable or healthy, there is plenty of evidence showing that several populations of pinnipeds that are now healthy were once reduced to much lower levels than this. Conversely, relatively few have gone extinct.

An important change made to the recovery criteria from the first draft of the RP is that the section requiring "population ecology and vital rates in the U.S. region are consistent with trend..." has been removed. This was a poorly defined recovery criterion for the WDPS which, in essence, left the judgement about whether to down-list in the hands of the biologists when their data are never likely to provide enough certainty for them to be able to make this judgement.

However, the criteria for down-list of the WDPS still seem overly precautionary. For example, if the population remained stable at current numbers for the next 15 years, the PVAs as applied in the RRP would almost certainly show an extremely low probability of extinction and would take the population well above the ESA criteria. However, because the criteria for down-listing require that the population should increase significantly over a 15 year period then the WDPS would not be down-listed in these circumstances. This shows that the recovery criteria being applied are inconsistent with the ESA listing criteria and with the policy apparently being developed by NMFS, such as it is. In my view, the probability of down-listing the WDPS using the criteria provided in the RRP is very low.

6. *Is the current WDPS population of 45,000 a relatively large number of animals that should allow the RP to be somewhat less conservative?*

Very roughly, if we consider the population sizes of pinnipeds world-wide in 5 broad categories on a logarithmic scale (1 = 100-1,000; 2 = 1000-10,000; 3 = 10,000-100,000; 4 = 100,000-1,000,000; 5 = > 1,000,000) there are probably <10 populations in the truly endangered category 1; there may be <50 in category 2 which could be considered as probably threatened; there are probably <20 in category 3 and <10 in each of categories 4 and 5. Although this assessment is built upon my own experience rather than an objective analysis of the data, I don't think a detailed analysis is likely to come to a very different conclusion. What this suggests is that the WDPS lies well within the normal range of population sizes for pinnipeds on a global scale. Of course some of these may be depleted but, overall, there is not an impression that pinniped populations are depleted on a global scale. Given this, and assurance that the rapid declines that occurred in the 1980s and 1990s have ended, there would be a case for saying that the WDPS is not an endangered species.

7. *Is the range of the SSL contracting from west to east and is this an important problem?*

Ideally, we would wish to see the geographic extent of the SSL range maintained in the long-term. However, changes in the balance of numbers in different regions within a range over time periods of decades to centuries should be considered to be normal in these types of populations.

The RRP probably places too much emphasis upon the avoidance of local extinctions. While it is reasonable to show some level of precaution towards the SSL as a whole, this does not need to extend to the SSL over its whole range. We do not know why there is an apparent contraction of range from west to east but there will always be an argument between those who "believe" that this is caused by human factors and those who do not choose to believe this. However, this is not an argument for science or scientists whose only role should be to advise those involved in the debate about the relative strength of evidence to support particular arguments (note, it is this objectivity that has been lost by NMFS scientists).

8. *Should Killer Whale predation be listed as a High threat based on the current evidence, regardless of the inability of the agency to control that threat?*

I cannot understand the logic applied in the RRP for down-grading the potential influence of killer whales. Is this just an inconvenient potential truth for NMFS? NMFS has systematically dismantled the killer whale hypothesis for reasons that are not completely clear and with arguments that verge on advocacy rather than objective assessments of evidence. I can understand this to some extent because those proposing the killer whale hypothesis tend to do the same. But it is NOT the job of NMFS to be the opposition in this case because, as we see in the RRP, it compromises their ability to arbitrate on the issue. As I also suggested in the summary to this document it also compromises NMFS competence to produce this Recovery Plan.

I certainly think that the threat from killer whales has to be consider to be at least as high as those relating to nutritional stress, based on current evidence. There is confusion between the concept of killer whales potentially having a significant impact and the causes of this effect, i.e. megafaunal collapse. This unfortunate confusion between the megafaunal collapse and a potential predator pit for the SSL appears to have led to an extreme polarisation of views. I think there is no doubt that killer whales could have caused the decline, in theory, but there is insufficient evidence either way to decide the relative strength of this hypothesis.

9. *Will the current management measures ever produce unequivocal results as a test of the competition hypothesis? If so, what sort of results should we look for and how many years must the current management measures remain in place to get those results, one way or the other?*

It is likely that current management measures, used in the context of a long-term experiment to manipulate the system to the advantage of the SSL, will never produce unequivocal results but they may eventually indicate a smoking gun. One of the problems with the approach is that it is always possible for those who "believe" there is an effect to argue that the experiments are inadequate if they show no effects. However, this is not a problem that is isolated to SSL-fisheries interactions. It is one that is used continuously by NGOs the world over.

As I have indicated in the past, extending the types of studies begun by Wolf and Mangel would start to define the presence/absence of signals of SSL-fisheries data. In this case, we would test formally for evidence of all the hypotheses simultaneously in all the data we have. This will provide a value for the relative support for each hypothesis from the data. It may, or may not, show a stronger effect of fisheries than other factors. In terms of time scale, I suspect we already have the data to do these analyses but we should be constructing them now and re-running them regularly to examine the emerging pattern. It may then be possible to modify management progressively based upon the emerging results.

We need a mechanism to undertake this work. I suggest it is necessary to engage 3-6 independent scientists/groups. Each needs to be provided with a brief and the same data and each needs to produce their own model structure independently. It is important to do this in order to eliminate model uncertainty through model averaging.

10. Has NMFS jumped to conclusions in its determination that nutritional stress is the cause for reduced reproduction and natality and in its assessment of the killer whale threat?

This is partly dealt with in my response to Q8 above. I suggest that NMFS has not taken a balanced view. NMFS contains some of the main advocates of the "it is not killer whales" hypothesis, if it can be called that. Although there is strength to their arguments, I feel that there has been an unfortunately confusion between the hypothesis of sequential megafaunal collapse and the hypothesis that killer whales could have been implicated as a cause in the decline of SSL. The megafaunal collapse hypothesis invades the territory of the wider ecological impacts of historical whaling, which is an extremely controversial subject. A fairly convoluted sequence of logic is required for this to be upheld and NMFS is probably correct to illustrate the weaknesses associated with using this as the causal mechanism for SSL declines.

However, in my view, NMFS has been guilty of selectively quoting from the literature to support the non-killer whale view. The same is true for those that proposed the killer whale hypothesis and, when read in isolation, both views seem plausible to an outsider. But we know that both can't be correct and, in reality, the truth is probably somewhere between what is being proposed on both sides of the killer whale argument.

NMFS staff should not be allowed, or allow themselves, to get involved in these types of arguments. In the end, NMFS has to sit in judgement on biological arguments and make management decisions. In this case, they are acting as both the judge and the advocate which is morally and procedurally wrong.

11. Has NMFS applied an appropriate weight of evidence approach to the assessment of nutritional stress?

Evidence of NMFS not applying an appropriate weight of evidence approach comes from the fact that much of the research conducted during the past 5-10 years has been specifically aimed at testing the hypothesis that there is evidence of nutritional stress. I think it can be said that, without exception, no study has found support for this hypothesis. There have been those that have found some evidence that the decline has been related to changes in the prey available to SSLs but this is weak and is in anycase one step removed from nutritional stress. Just because no evidence has been found does not mean that nutritional stress is not a potential cause but, relative to other hypotheses, the evidence places less weight upon it than in the past.

NMFS has used three main lines of evidence to support their arguments about nutritional stress:
(i) Changes in the condition of animals between the 1970s and 1980s. Elsewhere in this commentary I say why I do not think it is safe to place much weight upon this as evidence.

(ii) The results of fitting a demographic model to current population structure and the recent population trajectory. I also comment on this Holmes et al. model elsewhere in the commentary but it is worth noting that Holmes et al. themselves only place some form of nutritional stress as one of several possible, and at present equally likely, explanations for this observation. Recent evidence that there may be previously unobserved mortality of pups on rookeries is important in this context.
(iii) The relationship between the fishery activity and the local population trajectory of the SSL as described by Hennen. However, while these results are undoubtedly interesting, this study is flawed in the sense that it was an exploration of data to examine the possibility of a correlation between fishery activity and SSL population dynamics. In other words, it was not a fair test because it neither explored mechanisms for the interaction nor did it test the relative strength of alternative hypotheses (see Wolf and Mangel) or factors that could co-vary with the fishery. Although the Hennen study cannot be dismissed, it must carry relatively little weight in the assessment of evidence.

12. *Are there objective standards in the use of weight-of-evidence?*

I know of no methods other than to place the evidence in a statistical framework like that used by Wolf and Mangel. This has problems in that the statistical framework needs to be designed carefully so as not to introduce bias and also to capture the subtleties and the complexities of the data. This is why I have suggested that a fair test would involve several groups working independently to produce statistical frameworks with the same information. The funds currently allocated to research would be much better spent doing this than setting new hares running or continuing current relatively unproductive approaches. A further advantage of this approach is that it would help to identify those areas of research that need most attention because one could turn them into a sensitivity analysis highlighting which data are likely to yield the greatest return in terms of improved understanding.

Another type of test of the data, in terms of developing a weight of evidence approach, is roughly along the lines of that used by the Recovery Team, except that in this case the process was compromised for two reasons:
(i) The members of the recovery team were not independent, i.e. they were advocates for particular views, so the whole process of assessing weight of evidence was flawed (unless an independent judge or jury was also to preside and make the decisions);
(ii) The analysis produced was subsequently edited by NMFS which, as I have already indicated, does not take an independent view in this case.

13. Is the uncertainty over population segmentation such that down-listing is possible sooner rather than later?

My view is that the criteria probably no longer exist for classifying the WDPS as endangered. So long as the high rates of decline seen through the 1980s and early 1990s are no longer present, the conditions for classifying the population as endangered no longer exist. Nevertheless, it is important to maintain the measures introduced in the early 1990s to protect the SSL so it would be unfortunate if down-listing led to the return of those factors, especially indiscriminate shooting and a culture of extermination in some quarters. It is essential that we should never allow a return to those days.

Assessment of revisions made to the Recovery Plan following public consultation in 2007

Some important changes have been made to the text and structure of the Revised Recovery Plan (RRP). This has clarified some issues and made the RRC generally more readable and it has improved communication of some important ideas. It has also raised some important problems, especially concerning the inconsistent use of evidence to support the recovery policy developed within the plan.

Some of the following comments are highly critical. I emphasise that this criticism is aimed at the process that allows a plan of the type being proposed to be produced, not the individuals involved.

On a more mundane note, the system used to number paragraphs is irritatingly complex and makes navigation through the document, and also appreciation of one's location in the document, very difficult indeed. This is really simple to fix and would help greatly with the case that is being made by not making reading and digesting the document more complex than it needs to be. This is made more difficult by numbering errors, especially in Section V.

Additional sections to the report in the form of the RRP that are especially important include:

- (i) Nutritional stress, section I.H.5, and Table I-15
- (ii) Introductory explanation to Section III, "Factors potentially influencing the western population".
- (iii) Reassessment of the importance of killer whale predation in Section III.B.1
- (iv) Additional text assessing the possible effects of toxic substances (Section III.B.9) and nutritional stress (Section III.B.11) but also removal of some speculative assessments of nutritional stress.
- (v) Some additional introductory text to the Threats Assessment (Section IV)
- (vi) In Section V.A there is additional explanation of the definition of recovery.
- (vii) There is extensive additional explanatory material concerning the Population Viability Analysis (PVA) in Section V.C.1-3.

Many of these changes strengthen of the document and I am grateful to NMFS for giving attention to my original comments.

In my original commentary, I proposed that the approach taken in the production of the SSL RP is inappropriate and, because of this, the RP contains important logical inconsistencies and encourages polarised views of appropriate actions. The current approach assumes high levels of certainty in the knowledge-base which simply does not exist.

It is entirely possible to deal with high levels of uncertainty using risk-based approaches to management. This type of appraoch investigates solutions that do not preclude later action. This has the added advantage that funding is not wasted in a shot-gun approach to solving the problem.

General issues concerning the approach

In my previous review I suggested that "the RP should use a risk assessment framework ... involving regular review and re-assessment of management actions in the light of assessments of their effectiveness... Risk assessment involves a substantially greater level of managerial effort throughout implementation but it has the large advantage that it does not commit the Agency to a single course of action at the outset and it is based upon a *balance of evidence*. Perhaps the most frustrating aspect of the current RP is that the Agency is already using a *de facto* risk assessment approach but the RP fails to recognise this or to develop it into a formal mechanism. Much unnecessary tension could be avoided by doing so."

"...Implicit within the RP is the idea that a rational basis for management requires detailed knowledge and this can be achieved through high levels of investment, especially in research. My thesis here is that some of the vital information required by the RP may never be forthcoming – some of the scientific problems simply cannot be solved with our current technology and capability and they are very unlikely to be solved in the near future and certainly not within the lifetime of the current PR [sic]. The RP is knowledge-hungry to an extent that makes it unsustainable. Although admission of failure to solve some of the most pressing scientific problems may be a profoundly depressing scenario (especially for those toiling on SSL research), there are pragmatic ways of dealing with this issue."

Fundamentally, these comments still stand. While I appreciate that changing the structure of the plan, and the implementation process, may not be possible at this stage, I was hoping that NMFS would acknowledge the strengths of the Environmental Protection Agency's risk assessment/mitigation approach. With rather few changes, this could be implemented in this case and it would guide and focus the research effort being used to support the RRP outcomes. However, this would require a root and branch change in philosophy.

The risk assessment/mitigation approach would allow a variable level of management/mitigation depending upon feedback from indices of progress towards objectives. The research would then be focussed upon developing and maintaining appropriate indices.

Specific issues in the RRP that require comments

1. Nutritional stress

Considerable additional effort has been made to rationalise the concept of nutritional stress. This has been subdivided into acute and chronic forms of nutritional stress. My assessment is that this extended discussion simply deepens the doubts that exist about the nutritional stress hypothesis – even though its intention seems to be the opposite. The evidence leans heavily upon two shot samples of SSL from the 1970's and the 1980. As I emphasised as strongly as I felt I could in my previous commentary, these samples have to be viewed with a great deal of caution. Anybody who has sampled pinnipeds in this way understands how easy it is to build in biases, based upon a wide range of factors that lead to inconsistent and sometimes undetectable forms of bias. For example, I understand that the body measurements of SSL were not taken in identical ways between the two periods. On balance, these two samples, and the supposed differences between them, provide little evidence for nutritional stress affecting Steller sea lions and have to be weighted accordingly.

The new section of the RRP on nutritional stress spins a complex story around nutritional stress involving backdated growth through the lifetime of these animals to critical periods in life-histories of these animals. I simply cannot accept that this is justified. We have no life-history data for these individuals and we have no data about the levels of food supply through these periods. An example of the poor logic that has been spun is present in the following quotation from the concluding parts of the arguments put forward for nutritional stress (p42): "Females during the summer breeding season (on rookeries) appear to be able to attain [presumably 'obtain' is meant here] adequate energy to nurse their pups. However, pregnant females with and without pups **may** [my emphasis] be experiencing chronic nutritional stress after leaving the rookery as evidenced by decreased pregnancy rates of lactating females (Pitcher et al. 1998), and decreased natality rates overall (Holmes and York 2003, Fay 2004, Holmes et al. in review)."

An analysis of this statement shows how hollow it is. The information from Pitcher et al. (1998) was based upon the 1970s and 1980s samples discussed above and has to be given relatively little weight. The other papers quoted are examples of modelling exercises that fit different scenarios to data and that tend to show that part of the reason for recent population declines has been a low birth rate (See Appendix 1 for comments on the Holmes et al. paper that is in review). At best, they can be viewed as fairly circumstantial evidence supporting low birth rates but they say absolutely nothing about the causes of the low birth rates. They provide no evidence for a nutritional cause of low birth rates.

It would be possible to extract many statements of this type that have been built upon very little evidence. Indeed, the RRP itself is inconsistent in the weight it places on evidence. For example, on p29 there is the following statement "The studies [referring to most of those used above] attempting to estimate past demographic rates were motivated in part by the hope that these could shed light on the various possible causes for the changes in vital rates responsible for the population decline. In this, the retrospective studies have been largely inconclusive." This means that, having admitted that most retrospective analyses have been of little help, many of these analysis are then used in later parts of the RRP to justify a particular position especially about the effects of nutritional stress and also when assessing the levels of threat. In the same place, the RRP then goes on to say, "One exception is the study of Hennen (2006) which found an association between rate of by-rookery decline and the fishing activity around the respective rookeries..." However, there is no in-depth analysis of the inherent weaknesses in the Hennen study which appeared to have been designed from the start to investigate relations with fisheries, meaning that it began with a biased view and was probably constructed (most likely inadvertently) to show a positive result. Again, the conclusion from Hennen (2006) is greatly weakened by an uncritical and selective type of quotation of evidence. For example, it is not clear why the study referred to by Wolf on p28 is not also an exception.

An enormous amount of time, effort and resource has been expended on the nutritional stress hypothesis. While there are a broad range of additional scenarios that could involve nutritional stress, it may be impractical to investigate these in a way that will allow us to draw anything other than flimsy conclusions about their role in the population dynamics of the SSL.

My suggestion is that the section of the RRP describing nutritional stress says more about current internal agendas in NMFS than about what we actually know about the influence of nutritional stress on Steller sea lions.

2. Killer whales – contrasting treatment to nutritional stress

The RRP has also added a new analysis of the killer whale issues. However, the way in which killer whales have been dealt with is in stark contrast to the analysis of nutritional stress. Again, this inconsistency of approach probably reflects internal tensions and agendas in NMFS rather than genuine differences in the level of certainty that can be applied to the problem of nutritional stress as opposed to killer whales.

I am not very knowledgeable about the details of the killer whale data but, for example, reference on p85 to Maniscalco et al (in press) – which is not referred to in the list of references - states that predation events were lower than expected by Williams et al. (2004). Rather than then concluding that the observations of Maniscalo et al (in press) might be under-estimates, the RRP concludes that Williams et al. (2004) was wrong. I cannot understand why William's estimates have been dismissed so easily and much greater weight given to the data from Maniscalo et al. (in press). Although I have not had the pleasure of reading Maniscalo et al (in press), the estimates of killer whale predation events are very likely to be much more uncertain than the energy consumption estimates provided by Williams, which are based upon an extensive data set from marine mammals and a strong underpinning theoretical understanding which is, to a great extent, backed up by empirical observation. Through the use of fairly robust scaling relationships, the energy consumption estimates are easily scaled to killer whales from other marine mammal species.

On p88, the suggestion from Williams et al (2004) that a population of 170 mammal-eating killer whales could have caused the decline in SSL abundance is incorrect. Williams et al. suggested that fewer than 27 mammal-eating killer whales could have caused the decline.

Most of the discussion of killer whales shows that there are very high levels of uncertainty, that there is a strong case to suggest that killer whales could be responsible for declining Steller sea lion populations and that a precautionary approach would be to retain this as a potentially important factor regulating Steller sea lions. Unfortunately the predation hypothesis has become mixed up with the causes (sequential mega-faunal collapse) which is unhelpful, but it does not reduce the likelihood of the hypothesis.

Probably the worst aspect of this analysis is that NMFS appears to have gone out of its way to counter the killer whale argument put up by Williams et al (2004). Instead of conducting a balanced analysis of the pros and cons and assessing the overall level of uncertainty across all arguments, it has seen its role to put up counter-arguments. Given the current levels of uncertainty it seems perverse to come to any strong conclusions either way in a document such as the RRP.

Overall, the balance of evidence put forward as supporting nutritional stress is probably weaker than the balance of evidence supporting killer whale predation effects and yet the RRP comes to quite different conclusions about them as threats. The RRP chooses to place Environmental Variability and Competition with Fisheries and "potentially high" threats because of the effects they may have upon the nutrition of SSL. In contrast, the RRP has reduced the threat from killer whales to "Medium". I can see no rationale in the RRP for viewing all of these threats as being anything other than highly uncertain.

