North Pacific Fishery Management Council

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August 28, 2006

Kaja Brix
Assistant Regional Administrator – Protected Resources Division
Alaska Region – National Marine Fisheries Service
709 West 9th Street – Room 461
Juneau, AK 99802

ATTN: Ellen Walsh

Dear Ms. Brix:

The North Pacific Fishery Management Council appreciates the opportunity to review and provide comments on the draft revised Steller Sea Lion Recovery Plan (Plan) prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service. Thank you for extending the comment period to September 1, 2006. The Council and its Scientific and Statistical Committee (SSC) and Advisory Panel (AP) received a briefing on the Plan during the Council's June 2006 meeting in Kodiak. Given the importance of this Plan, the Council asked its SSC to make a thorough review of the document. The SSC met August 15-16, 2006 to conduct this review.

The Council convened on August 25, 2006 to review the SSC comments and to formulate recommendations to NMFS on the Plan. The SSC raises a number of concerns and recommendations for improving the Plan. The Council endorses these recommendations, and we ask that NMFS consider all of the SSC comments which are attached to this letter. Below we highlight some of our more pressing concerns:

1. The Recovery Team's Population Viability Analysis (PVA) provided in the Plan has raised concerns. The Council generally concurs with the use of a PVA as an analytic tool, but not necessarily the specific model used by the Recovery Team. **We recommend that the Recovery Team's PVA should be placed in an appendix and specifically referred to as an example, among other available PVA models, of how a PVA can be used to quantitatively evaluate risk to the SSL population.**

2. The SSC has identified a number of weaknesses and desirable improvements to the Plan's PVA model, and recommends that sources of uncertainty in the input parameters be explored. **The Council recommends that the Plan's PVA be rerun using the input parameters outlined in the SSC letter.** Using alternative assumptions and iteratively rerunning the PVA would test its sensitivity to these input parameters.

3. Given the number and the nature of SSC comments on this Plan, **we recommend that NMFS prepare a revision of the Plan and circulate this new draft for public review**. We recognize

that this may require additional time, and perhaps reconvening the Recovery Team, but this effort should produce an improved and more flexible framework for SSL recovery that is more consistent with the best available science.

4. The Plan should eliminate rigid recovery criteria, especially those that may be unattainable. We believe that the future management of SSLs in context with a changing environment evokes a need for a less rigid set of recovery actions; a process for measuring recovery should be dynamic and responsive to new scientific information. **The Council recommends that NMFS consider the following: (a) retain the 15 year time period for down-listing but expand the rationale for this criterion, (b) eliminate the measurement of vital rates as down-listing and delisting criteria, (c) remove the requirement that significant declines not be occurring in two adjacent sub regions, and (d) delete the 50 percent criterion for delisting.**

5. The Plan does not provide a clear rationale for the requirement for an adaptive management program as a needed recovery action for the western DPS. **While an adaptive management experiment could provide helpful insights into effects of fishing on the environment and sea lion response to these effects, we do not believe such an experiment is an appropriate high priority action before the western population is considered recovered, and we recommend this action be removed.**

The Council considers SSL management a high priority issue, and for many years has worked closely with the NMFS Alaska Region to implement fishery management measures to assure protection for this marine mammal while at the same time providing for sustainable fisheries in the Alaskan EEZ. The Council appreciates the work that NMFS and the Recovery Team have put in this draft revised SSL recovery plan, and we look forward to continued work with NMFS on SSL issues in the future.