3. Adaptive management program to evaluate fishery conservation measures – confused objectives

NMFS appears to be confusing two issues in its description of "adaptive management" (p5 & p160). The first is the need to be as responsive as possible to circumstances and to introduce mitigation of potential impacts on SSL as soon as they have been identified. The second is the need to develop an improved knowledge of how SSL respond to different potential impacts through experimental manipulations. Unfortunately, for NMFS, these are likely to be quite different activities. One is a best-practice, and often precautionary, response to a set of circumstances while the other is a designed approach to obtaining new knowledge.

I suggest that NMFS began adaptive management in the early 1990s and has continued that since with additional restrictions being placed upon the fishery. It is possible that we may only now, some 15 years on, be seeing some of the rewards from the measures introduced in the early 1990s mainly to eliminated depredation of the SSL. The long time lags there are between introducing management measures and measurable effects are a feature that cannot be overcome. They derive from a combination of the relatively slow dynamics of large mammal populations and the inherent imprecision of the measurements of population change. Although many of the management measures introduced to date seem sensible, some such as prevention of shooting are obvious whereas others such as the reduction of fishing activity in the vicinity of rookeries is precautionary because the evidence to support them is comparatively poor. Nevertheless, they are proportionate even though it may never be possible to determine if they are being effective.

The suggestions raised by Bowen et al. (2001) and the NRC (2003), also subsequently by Wolf et al. 2006, were of an entirely different nature. Their point was that if one wanted to clearly distinguish between different hypotheses it may be necessary to conduct and experiment. Not withstanding the fact that the types of models proposed by Wolf et al. (2006) use natural variability to move us along this track, there would unquestionably be advantage in this approach. However, the practicalities of implementation make these types of experiments almost impossible to conduct. The text on p160 says "Given signs of recovery in the western DPS, it is important to take this opportunity to implement an adaptive management program to test the underlying hypotheses of the conservation measures". THIS WOULD BE THE MOST FOOLISH RESPONSE TO A POSITIVE RESULT IN ANY EXPERIMENT. NMFS needs to understand very clearly that it is already in the middle of an experiment of sorts and to change the variables in mid stream would be a folly of gigantic proportions. It would simply muddy the waters for years to come.

My suggestion is that NMFS needs to review the current management measures for their likely relevance to SSL conservation but that, in general, they should be retained and reviewed after each range-wide survey. We know there are long time-lags in the system and fiddling with management on short time-scales will not help to clarify issues. NMFS needs to understand also (not just state this in the RRP) that the cause of the current population dynamics are almost certainly multi-factorial and experiments aimed at dealing with single factors, e.g. fisheries, will likely turn out to be inconclusive.

In the meantime, much more could be done by NMFS to undertake state-space, multi-factor modelling, like that begun by Wolf et al. (2006) to partition the variance in responses between different factors.

4. Population definitions

Additional explanations have been provided to underpin the issues about population structure on page 11. At present NMFS defines two "Distinct population segments", one in the west and the other in the east. For the current RRP to be useful the validity of the definition of a Western DPS needs to be justified because if one considers the SSL population overall (western DPS plus eastern DPS) a very different demographic and ecological picture emerges.

What the additional text on p11 reveals is a greater level of complexity than previously thought, perhaps not surprisingly. The text reveals that there is movement of breeding females from the western DPS to the eastern DPS. The narrative goes on to suggest that "This has potential long term implications to the viability of these populations and their management", but does not go on to elaborate what these implications are (I suspect this is because they are too difficult for NMFS to contemplate because it cuts across the current ESA classification). The narrative continues, "It is possible that we are witnessing in real-time a very infrequent event in which female sea lions from one population cross over and breed in another". The important question raised here is how plausible is it that this is a rare event and how plausible is it that this event does not also occur in the opposite direction?

Of course, it is possible that this event is a one-off occurrence that may never be repeated but the assumption really has to be that, given the low level of previous knowledge, these results are indicative of the normal rate of population introgression. Applying the same logic to some results in a manner that would be less convenient for NMFS would lead one to the conclusion, for example, that the difference in the apparent body condition and pregnancy rate of SSL in the shot samples from the 1970s and 1980s was abnormal and should be discounted in a similar way. However, considerable weight is placed by NMFS on this result when arguments are put forward about the effects of nutritional stress (see above). There is, therefore, an inconsistency in how evidence is being used to support a particular point of view.

As I proposed in my commentary on the previous draft of the Recovery Plan, the most parsimonious explanation for the population structure of the SSL is that the population should be viewed as occupying a linear habitat (the coastline), that inter-rookery distance is the most important factor regulating introgression and that there is probably comparatively little evidence that supports the clear division between the western DPS and the eastern DPS. In fact, the current description of the genetics and observed movement provided in the RRP does not support the current population definitions and makes little overt attempt to defend them. Based on the current evidence it seems much more likely that the SSL population is contiguous but with clines in genetic diversity through the long coastal range.

The implications for management are that it would be much more sensible to consider the western and eastern DPSs as a single management unit with meta-population structure divided by rookery, or some logical grouping of rookeries that show congruent dynamics. I suspect this would lead to a very different management scenario.

5. Declining birth rates

The RRP has been modified to include the results of a new study by Holmes et al. (in press). A detailed critique of this paper is provided in Appendix 1. Overall, the paper suggests there is a case for saying that the declines in the SSL population in the Central Gulf of Alaska have been driven by low birth rates. This is an interesting result, although it builds on previous population analyses from this group so it is not a complete surprise.

The Holmes et al. (in press) analysis employs a formal "balance of evidence" approach. Accepting that any decline of a population has to be caused by reduced birth rates or increased death rates or some combination of both, the approach examines to what extent there is evidence for any of these from the data for SSL in the Central Gulf of Alaska. On balance, the results push us in the direction of looking towards lower birth rates. However, this still does not preclude other possible explanations. It simply says that the balance of probability suggests that lower birth rates could have been a major driver. Note also that it says nothing about current or future causes; the analysis is necessarily retrospective.

I would suggest that this is one of the stronger lines of evidence provided within the RRP, mainly because it relies of data from direct counting of sea lions. However, its implications are much less clear although it makes a case for a shift in the focus of investigation of causation. Teratogenic toxicity, either from some form of infection (*brucella*, for example) or from chemical toxicity may need additional focussed study. The lactation physiology of females SSL may also require some research because we need to know the extent to which females may sacrifice a reproductive attempt to sustain suckling offspring. There is also a strong possibility that low birth rate is being confused with low perinatal/pup survival rate, especially for rookeries which are swept by waves on occasions. For example, it might be interesting to examine the effects of storms as a co-variate in the Holmes et al model.

One final issue that I suggest needs some further thought with respect to the types of models fitted by Holmes et al. is the extent to which the model structure may itself introduce bias. The probability surfaces explored to derive the kind of results coming from the Holmes et al. study can be complex and it is often not very clear the extent to which quite different positions on the probability surface, or assumptions attached to the calculation of joint probabilities, can affect the results. In addition, Holmes et al use maximum likelihood to explore this surface which is not a very sophisticated method and involves underlying distributional assumptions. This type of model uncertainty can be dealt with up to a point by sensitivity analyses but, ultimately, we probably need to see several independent groups of scientists tackle the same question using different approaches before we can build confidence in the output.

6. Population viability analysis

A substantial section of new text has been added to explain the PVA more clearly (p130-131). The limitations of the PVA are also listed on p132-133.

The additional explanation is helpful and, in addition, a study by Loughlin[2] and a report from the Marine Mammal Commission[3] has suggested that PVAs are now a fairly standard part of the development of the recovery plans for endangered species. The RRP suggests that the PVA has not been used in the development of the plan, although evidence remains that it has had a strong influence.

My view is that the general utility of PVA is now largely undermined. It is necessarily an unsophisticated projection of the past into the future. Although it may give comfort to some to rationalise management based upon a PVA, it is not a replacement for risk-based management using adaptive methods – which is, in effect, what NMFS has been practicing for many years.

Annex 1

Age-structured modeling provides evidence for a 28-year decline in the birth rate of western Steller sea lions
E. E. Holmes, L. W. Fritz, A. E. York and K. Sweeney

The paper explores the underlying drivers of the population dynamics of Steller sea lions in the Central Gulf of Alaska. It tests a range of different scenarios against the available data both through the formal fitting of models and through informal comparison between model results and ad-hoc data sets. Overall, the paper concludes that there has been a progressive decline in the birth rate within the Steller sea lion population.

The analysis conducted in this paper is sophisticated and probably robust. The authors have included sensitivity analyses and a range of checks to increase their confidence in the conclusions. The approach taken was to construct a broad range of different

[2] Loughlin, T.R. (2007) Review and comparison of recovery criteria in the 2006 draft revised Steller sea lion recovery plan. Report to the North Pacific Fisheries Management Council.
[3] Report of the Workshop on Assessing the Population Viability of Endangered Marine Mammals in U.S. Waters, 13-15 September 2005, Savannah, Georgia. Marine Mammal Commission.

population models that included many possible combinations of vital rates (birth and death rates in relation to age) and to examine which of the combinations gave the most convincing fit to the data. Because model complexity often leads to better fits, the authors used standard methods to penalise model complexity to help define the model that gave the best fit to the data.

All population models end up being a balancing of birth and death rates but changes in either can lead to increasing or declining population trajectories. However, it is sometimes difficult to distinguish between the relative effects of birth and death rates and this can only normally be resolved by examining the relative number of individuals in different age classes. For example, if a population has high birth rates and low survival rates then it will have a relatively large number of young animals. Fitting different models of the balance between birth and death rates to actual data is one approach to suggesting where the causes of changes in the trajectory of the population as a whole. In this case, the fitting process has generally pointed towards birth rates as the most likely source of the recent Steller sea lion population dynamics, at least in the Central Gulf of Alaska.

It should be appreciated that the conclusion of this study suggests that the weight of current evidence is that the birth rates are constraining Steller sea lion population growth in the CGA. This differs from proof of such an effect but it helps to focus attention on specific causes and perhaps suggests research that could be carried out and some potential management actions. It also does not distinguish between different causes of declining birth rate.

Furthermore, it is also important to appreciate that these models contain assumptions. They are imperfect views of the world but they are probably better at assimilating and synthesising across a complex set of data than less formal, ad-hoc approaches to data interpretation. Nevertheless, their complexity is such that their underlying characteristics are often difficult to understand and sometimes it is possible to inadvertently introduce bias into model structure that can lead it towards one conclusion or another.

For example, one important assumption of this approach is that neither sex ratio nor the proportion of non-pups hauling out has changed systematically across the period represented by this study. This assumption is recognised in the text of the methods. However, the text also makes the slightly odd statement that if this assumption is violated then the apparent stabilisation in the population since 2000 is "illusory". This statement is correct only under some circumstances.

Holmes and York also justify these assumptions (p15) but this justification does not account for systematic age-specific changes in behaviour, so the validity of these assumptions still need to be considered when interpreting the model outputs. It is difficult without running the whole model to fully appreciate the sensitivity there is to these assumptions but it does seem that relatively small changes in haulout behaviour between different age classes could lead to the observed effects. Although, on balance, such effects are not very likely, that they remain as a possibility is important.

These models are also often very sensitive to the starting conditions for population projection and, while the approach adapted here did make every effort to deal with this, ultimately it is limited by the data that are available.

Even taking into account all these issues, it seems to me that this paper builds a strong case for a declining birth rate in the Central Gulf of Alaska. Perhaps of more interest is the discussion of the potential causes which covers a wide range of different effects and, unlike the RRP, does not focus upon nutritional stress.

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July 18, 2007

Ms. Pat Livingston
Chair
Scientific and Statistical Committee
North Pacific Fishery Management Council
605 West 4th Avenue, Suite 306
Anchorage, AK 99501

<u>Draft Revised Steller Sea Lion Recovery Plan</u>

Dear Ms. Livingston:

The Marine Conservation Alliance ("MCA") submits the following comments on the Draft Revised Steller Sea Lion Recovery Plan (the "Draft Revised Plan" or the "DRSSLRP"), as made available for public comment on May 21, 2007 (72 *Fed. Reg.* 28473).

MCA is a broad-based coalition of Alaska coastal communities, fixed and mobile gear fishermen, vessel owners, processors, support industries, Western Alaska native villages and related Community Development Quota organizations, fishing organizations, consumers, and others who are directly or indirectly involved in various aspects of the fisheries off the coast of Alaska, including efforts to protect the Steller sea lion ("SSL"). Previously, on August 10, 2006, MCA submitted extensive comments to the North Pacific Fishery Management Council (the "Council") regarding the May 2006 draft of the SSLRP. MCA believes that its comments of last summer remain valid, and it is disappointed with the failure of the National Marine Fisheries Service ("NMFS") to adopt many of the changes MCA recommended. It does not intend, however, to repeat all its prior criticisms to the Scientific and Statistical Committee (the "SSC"). Nor does it intend to rehearse in this letter all the deficiencies it believes are found in the Draft Revised Plan. MCA intends to submit more comprehensive comments to NMFS by the August 20 deadline.

Overall, the Draft Revised Plan fails to analyze well the relative importance, going forward, of the historical causes of the SSL decline. That failure makes it extremely difficult to focus on the current and prospective conditions that are likely most relevant to the survival and recovery of the species. The primary objective of a recovery plan must be to provide a "basic road map to recovery," *Fund for Animals v. Babbitt*, 903 F. Supp. 96, 103 (D.D.C. 1995), based on an analysis of the reasons for the current plight of endangered or threatened species, with an analysis of the relevant importance of all possible threats, not just a focus on possible threats subject to management. It is within this context that MCA wishes to focus upon four matters which are of particular relevance and importance to the SSC: (1) the failure of the Draft Revised Plan to assess threats to SSL populations in an unbiased, scientifically sound fashion; (2) the elaboration in the Draft Revised Plan of recovery criteria that lack scientific justification and virtually guarantee that down-listing and de-listing will not be achievable; (3) the Draft Revised Plan's call for rigid maintenance of current fishery conservation and management measures as a required recovery action; and (4) the continued specification of an adaptive management program as a required recovery action, even though such a program is likely infeasible.[1]

1. The Revised Draft Plan Fails to Assess Threats to SSL Populations in an Unbiased, Scientifically Sound Fashion.

Under the Endangered Species Act, 16 U.S.C. § 1531, *et seq.* (the "ESA"), NMFS is required to develop and implement a "recovery plan" for each listed species under its jurisdiction, unless it "finds that such a plan will not promote the conservation of the species." ESA, sec. 4(f)(1). NMFS' Recovery Planning Guidelines, dated October, 1992, specify that a central element of any recovery plan must be a discussion of "factors affecting the species." It is elementary that the science that undergirds this discussion must be objective, sound and free of bias, basic criteria that NMFS fails to meet in the Draft Revised Plan.

NMFS' obligations with respect to scientific analysis in its resource management documents, such as the Draft Revised Plan, are spelled out in detail in the Data Quality Act, Treasury and General Government Appropriations Act for Fiscal Year 2001, Pub. L. No. 106-554, § 515, Appendix C, 114 Stat. 2763A-153 (2000) (the "DQA"), the implementing Guidelines of the Office of Management and Budget, 67 *Fed. Reg.* 8452 (Feb. 22, 2002) (the "OMB IQ Guidelines") and the Information Quality Guidelines of National Oceanic and Atmospheric Administration, dated November 6, 2006, available at

[1] In its comments last summer, MCA also stressed the need for the recovery plan to integrate metapopulation considerations into its analysis and questioned the inclusion of the Population Viability Analysis (the "PVA") as an appendix. Without wishing to belabor the point, MCA would note that metapopulation considerations continue to be relevant, especially since it is increasingly apparent that SSLs seem to be migrating eastward, with populations shifting from the Western to the Eastern region. MCA is disappointed that NMFS has not followed the SSC's recommendation last summer that there be a "more thorough evaluation" of SSL population dynamics, including "if it would be more realistic to describe the SSL as a metapopulation." Report of the SSC to the Council, August 15-16, 2006, p. 4 (the "SSC Report"). As far as the PVA is concerned, MCA notes that the SSC identified a number of weaknesses and desirable improvements that should be made to future iterations of the PVA. Even though nearly a year has passed, many of these have not been addressed, including comparing the results of this PVA with the results of other models. MCA appreciates that NMFS now takes the position that the PVA "does not guide management so much as it guided the [Plan Recovery] Team in their weight of evidence approach to deriving recovery criteria;" that the PVA is "only a tool not a deciding factor;" and that the PVA's "results were not used as recovery criteria." *See* NMFS, "Response to Comments on Draft Steller Sea Lion (SSL) Recovery Plan", pp. 18, 19, 20 (the "Response to Comments"). If this is the case, and given that there has been no further refinement of the PVA, one can question even more why this version of the PVA continues to be attached as an appendix to the DRSSLRP.

www.cio.noaa.gov/itmanagement/IQ_Guidelines_110606.htm (the "NOAA IQ Guidelines"). The DQA requires that Federal agencies have in place guidelines that ensure the "quality, utility, objectivity and integrity" of the information they disseminate. DQA, § 515b.2.A. The OMB IQ Guidelines stress, in particular, that "objectivity" relates to both presentation and substance. In terms of presentation, it "includes whether disseminated information is being presented in a clear, accurate, complete and unbiased manner" and, in terms of substance, it involves a "focus on ensuring accurate, reliable and unbiased information." OMB IQ Guidelines, Sec. V.3, 67 *Fed. Reg.* at 8459. The OMB IQ Guidelines apply strict standards to the dissemination of information that is considered "influential," that is, information which "will have or does have a clear and substantial impact on important public policies or important private sector decisions." OMB IQ Guidelines, Sec. V.9, 67 *Fed. Reg.* at 8460. Such information must be presented to ensure a high degree of transparency about the data and methods to facilitate its reproducibility by third parties. OMB IQ Guidelines, Sec. V.3.b.ii, 67 *Fed. Reg.* at 8460.

The NOAA IQ Guidelines, for their part, similarly define "objectivity" in terms of both presentation and substance, tracking the language of the OMB IQ Guidelines. They define "influential scientific information" as "scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions." They expressly cover "natural resource plans," such as the Draft Revised Plan, within this category. In accordance with the OMB IQ Guidelines, for influential information that assesses risks to the environment, such as the DRSSLRP, the NOAA IQ Guidelines call for the use of "(a) the best available scientific and supporting studies (including peer-reviewed science and supporting studies when available) conducted in accordance with sound and objective scientific practices, and (b) data collected by accepted methods or best available methods." For risk assessments that are quantitative in nature, "to the extent practicable," agency documents must discuss:

- each ecosystem component, including population, addressed by any estimate of applicable risk effects;

- the expected or central estimate of risk for the specific ecosystem component, including population, affected;

- each appropriate upper-bound and/or lower-bound estimate of risk;

- data gaps and other significant uncertainties identified in the process of the risk assessment and the studies that would assist in reducing the uncertainties; and

- additional studies known to the agency and not used in the risk estimate that support or fail to support the findings of the assessment and the rationale of why they were not used.

With respect to natural resource plans, the NOAA IQ Guidelines stress that such plans "will be based on the best information available," and "will be presented in an accurate, clear, complete and unbiased manner." In particular, under the Guidelines, "Clear distinctions will be drawn between policy choices and the supporting science upon which they are based." Supporting materials must be properly referenced to ensure "transparency."

The DRSSLRP does not measure up to these standards. This is reflected particularly in its discussion of killer whale predation and nutritional stress as factors affecting SSL populations -- a discussion which still lacks the "consistency" which the SSC last summer urged NMFS to strive to attain. *See* SSC Report, p. 5.

One of the major changes in the Draft Revised Plan from the Plan released in May 2006 is the downgrading of the threat assessment for killer whale predation from "potentially high" to "medium." DRSSLRP, p. 114. The Plan states that "[m]ajor limitations in the available data result in substantial uncertainty," and, while the Recovery Team was unable to reach consensus, NMFS changed the ranking based upon "public review and comment and additional scientific data which was not available to the Team." *Id.* If the NMFS downgrading of the killer whale threat was based on the Maniscalco paper cited on p. 111 (but not listed in the literature list), the data in the paper was presumably available prior to the preparation of the May 2006 draft since one of its authors was on the Recovery Team. Yet NMFS ranked the killer whale threat as "high" in that earlier draft. The difficulties with the Draft Revised Plan's analysis of this factor are highlighted in the comments of Dr. Ian Boyd, dated July 14, 2007 (the "Boyd Review"). Dr. Boyd points out that the Draft Revised Plan, without substantial justification, relies upon an unreferenced paper by Maniscalco, *et al.*,[2] to dismiss estimates of killer whale predation in an earlier paper, Williams, *et al.*, "Killer appetites: assessing the role of predators in ecological communities," *Ecology* 85(12): 3373-3384 (2004). Boyd Review, p. 15. Dr. Boyd also observes that the Draft Revised Plan (at p. 88) appears to understate the impacts of killer whales discussed in the Williams paper, by stating that a population of 170 transient killer whales could account for the decline of the western SSL distinct population segment ("DPS"), whereas, in fact, Williams suggests that fewer than 27 male transient killer whales or 40 female transient killer whales could have caused the decline. *Id.* If anything, the Williams findings would appear to be even more powerful today, since the latest transient killer whale population numbers show a population of about 314 animals. Draft Revised Plan, p. 84. This would appear to indicate that minimally only about 13% of the current transient killer whale population would be sufficient to explain the original decline -- almost double the size of the threat originally ranked as "potentially high."[3] In short, the Draft Revised Plan's discussion of killer whale predation does not appear to reflect an objective, unbiased discussion of this factor. Rather, as Dr. Boyd states, "NMFS appears to have gone out its way to counter the killer whale argument put up by Williams," Boyd Review, p. 16, and NMFS' treatment of this factor stands in stark contrast to its

[2] The paper is presumably "Assessing Killer Whale Predation on Steller Sea Lions from Field Observations in Kenai Fjords, Alaska," *Marine Mammal Science* 23(2): 306-321 (April 2007). Interestingly, this report strongly cautions against using its results to make comparisons to other times, areas or populations of transient killer whales and their effects on prey. The report specifically notes that it would not be appropriate to extrapolate the effect of this group of transient killer whales on Stellar sea lions to other regions of the state. Despite this caution, it appears that NMFS did indeed make such extrapolations.

[3] MCA understands that Dr. Williams has expressed similar concerns regarding the treatment of the predation data in the revised draft.

treatment of another factor, "nutritional stress," where, in Dr. Boyd's view, the evidence "is probably weaker than the balance of evidence supporting killer whale predation effects and yet the RRP comes to quite different conclusions about them as threats." *Id.* All this suggests a "worrying lack of objectivity," Boyd Review, p. 2, and "the possibility that NMFS is weighting the assessment to support preconceived notions of the underlying mechanisms [of decline]." *Id.*, p. 2. Plainly, this is contrary to NMFS' obligations under the DQA and its implementing guidelines.

The deficiencies in the Draft Revised Plan become especially apparent in its discussion of nutritional stress. *See* Draft SSLRP, pp. 36-42, 100-106. The DRSSLRP links nutritional stress with "competition with fisheries." Even while acknowledging that the Recovery Team could not reach "consensus" on this factor and that it is subject to "high uncertainty," NMFS continues to rank competition with fisheries as posing a "potentially high" threat to SSLs. DRSSLRP, pp. 102-104, 112-114. Again, MCA believes that Dr. Boyd's critique is on point. Dr. Boyd underscores that, "without exception, no study has found support for this hypothesis." Boyd Review, p. 9. As Dr. Boyd states, "[T]he extended discussion [of nutritional stress] simply deepens the doubts that exist about the nutritional stress hypothesis." Boyd Review, p. 13. Dr. Boyd points out that, based upon very limited samples from the 1970s and 1980s, "[t]he new section of the RRP on nutritional stress spins a complex story around nutritional stress involving backdated growth through the lifetime of these animals to critical periods in life-histories of these animals. I simply cannot accept that this is justified. We have no life-history for these individuals and we have no data about the levels of food supply through these periods." Boyd Review, p. 14. Dr. Boyd goes on to observe, "[H]aving admitted that most retrospective analyses have been of little help, many of these analyses are then used in later parts of the RRP to justify a particular position especially about the effects of nutritional stress and also when assessing the levels of threat." *Id.* The conclusion is inescapable that the Draft Revised Plan "says more about current internal agendas in NMFS than about what we actually know about the influence of nutritional stress on Steller sea lions." *Id.*, p. 15.

In its comments to the Council last summer, MCA underscored the difficulties with the nutritional stress hypothesis. MCA continues to question this hypothesis, particularly insofar as it may be deemed to implicate fisheries as a factor affecting recovery. Notwithstanding NMFS' strenuous efforts to assert the validity of the hypothesis, it remains dubious at best.[4] As Dr. Boyd pointed out in his June 7, 2006 testimony to the Council, "[T]here's really very little evidence to support the idea that there's been nutritional stress in this population as a causal factor in the population dynamics." Dr. Boyd went on to underscore that, even if nutritional stress occurred in the past -- a proposition that, even if dubious, cannot be entirely ruled out -- "the point is it's probably not happening now, and it's from now on that we need to manage the population." In short, nutritional stress, even if it could hypothetically be related to competition

[4] Dr. Boyd notes NMFS' reliance on the study by Hennen, "Associations between the Alaska Steller sea lion decline and commercial fisheries," *Ecological Applications* 16(2): 704-717 (2006), to establish the link between fishing activity and the "local population trajectory," but cautions, "[T]his study is flawed in the sense that it was an exploration of data to examine the possibility of a correlation between fishery activity and SSL population dynamics. In other words, it was not a fair test . . . [and] must carry relatively little weight in the assessment of evidence." Boyd Review, p. 10.

from the fisheries, is not a basis for targeting the fisheries as a factor significantly affecting the species from this point forward.

This leads to MCA's final point. The Draft Revised Plan indicates that the causes of recent declines in the Central Gulf of Alaska may be a low birth rate, relying on Holmes, *et al.*, "Natality declines in Steller sea lions suggest new conservation and research priorities," *in review*. Draft Revised Plan, pp. 39, 106. NMFS suggests (though it does not definitively state) that the low birth rate is associated with nutritional stress. Draft Revised Plan, pp. 39, 42. In Dr. Boyd's words, however, "At best, [the new studies] can be viewed as fairly circumstantial evidence supporting low birth rate but they say absolutely nothing about the causes of the low birth rates. They provide no evidence for a nutritional cause of low birth rates." Boyd Review, p. 14. Low birth rates might, for example, be the result of infection or chemical toxicity, and the paper in fact discusses a range of different, potential causative factors. *Id.*, pp. 4, 10, 18. Further, even if nutritional stress were a causative factor in low birth rates, the Draft Revised Plan suggests that such stress would have been chronic rather than acute, Draft SSLRP, p. 37, and the most likely explanation for any such chronic stress may be reduced carrying capacity in the North Pacific ecosystem rather than impacts from commercial fisheries.

Ultimately, what we know today is that the population of the western SSL DPS (WDPS) as a whole is increasing at the rate of about 3% per year since about 2000 and that the current population is about 44,800 animals, up 33% from the population low of 33,600 in 1994. Draft Revised Plan, pp. 1, 13-16.[5] As Dr. Boyd points out, this population size "lies well within the normal range of population sizes for pinnipeds on a global scale." Boyd Review, p. 7. At the same time, there is no current evidence of nutritional stress to adult male SSLs and juveniles. Indeed, we know that the health, survivability and longevity of juveniles and adults are unimpaired by nutritional stress or any other, identified factor. In such circumstances, the absence of evidence of nutritional stress to the western DPS as a whole suggests that one should be cautious in attributing the cause of a low birth rate to this factor. While it may be that the female reproductive rate is what is holding back the population, the causal factors simply remain unknown. In the face of such uncertainty, MCA fails to understand how NMFS can conclude that the fisheries threat is "potentially high," while it discounts such a factor as killer whale predation, which is subject to similar uncertainties. What is needed, as Dr. Boyd states, is for NMFS to "grasp and articulate, in an easily digestible form, the complexity of the knowledge base and to communicate this in a manner that is useful for policy implementation." Boyd Review, p. 3. Only in this way can NMFS meet its obligations to provide objective, unbiased information to the public in its natural resources plans, as required by the NOAA IQ Guidelines.

2. The Draft Revised Plan's Recovery Criteria Lack Scientific Justification.

MCA understands that NMFS is under an obligation to develop recovery plans which set out "objective" and "measurable" criteria for recovery. ESA, Sec. 4(f)(1)(B). The criteria outlined in the Draft Revised Plan, however, lack scientific justification, and they are written in such a way that they will make it difficult, if not impossible, for the Plan to achieve its objectives.

[5] The number rises to 60,000, if Russian populations, which NMFS deems relevant to recovery, are included.

MCA is pleased that the Draft Revised Plan no longer requires that "vital rates" be consistent with the observed trend of population growth for down-listing or de-listing to be warranted. *See* Response to Comments, p. 28. As expressed in its comments last summer, because of the uncertainties associated with measuring vital rates, using vital rates as a criterion for down-listing and de-listing was simply infeasible. Still, in several other respects -- the requirements that "non-pup trends in at least 5 of the 7 sub-regions are consistent with the [overall U.S.] trend," Draft Revised Plan, pp. 3, 4, that "the population trend in any two adjacent sub-regions cannot be declining significantly" (which implicates management of SSLs in Russia outside of U.S. jurisdiction), Draft Revised Plan, pp. 3, 4, and the requirement for de-listing that "the population trend in any single sub-region cannot have declined by more than 50 percent," Draft Revised Plan, p. 4 -- the Draft Revised Plan remains problematic and does not meet the SSC's recommendations of last summer that the recovery criteria should be grounded in "sound science." *See* SSC Report, p. 4.

For both down-listing and de-listing, the Draft Revised Plan would not only specify that "non-pup trends in at least 5 of the 7 sub-regions are consistent with the [overall U.S.] trend" -- a trend that shows a "statistically significant" increase over fifteen years and an average growth rate of 3% per year over thirty years -- but also that "the population in any two adjacent sub-regions cannot be declining significantly." Draft Revised Plan, pp. 3, 4; 72 *Fed. Reg.* at 28474. In Dr. Boyd's view, the criteria are "overly precautionary," since, "if the population remained stable at current numbers for the next 15 years, the PVAs as applied in the RRP would almost certainly show an extremely low probability of extinction and would, in effect, take the population well above the ESA criteria." Boyd Review, p. 7.[6]

MCA previously pointed out that there are at least three problems with NMFS' approach. It ignores that the distribution of SSLs may be shifting across its range; it assumes congruence between the current definitions of sub-populations and actual, biological sub-populations; and it assumes that some factors, *e.g.*, fisheries competition, were more likely drivers of past population declines than others. It is insufficient in response merely to state, as NMFS does in its "Peer Review Comments on Steller Recovery Plan (the "Peer Review Comments") (at p. 2) that "if this situation occurs, it would indicate that a significant portion of its range . . . was still in decline and suggest that NMFS has not fully understood or mitigated the threats to the population." The point is that declines in a particular region may have nothing to do with the overall health of the population.

The requirement that two adjacent sub-regions can't both be declining significantly also implicates the problem of management of SSL populations found in Russia. The DRSSLRP specifically references "Russia/Asia" as one of the seven regions it covers. DRSSLRP, pp. 3, 4.

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[6] "Recovery" is defined in NMFS' regulations to mean "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the [Endangered Species] Act." 50 C.F.R. § 402.02. In short, achieving the goal of recovery means just reaching the point where the species is no longer "in danger of extinction throughout all or a significant portion of its range" under current or reasonably foreseeable conditions. *See* ESA, secs. 3(6), (9) (defining the terms "endangered" and "threatened").

Although the ESA requires NMFS to consider a species' prospects for extinction "throughout its range," and while the status of a species' population outside U.S. jurisdiction, including in foreign nations, as well as foreign nations' conservation efforts, are appropriately taken into account in ESA listing and de-listing decisions, [7] nonetheless it is not sensible to peg recovery criteria so closely to the response of the species to a management regime over which the United States has no control. It might be that recovery efforts in Russia are insufficient, and so declines within Russian jurisdiction might continue. Yet, if they are offset by continued, positive growth in areas further to the east, then such declines may not be valid indicators that the population as a whole has not recovered to the point that down-listing is warranted. NMFS, *Interim Endangered and Threatened Species Recovery Planning Guidance* sec. 2.2.3 (October 2004), available at www.nmfs.noaa.gov/pr/recovery/guidance.htm, in fact suggests that NMFS has some discretion with respect to the inclusion of the recovery of foreign populations as part of the de-listing criteria in a recovery plan, depending upon the relationship between the status/protections of animals outside U.S. jurisdiction and the achievement of the goals of the recovery plan.

In addition to other factors being met, the Draft Revised Plan would require for de-listing that "the population trend in any single sub-region cannot have declined by more than 50 percent." Draft Revised Plan, p. 4; 72 *Fed. Reg.* at 48474. This criterion implicates some of the same concerns as the criterion requiring that trends be consistent in at least five of seven sub-regions, particularly that (a) there may be natural population shifts, not reflecting a species decline, that lead to a substantially decreased population in some regions, and (b) a major decline in an area outside U.S. control, that is, Russia, may not reflect on the success, for the species as a whole, of the recovery efforts within U.S. jurisdiction. Further, it is unclear what the starting date is for measuring the percentage decline.

In short, these criteria seem to be purely arbitrary with little to do with the health of the population as a whole and are essentially without biological basis. For example, the population in one or two sub-regions could grow such that the WDPS population increases to 60- 70 thousand animals in the U.S. but if one U.S. sub-region coupled with the Russian population decrease because of outmigration, then there is no possibility for downlisting to threatened. Moreover, the population could increase to more than 100,000 animals overall, but if the trend in two sub-regions is a "significant" decline then the population would not meet the delisting criteria.

Finally, the recovery criteria also appear overly stringent in comparison with criteria used in other recovery plans. In a review prepared for the Council, Dr. Thomas Loughlin compared

[7] The ESA states that all listing decisions shall be made "after taking into account those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species, whether by predator control, protection of habitat and food supply, or other conservation practices, within any area under its jurisdiction, or on the high seas." ESA, sec. 4(b)(1)(A), 16 U.S.C. § 1533(b)(1)(A). NMFS' regulations, for their part, recognize the role of foreign governments in the listing and delisting process. Thus, 50 C.F.R. § 424.11(e) provides that NMFS "shall give consideration to any species protected . . . by any State or foreign nation, to determine whether the species is endangered or threatened," while 50 C.F.R. § 424.11(f) provides that, in making listing and delisting determinations, NMFS "shall take into account . . . those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species."

the Draft Revised Plan with recovery plans for eleven other species. Loughlin, "Review and Comparison of Recovery Criteria in the 2006 Draft Revised Steller Sea Lion Recovery Plan" (May 14, 2007). Although the Loughlin paper in general suggests that the Draft Revised Plan's specification of recovery criteria is consistent with what NMFS and the U.S. Fish and Wildlife Service ("FWS") have done in other plans, nonetheless SSLs have a larger population, which has been stable or growing, rather than declining, than the populations of many of the other endangered or threatened species in the reviewed recovery plans. In these circumstances, regardless of what has been done in other plans, requiring three generations to achieve full recovery, *i.e.*, de-listing, can be viewed requiring more than is justified by reference to the past practice of NMFS and FWS.

3. The Draft Revised Plan does not Sufficiently Recognize the Need for Flexibility to Modify Fishery Conservation and Management Measures.

Section 4(f) of the ESA was not intended to hamstring agencies with a suite of inflexible actions that would have to be taken before a species could be removed from the list. *See, e.g.,* Bean and Rowland, *The Evolution of National Wildlife Law* 211 (3d ed. 1997). As science improves regarding the causes of the SSL decline and the constraints on the species' recovery, management agencies, such as the Council and NMFS, should be able to modify and/or remove particular fishery management and conservation measures, to the extent that they may not be relevant to achieving the objectives of the Draft Revised Plan.

MCA recognizes that the Draft Revised Plan, by its terms, would not necessarily straightjacket the fisheries with the precise suite of management measures currently in place until the recovery criteria are met. Instead, it would allow for current management measures to be replaced with measures providing "equivalent" protection, and for the current measures to be modified if "substantive evidence demonstrates that these measures can be reduced without limiting recovery." 72 *Fed. Reg.* at 28474; DRSSLRP, p. 5. NMFS' Response to Comments also makes it clear that "[the] Council and NMFS have flexibility to modify existing management measures as new information on Steller sea lions and fishery interactions becomes available," as long as the changes are appropriately evaluated through the ESA Section 7 consultation process. Response to Comments, p. 35. Yet, if, as discussed in Section 1 above, the weight of current scientific evidence would suggest that the fisheries are likely not a significant factor limiting SSL recovery, then the rationale for strict maintenance of current measures as required for recovery of the WDPS is weak.

In any event, MCA wishes to underscore that management flexibility may be appropriate even in the short run. For example, recent science suggests that juvenile SSLs are weaned during the summer instead of during the winter. *See* Trites, *et al.*, "Insights into the Timing of Weaning and the Attendance Patterns of Lactating Steller Sea Lions (*Eumetopias jubatus*) in Alaska During Winter, Spring and Summer," *Aquatic Mammals* 32(1):85-97 (2006). Winter is the most critical fishing time for the groundfish fleets because fish are aggregated and roe is an important product. Many of the mitigation measures now in place have reduced the winter fisheries in order, in theory, to protect weaning juveniles. With the new information in hand, the Council and NMFS may be able to modify those measures to enhance fishing opportunities without adverse effects on the SSL population. Similarly, current mitigation measures, which do not seem to discriminate among population segments, might be modified to give priority protection to segments of the population most important to increasing the population trend, such as breeding females, while mitigation measures that don't protect these segments might be reduced. MCA recognizes that any such changes will need to be supported by the appropriate ESA Section 7 analyses.

4. The Continued Specification of a Large-Scale Adaptive Management Program as a Needed Recovery Action is Inappropriate.

The Draft Revised Plan, rejecting previous comments from both MCA and the SSC continues to specify that designing and implementing an "adaptive management program" is one of three necessary recovery actions. Draft Revised Plan, p. 5; 72 *Fed. Reg.* at 28474. Even while acknowledging that "it will be a challenge to construct an adaptive management program that is statistically sound, meets the requirements of the ESA and can be implemented in a practical manner," *id.*, NMFS remains committed to what MCA believes to be a chimerical goal. Indeed, in its Response to Comments (at pp. 15-16), ignoring specific criticisms, including those of the SSC, *see* SSC Report, p. 5,[8] NMFS does no more than assert that "development of an adaptive management program would provide another means by which the scientific and management communities can evaluate new information, determine the efficacy of current regulations, and recommend that new actions be taken or regulations be changed." *See also* Peer Review Comments, p. 5 (asserting only that "without a program of this nature, it will not be possible to distinguish the magnitude of the various threats to recovery"). The insufficiency of this response is manifest.