Sincerely,

Stephanie Madsen
Chair

Cc: Dr. Jim Balsiger, Doug Mecum, Sue Salveson, Shane Capron, Chris Oliver, Bill Wilson

DRAFT REPORT
of the
SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
August 15-16, 2006

The Scientific and Statistical Committee met during August 15-16 at the Federal Building, Juneau, AK. The meeting was teleconferenced to sites in Seattle and Anchorage and by dial-in from other locations. Members present were:

Gordon Kruse, Chair *University of Alaska Fairbanks*	Pat Livingston, Vice Chair *NOAA Fisheries—AFSC*	Keith Criddle *University of Alaska Fairbanks*
Sue Hills *University of Alaska Fairbanks*	George Hunt *University of Washington*	Franz Mueter *Sigma Plus Consulting*
Steve Parker *Oregon Department of Fish and Wildlife*	Terry Quinn II *University of Alaska Fairbanks*	Doug Woodby *Alaska Department of Fish and Game*

Members absent:

Steven Hare *International Pacific Halibut Commission*	Mark Herrmann *University of Alaska Fairbanks*	Anne Hollowed *NOAA Fisheries—AFSC*
Seth Macinko *University of Rhode Island*	Ken Pitcher *Alaska Department of Fish and Game*	Farron Wallace *Washington Department of Fish and Wildlife*

Population Viability Analysis (PVA) Model

Prof. Dan Goodman gave an overview of the development of a model to conduct Population Viability Analysis (PVA) for the western and eastern DPS segments of Steller sea lions, under the auspices of the Steller Sea Lion Recovery Team (SSLRT). Public comments on the PVA were provided by Dave Fraser (Adak Enterprises Inc.), Kevin Duffy (MCA), and Donna Parker (Arctic Storm).

The PVA model is described in Appendix 3 in the current draft of the Steller Sea Lion Recovery Plan. This model is used in a decision theory framework to derive recovery criteria that satisfy ESA for the western DPS segment of Steller sea lion. **This approach, based on the best science available, helps to formulate a structured and technically defensible approach that offers a quantitative and biologically relevant basis for evaluating risk.** Although the ESA does not provide explicit standards for recovery criteria, it does require that recovery criteria be measurable and objective.) **The SSC recommends that the PVA be moved from the appendix and included in the main body of the recovery plan as a subchapter in the threats assessment section.**

A sub-panel of the SSLRT provided expert opinion for quantification of policy elements, specification on uncertain data elements needed for modeling, and specification of the probability of essential correctness of the core assumptions. The quantitative standard adopted in the PVA was that a quasi-extinction probability of more than 1% in 100 years would leave the western DPS in the endangered category; although another standard could have been specified, this standard has some support in the scientific literature. The reference point for quasi-extinction was assumed to be an effective population size of 1,000, which when adjusted to account for population demographics, corresponds to a total population size of 4,743 individuals.

Core assumptions adopted in this PVA are that:

- The western DPS is governed by the dynamics of a single integrated population.
- The net growth of the western DPS is not moderated by density dependence.
- The population growth rates is are independent and serially uncorrelated normal random variables that hold for discrete periods, and the duration of those periods is described by serially uncorrelated exponentially distributed random variables with a mean duration of 10 years.
- Underlying factors influencing population dynamics in the future will not differ from the underlying factors that have governed population dynamics for the past 50 years, except that the component of mortality attributed to human factors (extraneous influences) can be estimated and, to the extent that these factors have been mitigated, can be assumed to not influence future populations.
- Fishery restrictions adopted in 2000 have resulted in a 2.5% increase in annual growth relative to the 1989-2000 period because of reduced prey-competition with the fishery (Table 4).
- There is an 80% probability that the core assumptions of the PVA are correct as estimated by the PVA subgroup of the SSLRT. That is, the combined probability of all other alternatives (which assume there is no risk to the stock) is 20%.
- If the effective population size decreases below 1,000 individuals (corresponding to a total population size of 4,743 individuals) at any time, the population is considered to be extinct and has negligible probability of recovery.

While a PVA could have been structured around alternative assumptions, the assumptions adopted for this PVA are not unreasonable and the PVA modeling approach is not restricted to the particular assumptions used to characterize this PVA. **The SSC endorses the PVA modeling approach as a valuable tool that provides a transparent, quantitative approach that addresses some aspects of the ESA requirements for evaluating risk.** The PVA model is a major advance in linking sea lion dynamics to hypotheses about factors affecting the population. We note in particular that the PVA includes a parameter to represent extraneous mortality (such as that due to shootings in the 1980's) and a parameter to represent hypothetical competition between sea lions and fisheries. Although there are a lot of uncertainties about the model, it has already helped and can help in the future to structure our thinking about the problem, synthesize much of the available data in a coherent approach, identify data gaps, and suggest refutable hypotheses and priorities for research.