A "grand experiment" in adaptive management faces innumerable difficulties. Its practicality, costs and outcome are all in doubt. It may run afoul of the "jeopardy" and "no adverse modification" proscriptions of the ESA and so be infeasible as a matter of law. It may well not be able to produce, when the "experiment" is complete, any truly useful results. It is likely to be both complicated and expensive to design. It would raise internal equity questions between those in the fishery who would be able to fish under existing management measures in existing open areas and those who would be forced to move their operations, perhaps at substantial expense, or those who, for economic reasons, might be unable to transfer their operations at all. At the end of the day, there would be an upheaval in management, likely major costs imposed upon the industry, and far from certain benefits in terms of increased understanding of the potential impacts of the fishery on the recovery of SSLs. The bottom line is that, from a cost-benefit perspective, an adaptive management exercise is simply not likely to be worthwhile.

At the same time, the very need for any large-scale, adaptive management program, even if theoretically feasible and cost-effective, is open to question. As Dr. Boyd testified to the Council on June 7, 2006, "I don't think you need to do it. * * * [B]ecause of the highly variable trajectories that you have within the localized populations of the Steller sea lions, you already have enough statistical power there to come to reasonable conclusions about some of the drivers

[8] The SSC not only opposed inclusion of adaptive management as a required element of a recovery plan, but also indicated that any management experiments undertaken should be "at *small* but meaningful spatial levels." SSC Report, p. 5 (emphasis added).

for some of those changes overall." Dr. Boyd pointed out that statistical analyses have in fact already been done for SSLs, citing MRAG Americas, Inc., "Understanding the Decline of the Western Alaska Steller Sea Lion: Assessing the Evidence Concerning Multiple Hypotheses" (NOAA Fisheries, Alaska Fisheries Science Center #AB133F-02-CN-0085, 2005) (usually referred to as the "Wolf and Mangel" study). In short, whether or not the Wolf and Mangel study itself was sufficient, it appears that there may be enough data now available -- and certainly there are likely to be more data available in the future -- to allow the relative strengths of each hypothesis to be assessed through a table-top modeling exercise, essentially making any large-scale adaptive management program unnecessary.

As a final comment, MCA appreciates the time and effort the SSC has put into this issue over the past decade or so. When you reviewed the earlier draft of the recovery plan, you made a number of other recommendations (36 in total), some of which were addressed but many of which were not. MCA encourages the SSC to seek further clarification as to the issues raised in your earlier comments.

Thank you for your consideration of MCA's views. Please do not hesitate to contact me if you have any questions about this submission or any requests for further information.

Respectfully submitted,

David Benton
Executive Director

NORTH PACIFIC RESEARCH BOARD PROJECT FINAL REPORT

Steller sea lions *Eumetopias jubatus*: Direct mortality by humans

NPRB Project 646 Final Report

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ABSTRACT

Western Steller sea lion *Eumetopias jubatus* populations in the United States have declined more than 80% since 1970. The overall goal of the project was to gather, evaluate, and estimate the relative importance of significant information on anthropogenic mortality for Steller sea lions in Western Alaska. The main hypothesis of this research is that indiscriminate shooting is not a primary source of increased mortality on the western distinct population segment of Steller sea lions. The research included a literature review and results of key respondent interviews with individuals involved in the fishing industry. The study hypothesis was upheld by the research. The long-term subsistence use of Steller sea lions has continued into the 21st century, but appears to be declining overall, especially since the 1980s, accounting for fewer than 600 animals in any one year which were likely not a significant factor in the sea lion's decline. Commercial harvests ceased in 1972 and those effects on sea lion populations would have stabilized three to five years later, thus commercial harvests cannot account for population declines observed through the 1980s. Interview results indicate sporadic and generally low numbers of sea lions were taken during the conduct of commercial fisheries. From 1975 to 1990 indiscriminate takes by commercial fishermen show no consistent patterns except in the Shelikof Strait joint venture walleye pollock trawl fishery during the early 1980s. Our conclusions corroborate other studies' findings in which direct mortality was not a primary factor in Steller sea lion decline in the late 20th century.

Key Words: Steller sea lions, *Eumetopias jubatus*, western Alaska, Gulf of Alaska, Bering Sea, Aleutian Islands, Shelikof Strait, direct mortality by humans, qualitative research

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STUDY CHRONOLOGY

Work on the project began in August 2006 with an original end date of February 28, 2007. An extension was granted to June 30, 2007. A semiannual progress report was submitted to the North Pacific Research Board, December 31, 2006.

INTRODUCTION

This research describes the direct mortality by humans of Stellar sea lions *Eumetopias jubatus* in western Alaska. Direct mortality is the result of harvesting sea lions for subsistence uses, commercially for their pelts, incidentally in fishing gear, shooting to protect fishing gear, and by indiscriminate shooting. This research presents a literature review and results of interviews with those involved in the fishing industry at critical periods and areas associated with western stock sea lion declines. Phase two is recommended to compile available direct mortality statistics presented in literature and address questions of the affect on sea lion populations in the study area.

The western distinct population segment (DPS) of Steller sea lion, or western sea lion, breeds in rookeries in Alaska from Prince William Sound west through the Aleutian Islands and in Russia on the Kamchatka Peninsula, Kuril Islands and Sea of Okhotsk (Bickham et al. 1996, NMFS 2006). The Alaska portion of this range is the focus of this research. The eastern DPS of Steller sea lion breeds in rookeries in Southeast Alaska, British Columbia, Washington, Oregon, and California (Figure 1).

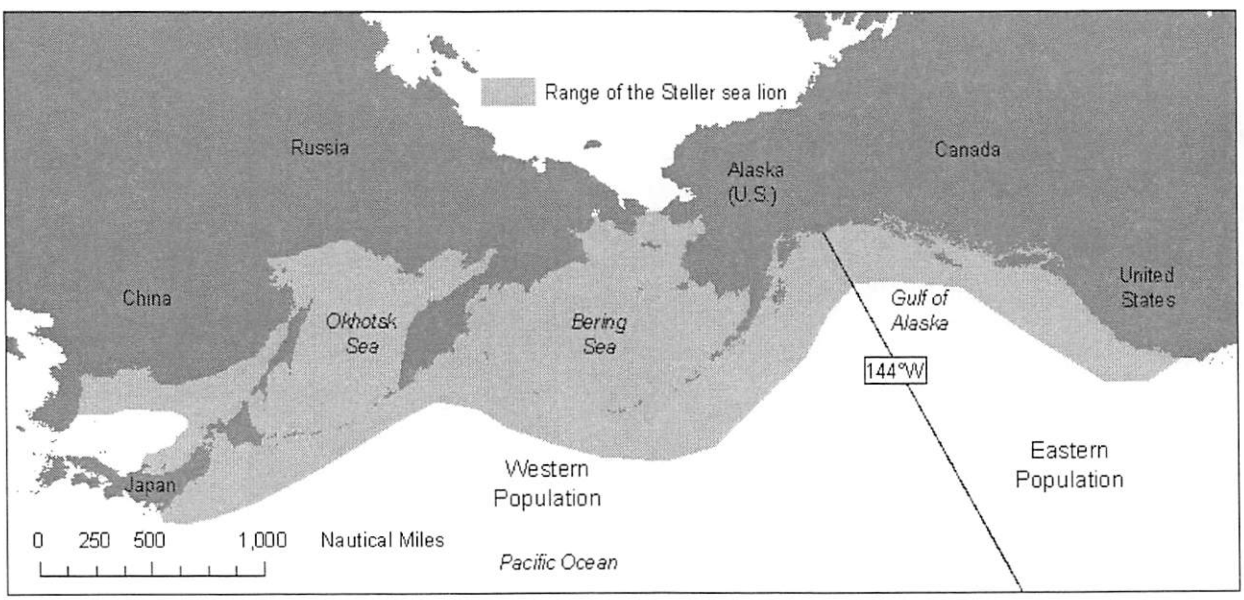

Figure 1. Range of the Steller sea lion (map courtesy of the National Marine Fisheries Service).

Recognizing multiple environmental factors that may have contributed to the precipitous decline of Steller sea lions between the 1970s and 1990, the National Research Council (NRC) (NRC 2003) noted the importance of retrospective information to explain the historical decline of sea lions, and its value "in understanding the prospects for recovery of the remaining population" and "improved estimates of direct mortality sources." The NRC recommended an assessment of the possible extent of anthropogenic or human factors as an area of study of the Steller sea lion decline with a goal of understanding and minimizing human activities that may threaten sea lion recovery. The North Pacific Research Board (NPBR 2005) Science Plan noted direct mortality by humans, specifically, as one of several anthropogenic factors to evaluate, particularly in areas where fishing and harvest activities intersect with Steller sea lion concentration areas, such as rookeries and haul-outs. The spatial patterns of direct mortality and sea lion population decline may provide insight into the degree of human-related impacts, and aid recovery plans.

BACKGROUND

According to the National Research Council (NRC 2003), western sea lion populations in the United States have declined more than 80% since 1970. Several factors have potentially contributed to the decline of the western sea lion population including:

- direct mortality by humans;
- predation by killer whales;
- a reduction in quantity, quality, and availability of prey; and
- the ecosystem changes that have been observed in the north Pacific Ocean (Trites et al. 2007).

In 1997, this distinct population of Steller sea lions was listed and remains as endangered under the Endangered Species Act (62 FR 24345). As identified in the draft revised Steller Sea Lion Recovery Plan (NMFS 2006), primary data gaps with respect to direct mortality by humans are estimates of the magnitude of illegal shooting and incidental take. Alverson (1992) put "indiscriminate shooting" as one of five major causes of increased mortality on Steller sea lions during the 30-year period from 1960 to 1990 and notes that "[a]n extensive interview of fishermen, cannery operators, and processors might yield a more quantitative answer" to the question of the overall impact of shooting sea lions. Incidental harvests, or bycatch, of sea lions in joint venture walleye pollock *Theragra chalcogramma* fisheries, some of which used "short wire" trawl techniques, according to industry testimony, reportedly contributed to mortality in a major way.

The directed commercial harvest of sea lions was terminated in 1972, and in 1990, through determinations made by the National Marine Fisheries Service (NMFS), it became illegal to shoot sea lions destroying fishing gear or causing a threat to human safety. The following year the domestic on-board observer program began with 100% coverage on vessels greater than 125 feet length overall, and 30% coverage on vessels between 60 and 125 feet. Additionally, stakeholder representatives, agencies, and industry print media began to inform commercial fishers how their killing of sea lions could result in significant restrictions on their fishing activity. Steller sea lion mortality rates eased, stabilized, and showed some improvement coincident with the prohibition on shooting, having observers on board vessels, and a broad education program (NRC 2003). How much these directed shootings and fishing gear bycatch contributed to the level of direct mortality remained a question (NRC 2003).

The presence of observers on larger trawl fishing vessels generally lead to the conclusion illegal shooting had declined in those fisheries, although a decline in other fisheries continues to be largely unsubstantiated (NRC 2003). Some studies show these and other direct human factors only explain a fraction of the population decline between 1980 and the early 1990s (Trites and Larkin 1996). The numbers themselves cannot be understood in a vacuum, without considering other anthropogenic activities and ecologies of different regions and individual rookeries (Trites and Larkin 1996, Trites et al. 1999). After reviewing some of these factors, the recently released draft revised recovery plan (NMFS 2006) concludes that direct mortality for subsistence uses and illegal shooting, among other factors, are relatively minor threats to the recovery of the western sea lions (NMFS 2006). Estimates of known mortality of sea lions in this population segment do not fully explain decline in the late 1990s (Loughlin and York 2000). Questions remain about the contribution that direct mortality has on a declining or severely depressed western sea lion population, even though it appears population recovery is underway (NRC 2003).

HYPOTHESIS AND RESEARCH FOCUS

The main hypothesis for this research is that indiscriminate shooting is not a primary source of increased mortality on the western distinct population segment of Steller sea lions. This hypothesis requires an examination of all human-caused, direct mortality to evaluate the extent and relative significance of the practice of indiscriminate shooting. This includes direct mortality as the result of harvesting sea lions for subsistence uses, commercially for their pelts, incidentally in fishing gear, and from shooting to protect fishing gear.

The focus of research included a systematic retrospective investigation gathering information on direct mortality by humans, framed around a key time period of 1975 to 1990. This is a key time period because populations of Steller sea lions in the western Gulf of Alaska and Bering Sea have been in decline since 1975, and by 1990, direct mortality from humans had declined significantly (NRC 2003). The key geographic areas are those of the western DPS of Steller sea lions, specifically those associated with commercial fishing activities. The research was consistent with recommendations posed in other studies of Steller sea lion abundance, dynamics, and proximate human-related activities (NRC 2003, NMFS 2006).

OBJECTIVES

The overall goal of the project was to gather, evaluate, and estimate the relative importance of significant information on six types of anthropogenic mortality for Steller sea lions in western Alaska. These are as follows:

1. Directed subsistence harvest
2. Directed commercial harvest
3. Incidental mortality in domestic commercial fisheries (gillnet, setnet, troll, seine, longline, crab, and groundfish)
4. Incidental mortality in foreign trawl fisheries
5. Incidental mortality in joint venture trawl fisheries
6. Direct shooting by fishermen

To address the six types of anthropogenic mortality, four research objectives focused on literature review and key respondent interviews:

1. A review of existing major literature with information about direct mortality by humans of Steller sea lions consistent with recommendations and suggestions in the NPRB Science Plan (2005); the NRC (2003) report; and the draft revised Steller Sea Lion Recovery Plan (NMFS 2006). Review and summarize unpublished documents, agency records, archaeological and historical literature.
2. Compile available direct mortality statistics presented in the literature for each direct mortality factor listed in Objective 1, and evaluate these estimates based on study findings.
3. Identify active and retired knowledgeable, experienced commercial fishers and others who are willing to candidly discuss common practices of defensive and indiscriminate shootings and fishing gear bycatch of Steller sea lions in key geographic areas for specific, critical periods.

4. Conduct systematic, key respondent interviews with 50 active and retired knowledgeable, experienced commercial fishers and commercial fisheries industry employees.

Three research questions addressed the objectives:

1. What have been the patterns of shooting by fishermen?
2. What have been the patterns of sea lion bycatch in fishing gear?
3. What is the contribution of direct mortality to sea lion decline?

METHODS

STUDY AREA

The geographic area being investigated includes the range of the western distinct segment of the Steller sea lion populations in Alaska from Cape Suckling in the Gulf of Alaska (144 degrees West longitude) to Attu Island in the Aleutian islands, including the Bering Sea (Figure 1). Research focused on areas where commercial fisheries were pursued in the study period of 1960 to 2006.

LITERATURE REVIEW

Four main categories of literature review were investigated as follows:

1. Literature cited in the NRC (2003) report
2. Literature recommend by scientists with expertise in Steller sea lion research
3. Agency reports, technical papers and environmental impact statements
4. Archaeological, historical and ethnographic literature

DIRECT MORTALITY

Direct mortality statistics presented in the available literature for subsistence harvests, commercial harvests and shooting of Steller sea lions by fishermen were compiled and evaluated.

KEY RESPONDENT INTERVIEWS

Face-to-face interviews were conducted with commercial fishermen and commercial fishing industry employees with fishing experience in the study area. Interviews took place in Seattle, Port Ludlow, and Bellingham in Washington State; Kodiak city, Anchorage, Juneau, King Cove, and Sand Point in Alaska. Researchers were not able to visit Dutch Harbor, Alaska, due to limited staff availability and time constraints.

Sample Selection Methodology

The study included interviews with 50 key respondents, representing diversity in terms of regional, temporal, and demographic categories. Typical of the qualitative interview method for gathering information, respondents were selected using a chain-referral sampling method. Researchers conferred with knowledgeable scientists associated with the sea lion recovery effort, and representatives of various fishermen's organizations to identify these target populations, and identify individuals who are knowledgeable key respondents about the study topic, who then referred researchers to others who might be knowledgeable. Thus, experts to be interviewed included a range of knowledgeable people.

The communities and areas selected as sources of experts were limited by available personnel and fiscal resources. Another study on a related topic by Drs. Gordon Kruse and Henry Huntington, "Local and Traditional Knowledge of the Nature and Extent of Interactions between Fishermen and Steller Sea Lions in the Gulf of Alaska and Bering Sea," will document interactions between fishermen and sea lions in the Gulf of Alaska and Bering Sea and collect local ecological knowledge from residents in Cold Bay and Sand Point, Alaska; the Seattle area; and Kodiak area communities. In order to avoid duplication and overlap the author met with Drs. Kruse and Huntington in late August 2006, and agreed that for economy of effort we would work cooperatively in the Seattle area and share mutually beneficial accounts from the other communities. Due to this arrangement questions were included in the interviews addressing ecosystem changes in the Bering Sea. Analysis of those data is beyond the scope of this report and instead will be included in Kruse and Huntington's report.

Both the use of the chain-referral method and the face-to-face interview technique are considered best for inquiry into sensitive topics because they minimize bias and maintain privacy and confidentiality. These are common research methods for gathering qualitative information in the social science and health policy research fields, and others as noted below. The study used the semi-structured interview guide approach for the key respondent interviews. This approach has the advantage of being systematic and comprehensive, while allowing for more complex and probing questions and getting more detailed responses. These methods and approach, however, require interviewers who are skilled and experienced, who know when to probe for more in-depth responses and can ensure all topics on the guide are covered for the purposes of data comparability and an assessment of respondent efficacy and reliability. The interviewers who worked on this project all have extensive experience conducting interviews on sensitive topics, including illegal harvesting activities, and have conducted many interviews with a wide range of people of different economic classes, ethnic groups, educational backgrounds, and ages.

The use of these techniques by professional, skilled, and experienced interviewers is one means that this study reduced bias. We used additional ways of reducing bias and ensuring quality of data in qualitative interviews by reviewing the consistency of the findings across interviews; and evaluating interview results for verification.

This type of data collection using the chain-referral method and qualitative in-depth key respondent interview technique is not intended to provide a random sample, or to compensate for sampling in a non-random way. The goal is to identify and sample from a small, hard-to-reach group of subject matter experts from an undefined or poorly defined population. Presently, there is no exhaustive list of population members from which a probabilistic sample could be drawn that would target the information sought and result in a representative sample of a normally distributed population. It is under such circumstances that the proposed chain-referral method of data collection is best suited; this method has been used effectively to characterize poorly defined or undefined populations. The method of information collection used in the study provided a meaningful description and evaluation of non-harvest shooting practices, activities, and amounts, as reported by individuals knowledgeable about the subject based on their own experiences and observations. From the results of this study, a subsequent investigation could be developed to systematically survey the defined target population using the respondent-driven sampling method using a mathematical model that can weight the sample to compensate for the fact the sample was collected in a non-random process.

Confidentiality

Respondent confidentiality and anonymity were addressed in several ways. First, when contacting potential interviewees, they were informed about the study and its purpose and asked to participate. At the outset of the interview process, informed consent for voluntary interview participation, note taking, and audiotape recording were obtained. Respondents were informed their names or any other potentially identifying information would not be used in the final report or publications. Responses were kept confidential and a unique identifying number assigned, which was kept separate from names.

Interview Format

Interviews were conducted with key respondents in several categories related to specific fishing years, geographic areas, and longevity in the fishery. Face-to-face, key respondent interviews are a standard research method for gathering qualitative information about specific topics from a range of people who are knowledgeable about the topic. This method is typically used in the social sciences, public health policy research programs, education research, criminal justice studies, and community planning and development, among others. The number of key respondents largely depends on information needs, time, and resources.

A primary element in key respondent, or in-depth qualitative, interviews, is to collect information from a range of people who have first-hand knowledge about a topic. By conducting interviews with a diverse group of knowledgeable respondents, bias in the results is reduced. It also provides an opportunity to gather information from those with varying experiences related to the subject or topic in question. For example where structured interview formats and discussions among small groups of experts were used to document the harvest of beluga whale for subsistence in Northwest Alaska and Chukotkan communities in Siberia (Huntington and Mymrin 1999, Huntington 1998), and for documenting the harvest of walrus for subsistence in western Bristol Bay Alaska (Fall et al. 1991).

The first interviews conducted for this study were open ended conversations with knowledgeable commercial fishermen who had fished in the western Gulf of Alaska and the Bering Sea during the 1970s through the present time. During the early stage of the research, experts on Steller sea lions were also consulted. These initial interviews were used to develop the interview schedule and a list of potential key respondents.

RESEARCH CHRONOLOGY

Interviews were conducted in Seattle, Washington; and Kodiak, Anchorage, King Cove, Sand Point, and Juneau, Alaska between September 2006 and February 2007. Alaska Department of Fish and Game (ADF&G) staff Mike Turek, Sverre Pedersen and Nancy Ratner, conducted interviews in Seattle, Anchorage, Juneau and Kodiak. Henry Huntington, Ph.D., consultant, and Gordon Kruse, Ph.D., University of Alaska, School of Fisheries and Ocean Sciences, Juneau Center, conducted interviews in Seattle, Kodiak, Sand Point and King Cove.

Interviews in Kodiak and Juneau conducted by ADF&G staff were audio-recorded and transcribed. At the request of key respondents none of the other interviews were audio recorded. Charts were sometimes used to identify locations of geographic features. All of the interviews used the key respondent interview guidelines prepared for the research (see Appendix).

Types of fisheries key respondents discussed included joint venture and domestic walleye pollock trawl fisheries, both mid water and bottom trawlers; yellowfin sole *Pleuronectes aspar*, and Pacific cod *Gadus macrocephalus* (trawl) fisheries; salmon *Oncorhynchus* seine fisheries; Pacific halibut *Hippoglossus stenolepis* and rockfish *Sebastes* longline fisheries; crab pot fisheries, red king *Paralithodes camtschaticus*, Tanner *Chionoecetes bairdi*, snow *Chionoecetes opilio*, and Dungeness *Cancer magister*; shrimp *Pandalus* pot fishery and tender operator. Respondents' experience in the western Gulf of Alaska and Bering Sea ranged from the late 1940s to 2006. Respondents had fished in the Kodiak area, Shelikof Strait, Bering Sea, Aleutians, Chignik, Alaska Peninsula and Southeast Alaska (Table 1).

Table 1. Key respondent interviews.

Table 1. Key respondent Interviews								
Location	Dates	Interviewer(s)	# Interviews	Type of Interview	A/V Transcriptions	Fisheries	Era	Areas Fished
Western WA & Anchorage, AK	Sept. & Oct. 2006	Turek, ADF&G	3	Unstructured, exploratory, Face to Face	No	Salmon, setnet and gillnet; Herring seine; Pollock trawl fishery	1970s-2006	Kodiak Island area, Shelikof Strait and Bering Sea
Kodiak Island, Alaska	Nov. 6-19, 2006	Pedersen, ADF&G	9	Face to face	Yes	Salmon, seine, setnet and gillnet; Longline, halibut, cod and rockfish; Herring seine; Dungeness and king crab; Pollock trawl fishery	1949-2006	Kodiak Island area, Shelikof Strait and Bering Sea
Seattle, Washington	Nov. 16 & 17, 2006	Turek, ADF&G, Huntington & Kruse	13	Face to face	No	Salmon, seine, setnet and gillnet; Longline, halibut, cod and rockfish; Herring seine; Dungeness, Tanner, Snow and king crab; JV and domestic Pollock trawl fishery, shrimp pot and tender operator	1960s-2006, 1940s and 1950s	Kodiak Island area, Shelikof Strait and Bering Sea, Aleutians, Chignik, Alaska Peninsula, and Southeast Alaska
Kodiak Island, Alaska	Nov 29-Dec 1, 2006	Huntington & Kruse	13	Face to face	No	Salmon, seine, and setnet; herring gillnet; Longline, halibut; cod pot; groundfish trawl; shrimp trawl	1950s-2006	Kodiak Island area, Shelikof Strait and Bering Sea, Aleutians, Alaska Peninsula, and Southeast Alaska
King Cove, Alaska	Dec. 12, 2006	Huntington	6	Face to face	No	Salmon, seine; Longline, halibut; groundfish trawl; shrimp trawl; crab	1940s - 2006	Gulf of Alaska, Bering Sea and Aleutian Islands
Sand Point, Alaska	Dec. 14, 2006	Huntington	1	Face to face	No	Salmon, seine, driftnet and setnet; Longline, halibut; groundfish trawl	1950s-2006	Bering Sea and Aleutian Islands
Anchorage, Alaska	Dec 8-18, 2006	Huntington	6	Phone	No	Salmon, seine; Longline, halibut; groundfish trawl; crab	1950s-2006	Bering Sea and Aleutian Islands
Juneau, Alaska	Dec. 4, 2006	Ratner, ADF&G	1	Face to face	Yes	Walleye Pollock, Yellowfin sole, midwater and bottom trawlers Shelikof JV Fishery	1980-1985	Kodiak Island area, Shelikof Strait and Bering Sea

RESULTS

DIRECTED HARVESTS FOR SUBSISTENCE

Prehistoric

A long-term use of Steller sea lions by humans in Alaska is confirmed by faunal remains in prehistoric archaeological sites. Sea lions remains have been found at archaeological sites in Alaska coastal areas including the Pacific coast of the Alaska Peninsula, Prince William Sound, the Kenai Peninsula, the Kodiak Island archipelago, and the Aleutian Islands. Aleutian Island sites with sea lion remains date to 3,000 years before present (bp) (Anangula Island) and 4,000 years bp (Chaluka Village) (Haynes and Mishler 1991). Implements and decorative pieces fashioned from sea lion bone were uncovered in Unalaska sites dating as early as A.D. 1 to as late as A.D. 1500 (Haynes and Mishler 1991).

Historic

In the 1830s, Ivan Veniaminov (1984), the Russian Orthodox missionary, recorded the use of sea lions by Pribiliof Islanders, reporting that an average of 2,000 sea lions were taken annually on St. George Island. Sea lions were hunted by driving them inland and killing them with sticks and spears. Firearms were occasionally used but were largely ineffectual because the bullet would not penetrate the sea lions' thick skull. Sea lion hunting occurred between the middle of September and November, after the fur seals had left the rookeries for the season. Hunting was done on rocks near shore at night when selected animals were captured and put into corrals. After several nights of corralling, two or three hundred animals were driven or herded overland, a process that spanned from five days to three weeks, before being slaughtered (Haynes and Mishler 1991).

Traditionally sea lions were taken for food, clothing and materials for skin boats. Sea lion blubber and meat, including the liver and heart, were dried, baked, boiled or eaten raw. The skin of flippers were used for boot soles, throats for the leg part of boots, and intestines for raincoats. The stomach was used as a water tight container, and the bladder was made into a fishing float. Sea lion whiskers decorated wooden hunting hats and were used to clean tobacco pipes (Haynes and Mishler 1991). The skin of young male sea lions was used to cover *baidarkas* [kayaks] (Dyson 1986).[1]

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[1] "The word *baidara*, a term originating on the rivers of the Ukraine, was used to describe the Natives larger open, skin-covered craft, (the Aleut umiak) while the diminutive of this, *baidarka*, referred to the distinctively hatched, smaller species of decked, skin boat" (Dyson 1986).

The indigenous skin boat, baidarka or kayak, was the traditional marine transportation in the Gulf of Alaska north of Yakutat and in the Bering Sea. Baidarkas were constructed of driftwood, whalebone, and sea lion skins. A single hatch boat required four to six skins of subadult male sea lions. Skins were replaced three to four times per year or more, depending on use (Dyson 1986, Maschner et al. *unpublished*). At the time of European contact, one-hole and to a lesser extent, two-hole baidarkas were common. A three-hole boat was developed post-European contact.

Although the Aleut population dropped significantly following the Russian invasion, the need for baidarkas in the commercial sea otter trade kept the numbers of boats and the need for sea lion skins high. Baidarkas, "were the key to Russian activity during the entire pre-1867 period. Baidarkas were being built by the thousands in the Russian-American colonies for close to 100 years. Almost anywhere they went, hunting or exploration, the Russians depended on the baidarka" (Dyson 1986:5). Russian sea otter hunting expeditions required several hundred baidarkas, expeditions with 600 to 800 boats are mentioned in the literature. Sea otter hunting baidarkas required new skins more often than boats used for subsistence hunting. By the mid 19th century lumber milled at Sitka was being used in the construction of baidarkas. The Russians supplied sea otter hunters with lumber and "sea lion gut and skins . . ." for baidarkas (Dyson 1986:68).

Following the 1867 purchase of Alaska, the Americans took over the sea otter trade, which still required deck loads of baidarkas. But by the late 19th century the marine mammal populations collapsed in the Gulf of Alaska and Bering Sea (NRC 2003). Petroff, collecting data for the 1880 U.S. census, described much smaller sea otter hunting parties consisting of "from 4 to 20 (two-hatch) baidarkas" (Dyson 1986:74). The collapse of the Steller sea lion populations in the late 19th century was so serious that the U.S. Government imported sea lion skins from California so baidarka construction could continue (Maschner et al. *unpublished*).

Waldemar Jochelson, the Russian ethnographer traveling in the Aleutians during 1909-1910, commented on the scarcity of marine mammals and skin boats, "The Atka Aleut still use skin-boats . . . but the Attu Aleut have no skins to cover their boats" (Dyson 1986:75). Wooden skiffs had now taken the place of skin boats. In 1910 the last sea otter hunt was conducted, and included in the hunt were 12 two-hatch baidarkas. Some of the baidarkas built at this time were using "cow skins" for coverings, a poor substitute for sea lion skins (Dyson 1986).

By the 1920s skin boats were rare in the Aleutians. A brief revival in baidarka construction occurred in the 1930s due to the economic depression and high costs for motors and fuel. In 1933 Birket-Smith described construction of baidarkas, stating that it took skins from six young sea lions for a single hole baidarka, nine for a two-hole baidarka, and 12 sea lions for a three-hole boat (Dyson 1986).

Contemporary

Today, Steller sea lions are harvested by Alaska Natives for subsistence uses. Although the animals are taken primarily for food, a few non-food uses continue. Sea lion skin is used for crafts such as miniature kayaks and small baskets. Traditional Aleut bentwood hunting hats continue to use sea lion whiskers (Wolfe and Mishler 1993). General descriptions of contemporary Steller sea lion hunting methods for the Pribilof Islands, Unalaska, and Atka have been presented by Veltre and Veltre (1981, 1982, and 1983). Haynes and Mishler (1991) described contemporary Steller sea lion hunting methods for Kodiak Island. Wolfe and Mishler (1993, 1995) described contemporary hunting and use patterns for Steller sea lions in the Kodiak Island region and the North Pacific Rim area, Nanwalek, Port Graham, Chenega Bay, and Tatitlek; and contemporary hunting patterns for St. Paul, St. George, Unalaska, Atka, Akutan, and Nikolski.

Hunting sea lions is a specialized subsistence activity in Alaska communities. A relatively small core of hunters, about 30%, reported taking about 69% of all sea lions during 2004, similar to previous years. Highly-productive hunters distribute marine mammal products to other households through non-commercial networks of sharing and trade (Wolfe et al. 2005).

According to ADF&G, from 1992 to 2005 the largest takes of sea lions by Alaska Native hunters are reported in the Aleutian-Pribilof region, Kodiak Island region, and North Pacific Rim area (Wolfe et al. 2006). Hunting techniques vary by community. In Unalaska, skiffs are used for hunting, and during long trips two or more boats often hunt together. Most sea lions are chased from haul-outs and taken at sea with rifles. Wounded sea lions are retrieved with a weighted hook attached to a line. In Atka sea lion hunting is done by pairs of men traveling in three or four skiffs along the coast of Atka and Amlia Islands. Sea lions generally are driven towards shallow water and the beach before shooting. At St. Paul Island hunting is conducted by individuals or by small groups of men on three-wheelers, snow machines, in trucks, skiffs, or walking. St. George Island hunting patterns resembled those on St. Paul, although boats are more often used because of the more limited road system (Wolfe and Mishler 1995).

Haynes and Mishler (1991) offer detailed descriptions of contemporary Kodiak Island Steller sea lion hunting techniques. A common method uses two or three individuals and one skiff. Hunters work as a team with one man operating the outboard motor and one or two hunters in the bow with rifles prepared to shoot at swimming sea lions. Another technique is to position a shooter on the shore while another hunter takes a skiff to the head of a bay and drives the sea lions back towards the shooter. A common strategy uses two skiffs. Hunters herd the sea lions back and forth between skiffs until the animals are tired and breathless, at which time the sea lions can be approached. Another method for tiring out swimming sea lions is to fire a rifle at a surfacing animal causing it to dive before getting a full breath of air. Sometimes sea lions will jump out of the water or "porpoise" when chased; a "porpoising" sea lion has more air in its lungs and will not sink as quickly as one without full lungs, making retrieval easier. If an animal is wounded, it is pursued rather than abandoned. Skiff drivers often chase sea lions toward shallow water, where they are easier to retrieve if they do sink after being shot. The preferred animals are young adult males of medium size rather than bulls or young pups.

Estimates of the Harvest for Subsistence

The ADF&G collected Steller sea lion subsistence harvest data from 25 communities in the lower Alaska Peninsula, lower Cook Inlet, Prince William Sound, and the Kodiak Island area during the 1980s. The annual subsistence harvest for these 25 communities was between 300 and 400 sea lions (Haynes and Mishler 1991).

Subsistence takes, including harvests and struck and lost animals, have been documented by the ADF&G from 1992 to 2005, excluding 1999. Steller sea lion harvest data from Alaska Native marine mammal hunters have been collected in 62 coastal Alaska communities. Total subsistence takes of sea lions by Alaska Natives declined between 1992 to 1995, with takes leveling off between 1996 to 2005 (Figure 2). The lowest recorded number of sea lion takes (164 animals) occurred in 1997. The subsistence take of 218 sea lions in 2005 was only 40% of the subsistence take in 1992 (549 animals) (Table 2) (Wolfe et al. 2006).

Notable declines in sea lion takes at the regional level have been reported by hunters from the Pribilof Islands where total sea lion takes fell from 297 animals (1992) to 32 animals (2005), a decline of 89%. Sea lion takes in the Aleutian Islands area increased to 88 animals in 2005 from a low of 37 animals in 1998, but was below the 135 animals taken in 1992. In Kodiak Island areas, the sea lion take in 2005 (25 animals) represented a 57% decrease from 1992 (58 animals) (Figure 3) (Wolfe et al. 2006).

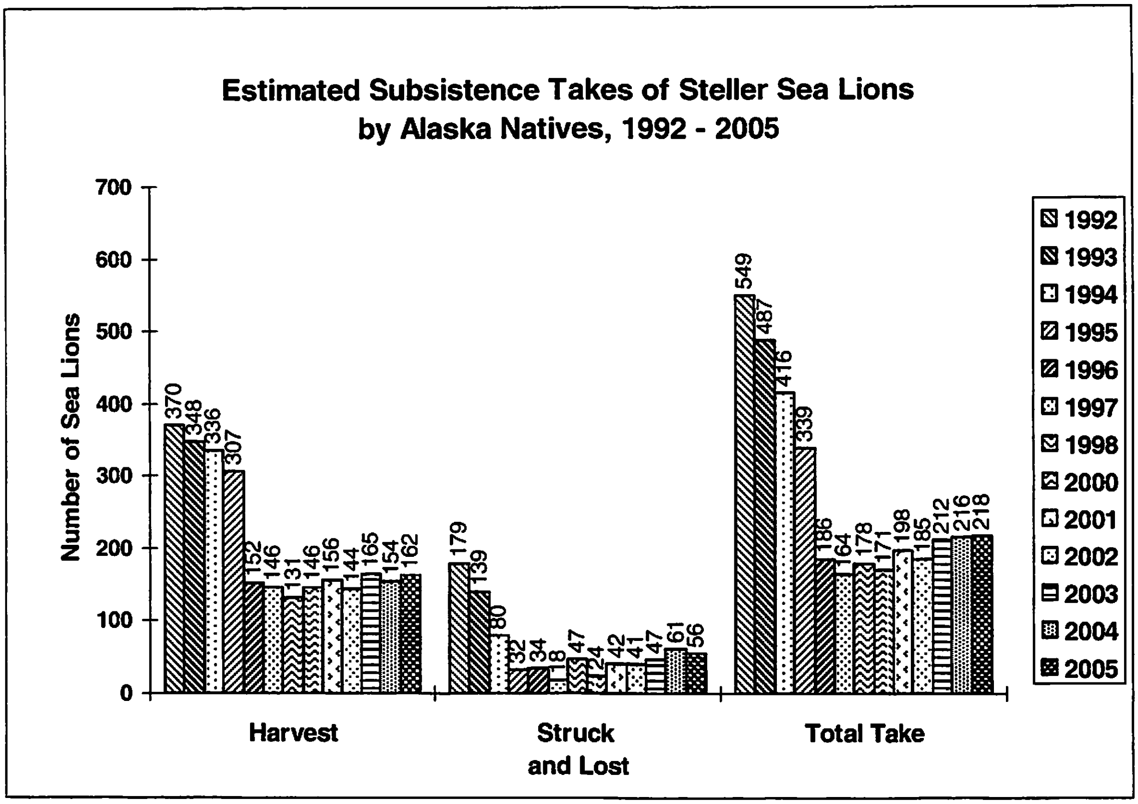

Figure 2. Estimated subsistence takes of Steller sea lions by Alaska Natives, 1992-2005 (Wolfe et al. 2006).

Table 2. Estimated subsistence takes of Steller sea lions by Alaska Natives, 1992-2005.

Estimated Subsistence Takes of Steller Sea Lions (*Eumetopias jubatus*) By Alaska Natives, 1992 - 2005

Year	Estimated Total: Harvest	Estimated Total: Struck and Lost	Estimated Total: Total Take	Lower and Upper Confidence Range for Total Take
1992	370	179	549	452 - 712
	67.4%	*32.6%*	*100.0%*	
1993	348	139	487	390 - 629
	71.4%	*28.6%*	*100.0%*	
1994	336	80	416	330 - 554
	80.8%	*19.2%*	*100.0%*	
1995	307	32	339	258 - 465
	90.5%	*9.5%*	*100.0%*	
1996	152	34	186	165 - 226
	81.7%	*18.3%*	*100.0%*	
1997	146	18	164	132 - 227
	89.1%	*10.9%*	*100.0%*	
1998	131	47	178	137 - 257
	73.6%	*26.4%*	*100.0%*	
2000	146	24	171	121 - 244
	85.5%	*13.9%*	*99.4%*	
2001	156	42	198	162 - 282
	78.7%	*21.3%*	*100.0%*	
2002	144	41	185	145 - 248
	77.9%	*22.1%*	*100.0%*	
2003	165	47	212	149 - 303
	78.0%	*22.0%*	*100.0%*	
2004	154	61	216	147 - 335
	71.6%	*28.4%*	*100.0%*	
2005	162	56	218	169 - 301
	74.5%	*25.5%*	*100.0%*	

Wolfe et al. (2006)

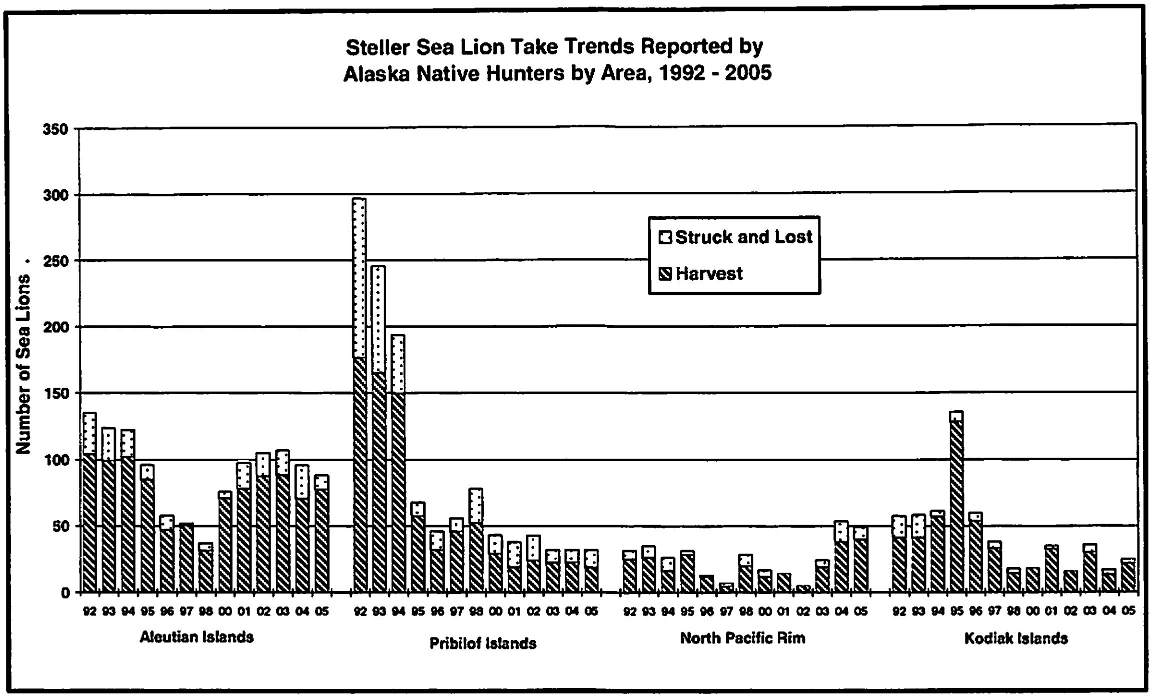

Figure 3. Steller Sea lion take trends reported by Alaska Native hunters, by area, 1992-2005 (Wolfe et al. 2006).