The SSC envisions that a formal assessment using this PVA will follow the approval of the recovery plan, and that further refinement and revision of the PVA will continue with regular reports to the Council. Shane Capron (NOAA Fisheries) confirmed that the intent is to review the Recovery Plan every 5 years, which would require PVA model development and results. In essence this would create a parallel assessment process for SSL recovery efforts that would accord with the assessment processes in place for groundfish, crab, and scallops.

The SSC identified a number of weaknesses and desirable improvements that need to be addressed in future iterations of the PVA model:

- The model is a simplification of the real population, lacking age structure, lag effects in recruitment and population parameters, and density dependent effects. Yet the SSLRT assigned the model an 80% probability of being the "correct" model, which seems too high given the uncertainty about the population ecology.
- There is obviously large uncertainty about the "correct" or "best" model to use. Other model structures (e.g. Winship and Trites, 2006, Marine Mammal Science 22:124-155) should be explored, for example models that incorporate age structure and models that incorporate metapopulation structure, both of which are likely to influence estimated likelihoods of extinction. Results of already existing models of Steller sea lion population dynamics should be

compared to the current PVA. (See for example, Gerber and Van Blaricom, 2001; Fay, 2004; Winship and Trites, 2006; Wolf and Mangel, in press).

- Other sources of uncertainty in the input parameters need to be examined through sensitivity analyses, including, but not limited to:
    - The assumed quasi-extinction level of 1,000 effective individuals. This was fixed in the model although the conservation biology literature includes ranges from 500 to as high as 10,000. The choice of this threshold can be expected to have a very large impact on the results.
    - The magnitude of the estimated fishery prey-interaction effect. The estimate (reduction of 2.5% in the absolute annual growth rate between 1989-2000 and 2000-2004) was not adequately justified and is likely to be highly uncertain. One case of interest would be to assume that there is no competitive effect at current prey biomass levels and fishery exploitation rates.
    - The magnitude of the estimated extraneous mortality that can be attributed to incidental takes, harvests, etc., is not known with certainty and should be examined through sensitivity analyses or modeled as stochastic processes.
    - The assumption that growth rates in successive periods are independent is likely to have an important influence in the results and should be closely examined. There appears to be positive autocorrelation in the growth rate between periods, which is not accounted for in the present model.
    - The effects of assuming a constant growth rate within a period.
    - The effect of weighting each observed growth rate equally, even though the rates were averaged over very different periods of time, ranging from 5-19 years. This has the effect of overstating the impact of the steep decline observed between 1985 and 1989. One alternative approach would be to combine two shorter periods. For example, 1977-1985 and 1985-1989 could be combined into a single period that would correspond to a known oceanographic regime. Other approaches include weighting period-specific growth rates by the number of years over which they were averaged, or representing growth rates as a moving average process.
    - The assumption that the population does not display density dependence was not adequately justified and models with density dependence should be explored. In particular, it would be of interest to determine the effect of increasing the growth rate at low population levels to 5-10% as has been observed in other pinniped populations.
    - The probability that the PVA model is correct.

The description of the PVA should be revised so that the rationale behind the assumptions and model specification are made more transparent. The rationale for aggregating survey data to the level of a single DPS-wide growth rate spanning a number of years is presented as a preferred choice while metapopulation structure, regional, or rookery-scale observations, or shorter-time scale observations were dismissed without discussion. Given the constraints imposed from utilizing only five growth rates to model a growth rate distribution, further discussion is warranted to enable the reader to understand the basis for the choice of binning. The data used to choose an effective population size threshold of 4,783 animals should be explicitly described, not just providing a reference to genetic effects. The rationale for choice of values for biological parameters and values for the fishery competition effect in Table 4 should also be made explicit. The term "regime" should be replaced with the term "period" as regime causes direct confusion with generally accepted oceanographic regimes that do not precisely correspond with the five periods represented in the PVA model.