Longer time series for subsistence harvests are available for the North Pacific Rim and Kodiak Island regions. For Kodiak Island communities sea lion harvests have been declining since the 1980s (Wolfe et al. 2006). During the early 1980s, the annual harvest for the 25 communities in which kills were documented was between 300 to 400 sea lions. During the late 1980s, the subsistence harvest appears to have been considerably less, due to declines on Kodiak Island and perhaps in other areas (Haynes and Mishler 1991). Steller sea lion harvests have declined for a variety of reasons. Declines in sea lion takes appear to be associated with drops in numbers of hunters. Sea lion hunters declined from a five-year average of 184 hunters (1992-96) to 68 hunters in 2005. Successful sea lion hunters fell from a five-year average of 123 hunters (1992-96) to 56 hunters in 2005 (Figure 4) (Wolfe et al. 2006).

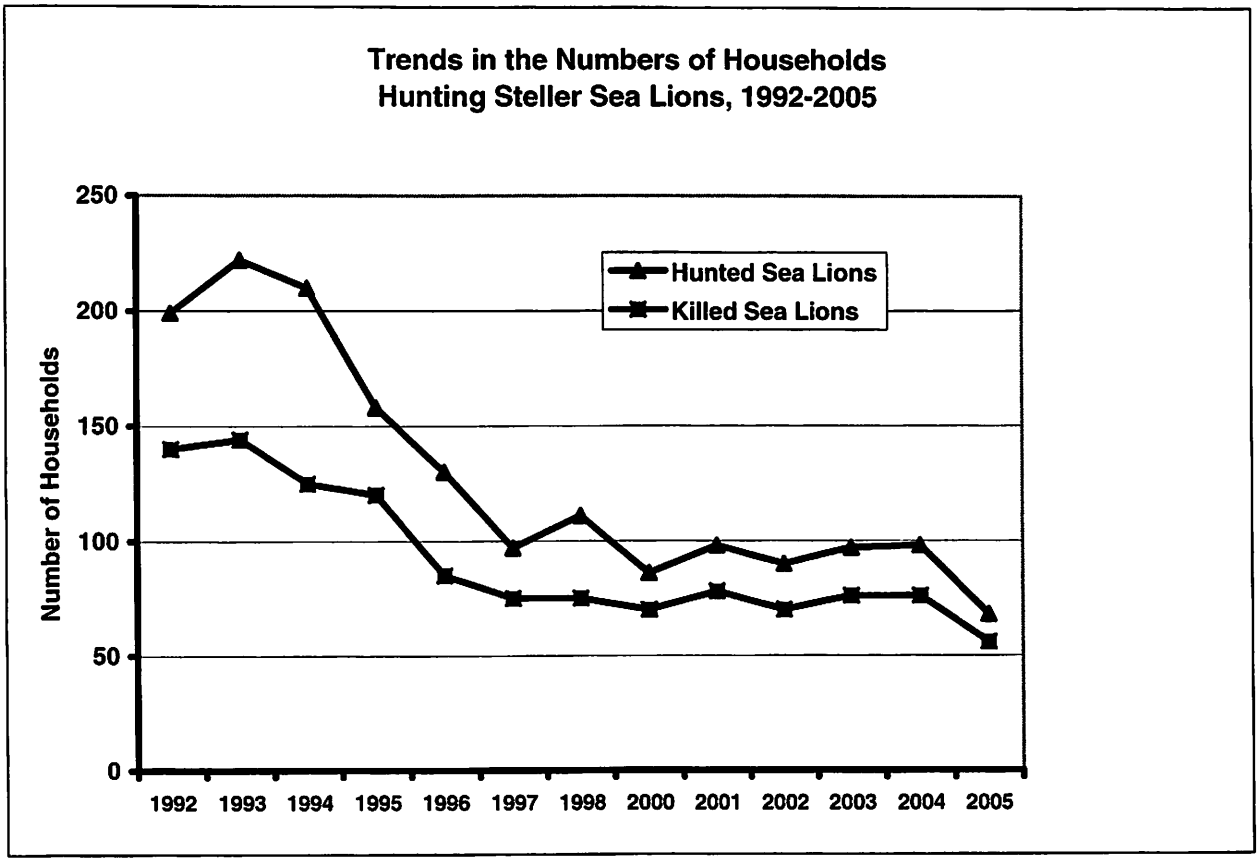

Figure 4. Statewide trends in the number of Alaska Native households hunting sea lions, 1992-2005 (adapted from Wolfe et al. 2006).

Researchers interviewing Steller sea lion hunters in 1992 learned that some hunters had ceased taking sea lions in the mistaken belief that Alaska Natives could no longer take sea lions in a subsistence hunt. This belief was prevalent among hunters of Kodiak Island and the Alaska Peninsula. Alaska Native sea lion hunters had misunderstood posters distributed among the communities in 1991 by state and federal agencies. The posters were intended to publicize that the direct taking of sea lions as nuisance animals by commercial fishers was illegal. The posters did not mention that subsistence hunting by Alaska Natives was legal (Wolfe and Mishler 1994).

PREDATOR CONTROL PROGRAM

The Federal Alaska Department of Fisheries instituted a predator control program in 1951. The program was initiated to reduce the impacts of marine mammals on the salmon gillnet fisheries. The program targeted harbor seals but also included sea lions. Complete tallies of sea lions killed are unavailable but unpublished accounts suggest that only a small fraction of the total population of sea lions were taken by the predator control program (NRC 2006). Research for this study did not find any documentary evidence of federal, state, or local government bounties paid for Steller sea lion kills.

DIRECTED COMMERCIAL HARVESTS

The Year 1959

Directed commercial harvests of Steller sea lions began in 1959 as an experimental harvest. Earlier pilot studies conducted on Chernabura Island, in the Gulf of Alaska's Shumagin Islands, indicated that sea lions could be taken from rookeries in commercial quantities. It was assumed that the sea lion meat could be used as either fur farm or fish hatchery feed. In 1959, the Federal Bureau of Commercial Fisheries contracted a commercial fishing company to conduct an experimental harvest of Steller sea lions in Alaska. That summer the ship, MV *Arctic Maid*, served as mothership and base for the operation taking 616 adult, male Steller sea lions from five rookeries on Marmot, Chowiet, Atkins, Jude, and Ugamak islands in the Gulf of Alaska between Kodiak Island and Unimak Pass (Thorsteinson 1961).

From 1963 to 1972

Commercial harvests resumed in 1963, continuing until 1972. During this period more than 45,000 Steller sea lion pups were harvested in the eastern Aleutian Islands and Gulf of Alaska (Merrick et al. 1987). Harvests occurred on Marmot, Sugarloaf, Akutan, Atkins, Round, Ugumak, and Jude islands. The largest harvests occurred between 1963 and 1972 on Sugarloaf Island, where 16,763 pups were killed, and Marmot Island, where 14,180 pups were killed (Table 3). On Sugarloaf Island in 1965 and 1968 pup harvests reached 50% of total pup production (Merrick et al. 1987).

Harvests were managed under permits issued by the ADF&G (see next section) and some hunts were monitored by department staff. Harvesting took place in May, June, and July but pelts taken in May and June were preferred, when the animals were smaller and not as scarred. Hunting parties ranged from two to 15, operating from land based camps and boats. Pelts were sold to the fur industry and marketed in Europe (Vania and Klinkhart 1966, 1967; Vania et al. 1968, 1969).

Table 3. Commercial Steller sea lion harvests, 1959-1972.

Commercial Steller sea lion harvests, 1959-1972

Harvest Location	**Year**										
	1959	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**
Marmot Island	137			1,024	1,650	2,675	2,150	2,516	2,365		1,800
Sugarloaf Island		4,000	1,500	2,005	1,400	2,180	1,968	2,692	1,008		
Akutan Island				1,659	857		80		2,159	2,250	1,627
Atkins Island	265			259							379
Round Island				574							
Ugumak Island	179								525	1,064	2,184
Jude Island	39			72							556
Chowiet Island	10										
Total	630	4,000	1,500	5,593	3,907	4,855	4,198	5,208	6,057	3,314	6,546

Source: ITG 1978 FEIS, Appendix D.

The harvesting of 45,000 pups reduced some local populations, perhaps holding constant the number of sea lions breeding in the Gulf of Alaska and Aleutian Islands through the 1960s and 70s (Trites and Larkin 1992). But scientists have stated that these pup harvests cannot account for population declines observed through the 1980s nor can they explain the declines in the western and central Aleutian Island sea lion populations (Trites and Larkin 1992, Merrick et al. 1987).

Alaska Department of Fish and Game Regulatory History

Prior to 1960 there were no regulations pertaining to seasons and bag limits for Steller sea lions. From 1960 until 1972 the Alaska Department of Fish and Game regulated harvests of marine mammals including Steller sea lions. In 1960, the State of Alaska established sea lion hunting regulations in all of coastal Alaska with no closed seasons and no bag limit. In 1962, a sentence was added to the sea lion hunting regulations: "Provided that the taking of sea lions for commercial purposes is permitted under the terms of a permit that may be issued at the discretion of the Commissioner" (ITG 1978). In 1965, a new sentence was added to the regulation: "Provided that the taking of sea lions for commercial purposes in excess of 10 is permitted under the terms of a permit that may be issued by the Commissioner in consideration of conservation requirements" (ITG 1978). The regulation did not change from 1965 until 1972. The Marine Mammal Protection Act of 1972 (Public law 95-522) became law on December 21, 1972, and management of all marine mammals came under the authority of the federal government (Table 4).

Table 4. Federal and State of Alaska Steller sea lion regulatory chronology.

Pre 1960	No state or federal regulations pertaining to seasons and bag limits.
1960	State of Alaska establishes hunting regulations; no closed seasons or bag limits.
1962	Taking Steller sea lions for commercial purposes is allowed under a State of Alaska permit.
1965	Permit and reporting requirements instituted by State of Alaska for taking Steller sea lions in excess of 10 sea lions.
1972	Marine Mammal Protection Act of 1972 (Public Law 95-522) becomes federal law. Management of marine mammals comes under authority of the federal government. The law allows fishermen to shoot Steller sea lions destroying fishing gear or causing threat to human safety.
1976	Passage of Magnuson Fishery Conservation and Management Act of 1976. Federal law requires U.S. observers on foreign fishing vessels.
1990	Steller sea lions listed as a threatened species under the federal Endangered Species Act. It becomes illegal to shoot Steller sea lions destroying fishing gear or causing threat to human safety.
1991	Federal, domestic on-board observer program begins with 100% coverage on vessels >125 ft, 30% on vessels 60-125 ft.
1997	Western DPS Steller sea lion listed as endangered under the federal Endangered Species Act.

INCIDENTAL MORTALITY IN COMMERCIAL FISHERIES

Domestic Fisheries

Steller sea lions have been incidentally caught and killed in domestic commercial net and hook and line fisheries by commercial fishermen in Alaska since at least the 1930s. In 1934, the Secretary of the Interior declared that sea lions occurred in excessive numbers in Alaskan waters and fishermen were suffering economic losses due to the animals (Wynne and Mercy 2005). During the 1950s salmon, halibut, and Pacific herring *Clupea pallasi* fishermen complained to federal and state agencies about sea lion depredations. The agencies responded with research on sea lions and their effects on commercial fisheries. The ADF&G and the Fisheries Research Institute of the University of Washington began research on sea lion biology, population estimates, and the effects of sea lions on commercial fisheries in the late 1950s. The organizations also conducted surveys of commercial fishermen in an effort to document time, location and nature of damage to gear and quantity of fish lost to sea lions (Thorsteinson et al. 1961). Survey results indicated that salmon fishermen suffered economic losses from sea lions. Halibut fishermen were also reporting significant losses of catch and damage to gear from sea lions. The International Pacific Halibut Commission conducted a survey of commercial halibut fishermen in 1958.

Fishermen estimated 1.3 million pounds of halibut were damaged or destroyed by sea lions (Thorsteinson et al. 1961).

Calkins (1989) developed a risk factor analysis to assess commercial domestic fisheries causing the highest sea lion mortality. He considered the type of fishery, the timing of the fishery and the amount of fishing effort based on the number of permits issued. Calkins concluded that for finfish fisheries (herring, salmon, and groundfish) managed by the state of Alaska, sea lions were more likely to be entangled or shot in the Prince William Sound drift gillnet fishery than any other fishery. The groundfish and setnet fisheries around Kodiak Island were next highest risk fisheries followed by the troll fishery in Southeast Alaska (Calkins 1989).

Several key respondents commented on commercial fishing prior to the 1970s noting that commercial salmon drift gillnet and set gillnet fishermen during the 1950s through 1970s were shooting at Steller sea lions to discourage them from taking fish and destroying gear.

Salmon Drift Gillnet and Set Gillnet Fisheries

Drift gillnets and set gillnets catch salmon, primarily sockeye *Oncorhynchus nerka*, chum *O.keta*, and coho *O. kisutch* salmon. Drift gillnets are long, curtain-like nets, set perpendicular to the direction the targeted fish are traveling. The net has a float line on the top and weighted lead line on the bottom. The mesh openings are just large enough to allow the male fish, which are usually larger, to get their head stuck ("gilled") in the mesh. Drift gillnetters set long stretches of nets for extended periods, leaving their gear and catch vulnerable to sea lions. The 1978 drift gillnet fishery in the Copper River delta (southeast of Prince Williams Sound) is one of the few commercial fisheries where sea lion mortality has been documented. Matkins and Fay (1980) estimated that in 1978, 450 gillnetters shot about 300 sea lions in May and early June. None of the respondents we spoke to commented on this particular fishery but several did discuss their experiences as commercial salmon drift gillnet fishermen. Sea lions can be a problem for drift gillnet fishermen and prior to the 1990s shooting at animals harassing gear or catch was common for this gear group.

A setnet is an anchored gillnet, hung from a set line with corks on the top and a lead line on the bottom. The net does not sink; if water depth is sufficient there is enough floatation in the cork line to float the lead line off of the bottom. Setnetters often leave their net in the water for extended periods, leaving their gear and catch vulnerable to sea lions. Sea lions in the Kodiak area taking fish from setnets and damaging gear was common in the 1970s and 80s. As the sea lion populations declined in the mid to late 1980s, this problem became less frequent. Respondents from this study stated that both seals and sea lions take fish from setnets but sea lions often damage nets, "A seal will go in there, and he uses a net like a dinner table.

He'd sit there and eat the fish right out of the net and not break the mesh. . . . a sea lion, at the very least, is going to rip a huge, gaping hole until he rips that fish out of the net, they just swim right through the net. And it's like a freight train going through it. It'll destroy a net." Different techniques were used by Kodiak setnetters to address sea lion problems; shooting at sea lions to scare them away was the most common technique. One respondent added that some setnet fishers did shoot to kill. Another respondent said that he did a lot of shooting but only killed two or three sea lions a season and thought this was a common practice, adding that sea lions are hard to hit when shooting from a boat bobbing in the water. Respondents added that sea lions have begun returning to some areas and some setnet fishers have had to abandon their sites due to increasing numbers of sea lions. Respondents also commented on shore based riflemen shooting sea lions at setnet sites. This practice occurred on the outer capes on the east coast of Kodiak Island, Cape Ugat and "Prominent Mound," were two locations mentioned by respondents. Shooting sea lions with rifles from shore-based locations was said to be more lethal than shooting from a boat.

Salmon Troll Fisheries

The salmon troll fishery targets chinook *Oncorhynchus tshawytscha*, coho and pink salmon. Troll vessels use multiple, four to six main wire lines with 8 to 12 nylon leaders spaced along its length, each of which end with a lure or baited hook trailing from the moving vessel. Hooked fish are retrieved with on board spools via hand cranks (hand trollers) or hydraulic power (power trollers). Troll vessels come in a variety of sizes ranging from small hand troll skiffs to large ocean-going power troll vessels of 50 feet or more. Salmon troll fisheries operate throughout Southeast Alaska.

Calkins (1989) rated interactions with Steller sea lions in the Southeast Alaska salmon troll fisheries as third highest. Although Southeast Alaska fisheries were not included in this study, some of the fishermen interviewed had participated in the salmon troll fishery during the 1970s. Respondents said that Southeast Alaska salmon troll fishermen did shoot at Steller sea lions, including on rookeries and haulouts, adding that they saw very few sea lions in Southeast Alaska in the 1970s and 1980s .

Crab and Other Shellfish Fisheries

Crabbers target Dungeness, king, and Tanner crabs using twine or wire-meshed steel pots (traps). Pots are baited with herring or other fresh bait and left to "soak" for several days. To mark locations of pots a line extends from each pot to a surface buoy. A power winch is used to retrieve the pots. Crab boats come in a variety of shapes and sizes from small outboard motor powered skiffs fishing inside waters for Dungeness, to seagoing vessels of 100 feet or more fishing the Bering Sea and the Gulf of Alaska for king crab.

The U. S. king crab fishery, centered in the central Gulf of Alaska, Kodiak Island, South Alaska Peninsula and Cook Inlet, began as a trawl fishery in the 1940s and was replaced by a pot fishery in 1959. The fishery began to decline in the mid 1960s and was closed in 1983. The Tanner crab fishery began following the king crab collapse in the late 1960s and grew rapidly. The Tanner crab fishery was also concentrated in the central Gulf of Alaska and declined rapidly in the 1980s. Dungeness crabs have been fished since 1900 in Southeast Alaska and more recently at Kodiak Island (Trites and Larkin 1992).

Several fishermen who had fished for king and Dungeness crabs in the Kodiak area were interviewed for this study. Crab fishing crew's interactions with sea lions were unique to the fishery. Steller sea lions were attracted to the inflatable floats used in the fishery, puncturing them. Fishermen reacted to this behavior by shooting at sea lions. The inflatable floats were eventually replaced by closed cell foam floats. Some fishermen also used sea lion meat for crab bait but there was disagreement among the crabbers interviewed for this study about the quality of sea lion meat for crab bait. One respondent who began crab fishing in the 1960s said that shooting at sea lions including on rookeries was prevalent amongst crabbers but added that not everyone was involved. Crews shooting sea lions for bait often killed several at a time. The respondent said that this was a common practice amongst crabbers at the south end of Kodiak Island and in the Chignik area.

Salmon and Herring Purse Seine Fisheries

Purse seine boats catch salmon, primarily pink salmon *Oncorhynchus gorbuscha*, and herring by encircling the fish with a long net and drawing (pursing) the bottom closed to capture the fish. The fishing begins with the net stacked on the boat and then played into the water while the boat makes a large circle around the fish. The far end of the net is attached to a jitney, referred to by respondents as "power skiff," which assists the operation by holding the net while the seine boat completes the circle. The top of the net stays on the surface of the water due to a "float line" running through thousands of floats which hold the top of the net up, the bottom of the net falls vertically because of a weighted "lead line." This results in the net hanging like a curtain around the fish. The crew then purses the bottom of the net with a "purse line." The lines and the net are retrieved with a hydraulic winch.

Trites and Larkin (1992) found there was little interaction, either through bycatch or directed shooting in the seine fisheries. The seine boat fishermen interviewed for this research agreed, stating that Steller sea lions were not a problem for them. If a sea lion got into the net it was usually able to jump over the top of the net before it closed.

Bottomfish Longline Fisheries

Longline vessels catch bottomfish (halibut, sablefish *Anoplopoma fimbria*, lingcod and, rockfish) with a longline laid on the bottom. Attached to the longline are leaders with baited hooks. Each longline can be up to a mile in length and have thousands of baited hooks. The lines are anchored at each end of each "set." Longline vessels typically set several lines for a 24 hour soak. Longline vessels are large boats, 50 to 100 feet in length and can pack 20 to 40 tons, or more, of iced product.

In the 1950s, halibut longliners reported a significant loss of catch and damage to gear from sea lions. In 1958, fishermen estimated 1.3 million pounds of halibut were damaged or destroyed by sea lions (Thorsteinson et al. 1961). The longline fishermen interviewed for this study, fishing in the Gulf of Alaska and Bering Sea since the 1970s, said that they had limited interactions with Steller sea lions. Respondents noted that a sea lion will occasionally be caught on a longline and brought up dead, or take the belly out of a fish caught on the longline, but sea lions are not a significant problem.

Walleye Pollock, Bottomfish, and Shrimp Trawl Fisheries

Trawl vessels catch large quantities of mid-water species, such as walleye pollock or pink shrimp, and bottomfish, such as flounder, by towing a large, cone-shaped net. Most trawl nets have "doors" on either side of the net's opening to help hold it open, and some, fished near the bottom, have a heavy chain strung along the bottom of the opening to hold it close to the sea floor. The net is retrieved by using huge winches and a power drum upon which the net is rolled as it is brought aboard. The end of the net, the "bag" or "cod end," holds the fish and is usually pulled right up into the back of the vessel on a slanting stern ramp. Trawlers are generally large vessels, up to 600 feet in length; the largest in the ocean walleye pollock fishery are factory trawlers with on board processing facilities. Catches are often enormous, with a 2-hour tow of the net yielding up to 100 tons or more, depending on the fishery, the size of the vessel, and the concentration of fish in the area. Several respondents interviewed for this study had fished in the ocean walleye pollock fishery on joint venture vessels during the 1980s; see below for more information.

There is limited information about incidental catches in the domestic groundfish fishery because only a small portion of the fleet (3%) was observed. The people we interviewed for this study had not been involved in this fishery. The limited results suggest that very few sea lions were caught by domestic trawlers. The low catch rates of the domestic fleet may have been the result of fishing for Pacific cod during daylight hours when fewer sea lions were feeding (Trites and Larkin 1992). A change in fishermen's attitudes towards the killing of sea lions in the late 1980s or a change in fishing methods and locations may have also contributed to the apparent lack of sea lion kills in this fishery (Trites and Larkin 1992).

Foreign Trawl Fisheries

The Japanese introduced the trawl fishery to the Northeast Pacific Ocean with exploratory fisheries in 1929 and 1933-37, harvesting Pacific ocean perch *Sebastes alutus*, walleye pollock, and yellowfin sole *Pleuronectes aspar*. In 1940, a Japanese mothership with nine to 12 catcher vessels fished in the Bering Sea. In 1954 the Japanese sent two motherships and nine catcher boats to the Bering Sea. Soviet exploratory fisheries began in the Bering Sea in the early 1930s but commercial operations did not begin until 1959. During the late 1950s and early 1960s Soviet and Japanese trawlers concentrated on Pacific ocean perch and yellowfin sole until catches began to decline in the late 1960s (Perez and Loughlin 1991). Following the decline in ocean perch and sole catches, the foreign trawl fisheries concentrated on walleye pollock (Perez and Loughlin 1991). None of the respondents interviewed for this study had been involved in the foreign trawl fisheries.

Steller sea lions were incidentally caught in the foreign trawl fisheries in the Bering Sea and Gulf of Alaska since the beginning of these fisheries. By the mid 1960s foreign trawl fisheries efforts were increasing in Alaska, and Steller sea lion populations were also growing. Perez and Loughlin (1991) estimated a total of 11,650 Steller sea lions died in trawl fisheries from 1966 to 1977 in the Bering Sea. During this same time period Perez and Loughlin (1991) estimated a total of 3,180 Steller sea lions died in trawl fisheries in the Gulf of Alaska.

Observer Data

Incidental catch estimates of marine mammals are based on observer data. In 1973 and for several years after, data on incidental catch of marine mammals were recorded by U.S. observers on a limited number of foreign vessels. U.S. observers aboard foreign vessels from 1973 to 1977 recorded incidental takes of marine mammals in an inconsistent manner. Passage of the Magnuson Fishery Conservation and Management Act of 1976 (MFCA) required foreign vessels to accept observers. In mid 1977, a standardized reporting system for the collection of data on the incidental take of marine mammals was developed requiring all observers to record marine mammal incidental takes. However, the collection and recording of fishery-related data remained the observers' primary duty, marine mammal incidental catch data were secondary and recording was not to interfere with collection of fishery catch data. Since 1978 data on the incidental take of marine mammals in the U.S. Exclusive Economic Zone (EEZ) have been routinely collected and uniformly recorded. These data were not reviewed as part of this study. Estimates of Steller sea lion takes prior to 1978 may be low (Perez and Loughlin 1991).

Foreign and Joint Venture Trawl Fisheries

From 1973 to 1988, 3,661 marine mammals of 17 species were reported as incidental catch by U.S. observers aboard foreign and joint venture trawl vessels in the U.S. EEZ in the North Pacific Ocean and Bering Sea. Steller sea lions accounted for 90% of the reported incidental mortality; 43% were caught in the Bering Sea and 57% in the Gulf of Alaska. Nearly half of these sea lions were taken in trawl nets in the Shelikof Strait, Alaska joint venture walleye pollock fishery during 1982 through 1984 (Perez and Loughlin 1991). Respondents interviewed for this study involved in the Shelikof Strait walleye pollock fishery in 1982 through 1984 support the findings of Perez and Loughlin (1991). See below for a more detailed description of the respondents' comments on this fishery.

Steller sea lions were caught in trawl nets in all months of the year and nearly 60% were caught at night, from 8 PM until 5 AM, when the animals tend to feed. In the Bering Sea foreign trawlers caught 29% of their annual incidental take from February to May and 55% from September to December. Alaska joint venture walleye pollock vessels caught 62% of their annual incidental take during April and May. In the Gulf of Alaska foreign trawlers caught 65% of their annual incidental takes from September to November and joint venture walleye pollock vessels caught 92% of their take from February to April, primarily in Shelikof Strait (Perez and Loughlin 1991).

Perez and Loughlin (1991) estimated a total of 14,830 Steller sea lions died incidentally in trawl fishing during 1966 through 1977, based on the average observed incidental catch rates during 1973 through 1977. Perez and Loughlin (1991) also estimated that a total of 6,543 Steller sea lions were incidentally caught and died in trawls of both foreign and joint venture walleye pollock fisheries throughout Alaska during 1978 through 1988. Based on average observed rates, Perez and Loughlin (1991) found that incidental takes of Steller sea lions between 1973 and 1988 were higher in the Gulf of Alaska than in the Bering Sea and greater numbers of Steller sea lions were caught by joint venture trawlers (66% of the total) than foreign trawlers during this same period. Joint venture fisheries experienced nearly 100% mortality of sea lions caught in trawls. The greatest incidental mortality levels observed during 1973 through 1988 occurred in the 1982 Shelikof Strait joint venture walleye pollock fishery in which 528 observed and an estimated 958 to 1,436 sea lions were killed (Loughlin and Nelson 1986). Sea lions in Shelikof Strait are included in the western DPS of Steller sea lions.

Shelikof Strait Joint Venture Fishery

The Shelikof Strait walleye pollock joint venture fishery began in 1980 when U.S. catcher boats delivered walleye pollock to Republic of Korea (R.O.K.) processing vessels. The fishery expanded rapidly during the first four years with U.S. catcher boats delivering walleye pollock to R.O.K. processors in 1981 to

1984; Japanese processors in 1982 to 1984; Polish processors in 1982; and (West) German processors in 1984. The fishery targeted the enormous spawning schools of walleye pollock aggregating in the Shelikof Strait, Simidi Islands region between January and March. Domestic vessels caught the fish using mid water trawls. Each foreign processing vessel was served by one to 10 domestic catcher boats (Loughlin and Nelson 1986).

Prior to 1982, even though the mortality rates of Steller sea lions taken in the joint venture fisheries were high, the numbers of animals caught were relatively low. In 1982 during the joint venture fishery in Shelikof Strait, the numbers of animals taken were high and it was not unusual for 50 or more dead Steller sea lions to be found in a single haul. American observers reported trawls with as many as 100 dead sea lions (Loughlin and Nelson 1986). Key respondents interviewed in 2006 confirmed these high catches of sea lions. One respondent reported 108 sea lions in one haul of the net. High sea lion bycatch was common enough that the Korean processors devised a formula for subtracting the weight of the Steller sea lions in the net from the total pounds of product delivered to them.

There are several possible reasons for the high Steller sea lion bycatch in the 1982 Shelikof Strait joint venture fisheries. In the joint venture fisheries the catch was enclosed by tying off the cod end of the net after it was hauled back by the trawler. Normally the net remained in the water before it was loaded aboard the foreign processor. According to key respondents, it was when the net was full of fish and in the water that the sea lions were attracted to the gear, climbing onto the bag and biting fish sticking out of the net. This was also when crews were shooting at the sea lions on the bag and near the ship.

In 1982, observers were told by fishermen that the spawning schools of walleye pollock were so dense that more fish were often caught than could be accommodated by the gear or the processing vessel. This resulted in nets full of fish left in the water for long periods, such as six to eight hours. In later years, the tow time was reduced to lower the amount of fish caught (Loughlin and Nelson 1986).

Another possible reason for the high sea lion bycatch in Shelikof Strait was the timing and location of the fishery. In 1982 the joint venture fishery was active through April, when 80% of the sea lions were caught. In 1983 and 1984 the fishery was slowing down by late March and terminated in early April, resulting in fewer sea lions caught. The location of the fishery in 1982 may have also contributed to the sea lion bycatch (Figure 5). During the 1982 fishery vessels fished farther east and closer to shore than in later years. The ADF&G survey results indicate that there are more sea lions in this part of Shelikof Strait during mid to late April than during January to March (Loughlin and Nelson 1986).

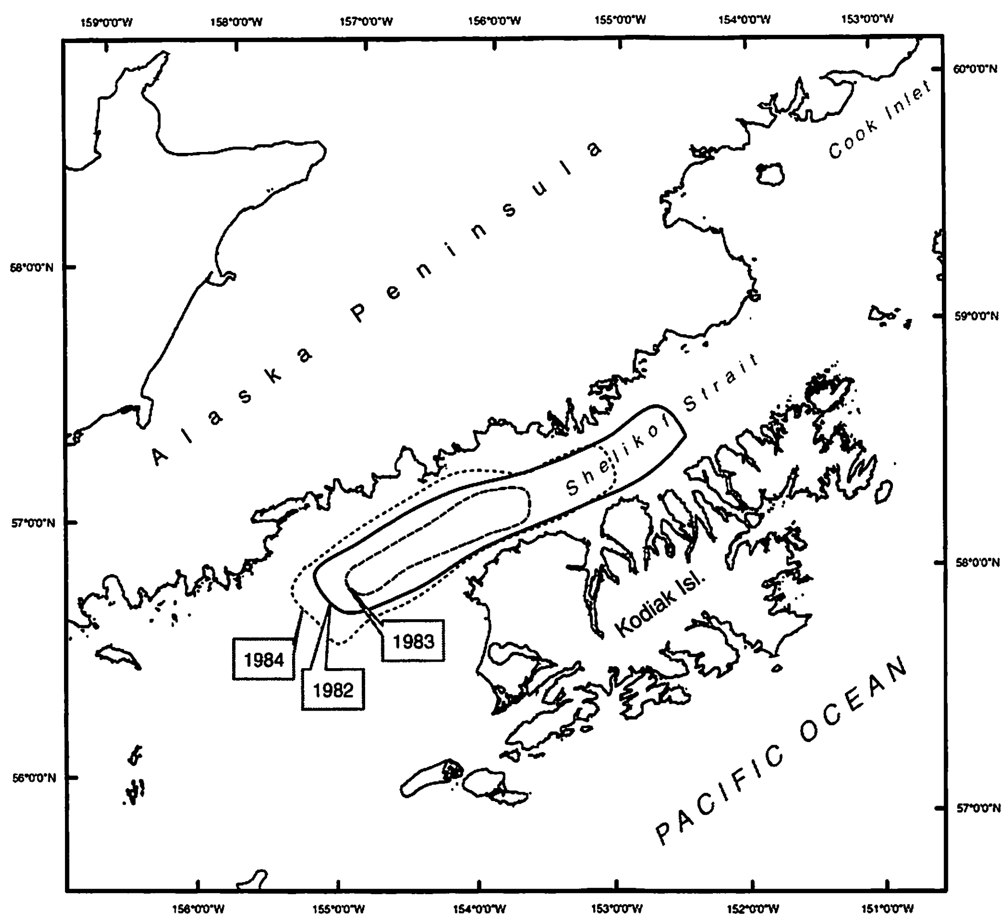

Figure 5. General areas where Steller sea lions were caught, 1982-1984 in the Shelikof Straight joint venture walleye pollock fishery (Modified from Loughlin and Nelson 1986).

Key respondents interviewed in Seattle and Kodiak also commented on the reasons for the high sea lion bycatch in the 1982 joint venture fishery. Several respondents mentioned that in the early 1980s the processors were "chumming," or throwing overboard unwanted walleye pollock. According to one respondent with many years of experience in the commercial fishing industry in Alaska, "In the early days, the foreign motherships didn't keep all the fish . . . all they wanted was the females. So the males were going back overboard, and boy, those sea lions were fat and happy." Respondents thought that this chumming of walleye pollock resulted in sea lions following the processors.

Respondents also discussed the operation of equipment contributing to the bycatch in Shelikof Strait. One technique used by the catcher boats to preserve their catch until there was room in the processor's hold for their fish is known as "short lining" or "short wiring." A catcher boat partially retrieved the net, so that it was no longer actively fishing, but still maintained trawling speed so the fish already captured could not escape. If sea lions swimming around the catcher boat got in front of the net there was a good chance that they would end up in the net and die. According to respondents it took some time before the joint venture fleet understood this was creating a problem. One respondent described the technique devised by the joint venture fleet to address the bycatch problem. Before towing the cod end full of fish the crew closed the doors at the front of the net and winched the net up to the stern of the boat, eliminating the opening the sea lions could swim into.

Direct Mortality from Shooting

Sea lion takes, including direct mortality from shooting, have not been recorded through a regulatory program, a bounty program, or other wildlife programs. Thus interviews with fishermen were found to be the best source of information. The importance of retrospective information concerning direct mortality from shooting in order to explain the historical decline of Steller sea lions was noted by the National Research Council (NRC 2003). Alverson (1992) put "indiscriminate shooting" as one of five major causes of increased mortality on Steller sea lions during the 30-year period from 1960 to 1990 and notes that interviews of fishermen, cannery operators, and processors might yield more quantitative answers to the question of the overall impact of shooting sea lions.

In the past, Steller sea lions were shot at by some commercial fishermen in Alaska, since at least the 1930s. Sullivan (2005) describes a commercial fishing crew shooting sea lions on Amak Island in 1977. On occasion, military personnel also shot at Steller sea lions, sometimes firing thousands of rounds of ammunition at animals on rookeries (Lawhead 1953, NRC 2006). Fishermen, especially in finfish and crab fisheries, considered Steller sea lions predators and pests competing with them for fish. Fishermen also believed sea lions carried parasites, "codfish worms," which they passed on to fish. Unlike harbor seals, there were no federal, state, or territorial bounties on Steller sea lions, and other than the limited commercial harvests, as noted above, no direct economic incentive for killing sea lions. Nevertheless, not until the passage of the Marine Mammal Protection Act of 1972 (Public Law 95-522) did federal, territorial and state governments stop supporting the indiscriminate shooting of Steller sea lions. Until 1990 the Marine Mammal Protection Act allowed fishermen to shoot Steller sea lions posing a threat to life or property. Prior to 1990 shooting by commercial fishermen was widespread, common and opportunistic, but it was not systematic. Our research could find only one case where Steller sea lions were regularly shot and taken as bycatch in a location where sea lions were found in large numbers. That case was the Shelikof Strait joint venture walleye pollock trawl fishery.

Shelikof Strait Joint Venture Walleye Pollock Trawl Fishery

Of all the commercial fisheries that respondents discussed, the joint venture walleye pollock fishery in Shelikof Strait in the early 1980s was the only one where incidental takes and direct mortality from shooting were concentrated in time and place. Several of the key respondents interviewed were involved in the early years 1981 and 1982 of the joint venture fishery, stating that the Steller sea lions in Shelikof Strait during the early 1980s were "numerous" and "aggressive." One respondent said that as many as 200 to 300 sea lions were seen following a boat.

Several respondents said that the sea lions appeared to be responding to the sound of the trawler's hydraulic gear as the net was hauled in. Sea lions would approach the boat when the hydraulics were started and climb up on the net as it was being hauled. Sometimes sea lions were delivered in the net to the processor ships. One respondent stated that he had personally observed 27 Steller sea lions caught in a haul, but had heard of as many as 100 being caught in one haul. Another respondent said that catcher boats might deliver 50 sea lions to the mother ship and on some occasions hauls were delivered with more sea lion tonnage than walleye pollock tonnage. Shooting did occur at this time with crew members standing on the stern of the vessels firing at sea lions. One respondent estimated 15 to 20 Steller sea lions being killed per month per boat. During bad weather when boats could not fish some crews went to rookeries to shoot sea lions, but this was not common. Fishermen said that they were in Shelikof Strait to catch fish, not shoot sea lions. One respondent estimated that the number of sea lions shot and killed probably equaled the amount caught as bycatch. Another thought that more sea lions were shot than caught in the nets. Respondents agreed that most sea lion activity, and thus interactions with fishermen, occurred at night.

Respondents commented on why they thought sea lions were so numerous and aggressive in Shelikof Straits. One fisherman believed that the eulachon *Thaleichthys pacificus* in Shelikof Strait in the early 1980s were the primary prey of the sea lions and the animals were taking walleye pollock opportunistically. Another respondent thought “roe stripping” in the early 1980s was a factor in the number of Steller sea lions and their aggressive behavior around fishing boats. The respondent estimated that 30 boats were involved in the roe stripping, adding that as many as 100 Steller sea lions followed the boats, attracted to the fish carcasses thrown overboard. As noted above, several respondents mentioned that the processors in the early 1980s were also discarding, or “chumming,” unwanted walleye pollock, throwing male fish overboard and thus attracting sea lions to the boats.

According to respondents, by the late 1980s the joint venture trawl fleet ceased shooting at sea lions. Respondents reported that the decline of Steller sea lion populations and a growing concern for how the fishery was perceived by the public and increasing scrutiny by federal managers contributed to the cessation of shooting.

Observations of Interviewees on Sea Lion Population Levels

All respondents agreed that there were far fewer Steller sea lions in the Bering Sea during the 1970s and 1980s than in Shelikof Strait. In the Bering Sea, both fishing boats and sea lions were dispersed, and consequently, sea lion interactions were not as common as in Shelikof Strait. Several respondents who fished in Southeast Alaska and Shelikof Strait in the 1970s commented on the few Steller sea lions they saw in Southeast Alaska compared to the large population in Shelikof Strait. One respondent added that he has observed very few sea lions in Shelikof Strait in 2000 to 2005 but that the sea lion populations appear to be growing in Southeast Alaska.

DISCUSSION

Directed Harvest for Subsistence

A long-term use of Steller sea lions by humans in Alaska is confirmed by faunal remains in prehistoric archaeological sites and historical data. Traditionally, sea lions were taken for food, clothing and materials for skin boats. Although the Aleut population declined significantly following the Russian invasion, the need for baidarkas in the commercial sea otter industry kept the numbers of boats and the need for sea lion skins high. Dyson (1986) estimated thousands of baidarkas were being built in the Russian-American colonies from 1800 to 1870. For nearly 100 years fleets of six to seven hundred skin boats were annually crossing the Gulf of Alaska in search of sea otters (Dyson 1986). Six large skins of young sea lions were needed for a single-hole baidarka, nine for a two-hole, and 12 skins for a three-hole baidarka (Dyson 1986). Due to wear, the sea lion skins had to be replaced several times a year. Maschner et al. (*unpublished*) estimated that the sea lion skins were replaced at least three times per year and probably more often due to commercial use of the boats.

From 1800 to 1870 the numbers of sea lions needed for the annual manufacture and maintenance of the commercial skin boat fleets were likely in the thousands. This intense harvest pattern of sea lions should be referenced as an important point of comparison for all subsequent assessment of the relationship between directed harvests and possible effects on the abundance of sea lion populations. By 1900 sea otter hunting was no longer a commercially viable enterprise and the Steller sea lion populations in the Gulf of Alaska and Bering Sea were depleted. Alaska Natives were relying on wooden skiffs instead of skin boats (Dyson 1986).

Steller sea lion populations remained low until perhaps the late 1930s with the populations increasing in the 1940s through the 1960s (Maschner et al. *unpublished*, Trites et al. 1999). A brief revival in baidarka construction occurred in the 1930s. Following World War II Alaska Natives were using skiffs and commercial fishing vessels for transportation. Although subsistence harvests continued though the 20th century, there was no longer a need to harvest Steller sea lions for their skins.

There are no harvest data available for subsistence takes of Steller sea lions until the 1980s, but anthropological research conducted in the 1980s indicates that subsistence harvests continued during the early to mid 20th century. Estimates of harvests in the 1980s and 1992 through 2005 reveal declining harvests. Steller sea lion takes reported by hunters from the Pribilof Islands fell from 297 animals in 1992 to 32 animals in 2005, a decline of 89%. Although sea lion takes in the Aleutian Islands area increased to 88 animals in 2005 from a low of 37 animals in 1998, the number of animals taken was less than the 135 sea lions taken in 1992 (Figure 3). For Kodiak Island communities, sea lion harvests have been declining since the 1980s (Wolfe et al. 2006). During the early 1980s, the annual harvest for the 25 communities in which kills were documented was between 300 to 400 sea lions. During the late 1980s, the subsistence harvest appears to have been considerably less (Haynes and Mishler 1991). Thus, subsistence harvests during the critical period 1975 through 1990 were not likely a significant factor in the decline of the western stock of Steller sea lions.

DIRECT MORTALITY FROM COMMERCIAL HARVESTS

Commercial harvest of Steller sea lions in Alaska began in 1959 with an experimental harvest of 619 adult male sea lions from five rookeries on islands in the Gulf of Alaska between Kodiak Island and Unimak Pass. From 1963 to 1972 over 45,000 Steller sea lion pups were commercially harvested in the eastern Aleutian Islands and Gulf of Alaska (ITG 1978). Pups were harvested for the European fur market, but the pelts were poor quality fur and the economics of the hunt were questionable. With the passage of the Marine Mammal Protection Act in 1972, commercial harvests of Steller sea lions ceased.

The harvesting of 45,000 pups reduced some local populations, and could have depressed recruitment in the short term, thus reducing the number of sea lions breeding in the Gulf of Alaska and Aleutian Islands through the 1960s and 70s (Trites and Larkin 1992). Commercial harvests ceased in 1972 and those effects on sea lion populations would have stabilized three to five years later (1975 to 1977). Thus, these harvests are not considered to account for population declines observed through the 1980s (Trites and Larkin 1992, Merrick et al. 1987). Harvests near Kodiak Island and the lower Alaska Peninsula do not explain the declines in the western and central Aleutian Island sea lion populations where no commercial harvests occurred (Merrick et al. 1987).

Direct Mortality from Shooting

There has been little documentation of direct mortality from shooting Steller sea lions. Available data regarding direct mortality were examined for this report. There are no complete tallies of Steller sea lions killed by agents of the Alaska Department of Fisheries predator control program, instituted in 1951. Unpublished accounts suggest that predator control impacts were limited and had no significant effect on sea lion populations (NRC 2006). A partial survey of salmon trap operators on Kodiak Island and the Alaska Peninsula in the early 1950s, estimated 816 Steller sea lions killed (NRC 2006). Alverson (1992) published speculative estimates, 34,000 sea lions killed, of direct mortality from shooting by commercial fishers for the period 1960 to 1990. Matkins and Fay (1980), reported field observations of 305 sea lions killed in one season of the Copper River Delta salmon drift gillnet fishery. For the Bering Sea and Gulf of Alaska joint venture walleye pollock trawl fishery 1978 to 1989, Trites and Larkin (1992) made a hypothetical estimate (based on 20 sea lions shot and killed per boat) of 4,041 sea lions killed. Because Steller sea lion takes were not recorded through a regulatory program, a bounty program, or other wildlife programs, and the documentary evidence is so limited, interviews with fishermen were found to be the best source of information.

Indiscriminate shooting was a common and widespread practice from at least the 1940s until the early 1990s. Patterns of shooting by fishermen during the 1970s to the early 1990s show no consistency. Shooting was random and opportunistic. Shooters generally did not target rookeries or haulouts, although this did sometimes occur. Pups were not targeted and it appears that shooters did not favor taking males over females, juveniles or adults.

RELATIVE EXTENT OF MORTALITY FROM INCIDENTAL TAKES IN COMMERCIAL FISHERIES

Sea lions are incidentally caught and killed in domestic commercial net fisheries and in hook and line fisheries. Sea lions have also been shot at by fishermen when approaching fishing gear. Incidental mortalities have not been well documented. The 1978 drift gillnet fishery in the Copper River delta is one of the few commercial fisheries where sea lion mortality was documented. An estimated 450 gillnetters shot about 300 sea lions in May and early June of 1978 (Matkins and Fay 1980). Sea lions were more likely to be entangled or shot in salmon drift and set gillnet fisheries than any other finfish fishery (Calkins 1989, Trites and Larkin 1992). Set gillnet fisheries are particularly susceptible to sea lion depredations and fishermen responded with a variety of techniques including shooting. Since 1990, as in all of the other commercial fisheries, sea lion mortalities in the gill net fisheries have declined. Declines in Steller sea lion populations and fishermen's fear of being prosecuted for shooting sea lions have resulted in fewer interactions. According to key respondents, in some locations where sea lions have returned to setnet sites, fishermen have abandoned their sites rather than risk prosecution for shooting the animals.

Trites and Larkin (1992), citing Calkins' (1989) risk factor analysis, concluded that Southeast Alaska salmon troll fisheries are estimated to have high interactions with sea lions. Interviews with fishermen involved in the Southeast Alaska salmon troll fishery support this assumption. With increasing populations of Steller sea lions in Southeast Alaska it is not known if salmon trollers are again shooting the animals. Research assessing patterns of responses to sea lion interactions in the commercial fisheries is needed to have a better understanding of what is occurring in Southeast Alaska. Although this region is outside the main area of this investigation, the changing attitudes of fishers regarding sea lions as a threat could help indicate whether fishers elsewhere may have similar perceptions and thus take similar actions regarding shooting.

Key respondents with experience in commercial seine net fisheries stated that interactions with sea lions in salmon and herring seine net fisheries are rare. When sea lions do get into seine nets they usually escape without damaging the gear and the quantity of fish taken are insignificant.

In the 1950s commercial halibut longline fishermen claimed that Steller sea lions were taking fish and damaging gear (Thorsteinson 1961). Fishermen interviewed for this research with experience in longline halibut and rockfish fisheries since the 1970s stated that sea lion interactions were rare, and that whales were a larger concern. One key respondent with many years of longline fishing experience in Southeast Alaska, the Gulf of Alaska, and the Bering Sea said that Sperm Whales *Physeter macrocephalus* were much more of a problem for halibut longline fishermen than sea lions. Since the 1980s sea lion populations have declined, but some whale populations have increased since the 1950s. This may explain the apparent conflict between these two sources of information from different time periods.

Steller sea lion interactions have occurred in the foreign and joint venture trawl fisheries since these fisheries began and estimates of incidental takes date from the 1960s. Based on average observed rates Perez and Loughlin (1991) found that incidental takes of Steller sea lions between 1973 and 1988 were higher in the Gulf of Alaska than in the Bering Sea, and greater numbers of Steller sea lions were caught by joint venture trawlers (66% of the total) than foreign trawlers during this same period. Joint venture fisheries experienced nearly 100% mortality of sea lions caught in trawls and the majority of sea lions taken were sexually mature females. The greatest incidental mortality levels observed during the 1973 to 1988 period occurred in the 1982 Shelikof Strait joint venture walleye pollock trawl fishery, an anomalous year for the fishery with an estimated 1,436 sea lions taken as bycatch (Loughlin and Nelson 1986). Perez and Loughlin (1991) estimated that joint venture fisheries throughout Alaska had an average incidental mortality in the catch of less than 500 sea lions per year.

Information about sea lion interactions with the domestic groundfish trawl fishery is limited but does suggest that few sea lions were caught in this fishery (Trites and Larkin 1992). Fishing for Pacific cod during the daylight hours when fewer sea lions are feeding may have led to few interactions in the early 1980s. A change in fishermen's attitudes toward killing sea lions, a change in methods and locations, or both, likely contributed to the lack of kills since the late 1980s (Trites and Larkin 1992).

Steller sea lion interactions occurred with the king crab fishery in the Bering Sea and Gulf of Alaska during the 1970s and early 1980s. Although some sea lions were shot for crab bait and harassment of gear, the extent of sea lion mortalities in commercial crab fisheries is unknown. Crab fishermen interviewed for this project had mixed opinions about the fisheries interactions with sea lions.

Shelikof Strait Joint Venture Fishery 1982

The highest recorded Steller sea lion bycatch and according to key respondent interviews, associated shooting by fishermen, occurred in the Shelikof Strait joint venture walleye pollock trawl fishery in 1982 (Loughlin and Nelson 1986). According to key respondent interviews this was the only location where incidental takes and direct mortality were concentrated temporally and spatially. If, as noted in bycatch data, sexually mature females were the majority of animals taken incidentally in the 1982 fishery, as well as the majority killed by shooting, this may have disproportionately affected this segment of the sea lion population (Loughlin and York 2000). Further research in this area may reveal whether incidental mortality and indiscriminate takes in the 1982 Shelikof Strait joint venture fishery should be considered a significant part of the cumulative impacts on populations Steller sea lions. The relative significance would need to be assessed, along with factors such as predation by killer whales, a reduction in quantity, quality, and availability of prey, and the suite of ecosystem changes that have been observed in the North Pacific Ocean.

CONCLUSIONS

By using a combination of data from literature and from semi-structured key respondent interviews of fishermen, a clearer picture is emerging to show the relative amount and duration of recent directed human-caused mortalities of Steller sea lions. Although quantitative data are limited for most sources of human-caused Steller sea lion mortality, robust quantitative data exist for subsistence and commercial harvests.

Each commercial fishery in which there are conflicts with sea lions has a distinct history of whether the sea lions adversely and seriously affected the integrity and thus the effectiveness of the fishing gear. In those fisheries for which sea lions damaged gear or impaired harvest of fish, the animals were more likely to be shot at to scare or kill them. However, interview responses showed that beginning in the early 1980s changes in fishing techniques and gear as well as laws prohibiting shooting sea lions in the early 1990s substantially changed these older attitudes and practices.

Directed human-caused mortality of sea lions have fluctuated significantly during the past two hundred years, with large harvests during the 19th century to provide skin boats for the sea otter trade. Subsequent declines in populations of both species, as well as changing human use patterns of sea lions led to much lower subsistence and commercial harvest levels after 1900. The long-term subsistence use of Steller sea lions continued into the 20th century, but appears to be declining overall, especially since the 1980s, accounting for fewer than 600 animals in any one year. Commercial harvests of Steller sea lions during 1959 to 1972 occurred prior to the critical period of 1975 to 1990 and only in a relatively confined geographic area. Steller sea lion specialists consider these commercial harvests to be less than a primary factor in the decline of the western DPS of Steller sea lions in Alaska (Trites and Larkin 1992, Merrick et al. 1987). Neither of these two sources of directed harvest appears to explain the decline in Steller sea lions during the critical period of 1975 to 1990.

Quantitative data about mortality of sea lions are of limited quality for most commercial fisheries, thus qualitative data are an important source of information about extent and scale of relevant practices. The interviews from this project consistently indicate sporadic and generally low numbers of sea lions have been taken during the conduct of most commercial fisheries. For all the commercial fisheries in which incidental harvest is known only one has data showing substantial levels of sea lion bycatch. The greatest incidental mortality levels documented occurred in the Shelikof Strait joint venture walleye pollock trawl fishery in 1982. From 1975 to 1990 indiscriminate takes by commercial fishermen show no consistent patterns except in the Shelikof Strait joint venture fishery during the early 1980s. Further research in this area may reveal whether incidental mortality and indiscriminate takes in the 1982 Shelikof Strait joint venture fishery should be considered a significant part of the cumulative impacts on Steller sea lion populations in the North Pacific Ocean.

Study objectives were addressed through a review of existing major literature with information about direct mortality by humans of Steller sea lions consistent with recommendations and suggestions in the NPRB Science Plan (2005), the NRC (2003) report, and the draft revised Steller Sea Lion Recovery Plan (NMFS 2006). Available direct mortality statistics presented in the literature were evaluated based on study findings. A more thorough evaluation of mortality statistics would be beneficial and is recommended for further research on this topic. Contextual and specific information from written documents on reported direct mortality could help to further evaluate hypotheses about the contribution to direct mortality on the western distinct population segment in key areas. The literature review part of this study included unpublished documents and agency records, although a more thorough and quantitative review is warranted.

The study hypothesis, that indiscriminate shooting is not a primary source of increased mortality of the western distinct population segment of Steller sea lions, was upheld by the research. To evaluate the relative significance of mortality from indiscriminate shooting, all other categories of human-caused, direct mortality were examined.

The portion of mortality from subsistence takes from 1992 to 2005 appears to have declined overall and accounts for less than 600 animals in any one year. Commercial harvesting of pups on rookeries ceased in 1972 prior to the critical period 1975 to 1990. Sea lion biologists consider that those commercial harvests were not a primary factor in the sea lion decline. From 1975 to 1990 indiscriminate shootings by commercial fishermen show no consistent patterns except in the Shelikof Strait joint venture fishery during the early 1980s. The greatest specific incidental mortality levels occurred in the 1982 Shelikof Strait joint venture walleye pollock trawl fishery, where an estimated 1,440 sea lions were killed. Our conclusions corroborate other studies that concluded direct mortality by humans was not a primary factor in Steller sea lion decline in the late 20th century.

It was anticipated that key respondents for this project would reside in Kodiak, and Dutch Harbor, Alaska and the Puget Sound area of Washington State. Due to limited staff time and travel difficulties, Dutch Harbor was not included but interviews in King Cove and Sand Point, Alaska, were completed. Due to the controversial nature of the material covered in the interviews, all but 10 of the 50 key respondents interviewed for this project declined to be audio recorded. As a consequence of having a limited number of interviews audio recorded and transcribed, the searchable text database planned for the project was not developed.

RECOMMENDATIONS

Recommendations for further research of direct mortality by humans on Steller sea lions in Alaska would include key respondent interviews with commercial fishermen who fished in Southeast Alaska from 1970 until 2000. This would provide a comparison with the results of the interviews conducted for this study, specifically comparing the indiscriminate shooting patterns of fishermen and the changes in Steller sea lion populations 1970 to 2000. None of the respondents interviewed for this study had been directly involved with the foreign trawl fisheries. We did not have the time to review observer data collected post 1978. In order to attain better information about Steller sea lion bycatch in these fisheries, research should be conducted on the NMFS fisheries observer records. Another recommendation is for a review of the literature of the Alaska sea otter trade, 1800 to 1870. The goal of the literature review would be to search for references to Steller sea lion harvests and uses in the sea otter industry.

PUBLICATIONS

A journal article is in preparation, to be coauthored with Kruse and Huntington, and titled "Fishermen's Knowledge of Historical Human Interactions with a Declining Population of Steller Sea Lions in Alaska." Proposed journals to consider for submittal include Ecological Applications and Environmental Management. The projected date of submission is September 28, 2007.

OUTREACH

Conference Presentations

Alaska Marine Science Symposium (poster), January 2007, by M. Turek

Presentation in Schools

University of Alaska Southeast, Cultural Anthropology and Methods and Theories in Archaeology, March 2007, Juneau, Alaska

Presentation at the North Pacific Fisheries Management Council

Steller Sea Lion Mitigation Committee Meeting presentation, April 2007, Juneau, Alaska

Press Articles

Anchorage Daily News, December 8, 2006

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APPENDIX. INTERVIEW PROTOCOL

Alaska Department of Fish & Game SSL Interview Guidelines/Schedule

Interviewer__________ **Location (of interview)**____________

Date _____________ **Key Respondent Number**___________

Audio Recorded YES NO **Locations on Chart YES NO**

<u>Key Respondent Information</u>

Fishing crew status – skipper or crew member__________________

Industry employee____________________________

Agency Employee____

Researcher____

Other____

Identify which fisheries respondent was involved in:

Species_______________________________

Gear type_______________________________

Period (Years)____________________________

Area(s) fished_________________________________

<u>Where and when did shootings take place?</u>

Locate on chart. (specify Sea Lion locations, rookeries, haulouts, near shore, at sea)

When? What year(s) and time of year by month.

<u>Shooting Practices</u>

How was shooting done? Did shooting practices vary among vessels, individuals, fleets/fisheries?

Describe shooting techniques, include weapons used, who did the shooting, skipper, crew?

Can fishermen estimate how many sea lions were shot? Can they estimate how many were killed? Any patterns in the age & sex of animals shot?

<u>Sea Lion Behavior</u>

Did sea lions pursue fishing gear or vessels? Did sea lions behave differently in different locations, seasons, or periods? Any other observations about sea lions in different locations, seasons, or periods? Any other observations about sea lions and fisheries?