The PVA provides a useful framework for future evaluation of population recovery and changes in extinction risk. In the future, as additional consistent, spatially discrete biennial counts are completed, the PVA model can be refined to better reflect information on distribution of growth rates to more accurately

describe the variance in that distribution for forecasting. This should allow the approach of other modelers to be incorporated and yielding a currently optimal model form and parameter choices and to ultimately create a spatially explicit metapopulation model of the western DPS.

SSL Recovery Plan

The SSC received a presentation on the draft revised Steller Sea Lion Recovery Plan at the June 2006 meeting in Kodiak. At this meeting, the SSC identified major issues and developed comments on the plan as advice to the Council.

The SSC appreciates the efforts of the SSL recovery team to provide a balanced and fair treatment of the difficult issues surrounding development of a recovery plan. Public comments were provided by Dave Fraser (Adak Enterprises Inc.), Kevin Duffy (Marine Conservation Alliance), Doug Eggers (ADF&G), and Donna Parker (Arctic Storm). **The SSC identified seven major issues within the recovery plan for which we offer the following comments and recommendations.**

Population Structure

The SSC recommends that the plan be revised to provide a more comprehensive examination of the structure of the SSL population. For present legal purposes, there are just two segments – the eastern DPS and the western DPS. However, from a scientific perspective, **there needs to be a more thorough evaluation of whether the population dynamics of this species are well described as two largely independent population segments or if it would be more realistic to describe the SSL as a metapopulation.** A metapopulation, by definition, consists of discrete population segments (perhaps rookeries or fixed or slowly shifting sets of rookeries) connected by dispersal, where the dispersal among segments is not so minimal as to be negligible, nor so great that local dynamics are swamped. Information is presented in the recovery plan on segment mixing and on nuclear DNA research suggesting that male dispersal and inter-segment mixing may be higher than would be concluded from the mtDNA research alone, supporting a metapopulation interpretation. If the issue of population structure cannot be resolved, at a minimum, the management implications of the several possibilities should be clearly spelled out.

Biological Criteria

The delisting criterion for the western DPS (3% average annual increase for 30 years) is poorly motivated; the logic of using the recent history of the eastern DPS as a model for criteria to apply to the western DPS is, at best, questionable. A logically consistent approach could be based on a quantitative assessment of the probability of extinction in a specified time period for down listing and delisting, as would be provided by a PVA, as discussed above. If the population risk of extinction as generated by the PVA is above the threshold for down listing or delisting, then biological criteria (vital rates) are irrelevant. It is only if the population does not meet the stated thresholds that other data are needed to help explain why and help to define the threat to the population. **The rationale for criterion 3, which requires that no two adjacent population units are simultaneously in decline, should be grounded in sound science, possibly from results of a spatially distributed or metapopulation–based PVA model.** A criterion of this sort should reflect the reality of the spatial correlation that is likely to occur between adjacent areas due to the spatial and temporal scales at which oceanographic processes are likely to operate. Also, the SSC suggests that the plan clarify that this criterion applies for the specified time period in criterion 1, and that this criterion is predicated on criterion 1 being achieved.

Research plan to test the three major hypotheses (climate, killer whales, prey availability)

The SSC recommends that there be greater consistency within the plan in the treatment of hypotheses. In particular, Appendix 2A cites a substantial body of evidence that is inconsistent with nutritional stress as a causative factor in the 1990s, whereas the plan (p. 89-92) purports that evidence that sea lions were nutritionally stressed in the 1990s has been inconclusive. The recovery plan should be revised to reflect the evidence presented in Appendix 2A or should include explicit arguments for why that evidence is rejected. **We recommend that Appendix 2 be incorporated into the body of the recovery plan and that the distinction between acute and chronic nutritional stress be clarified.** The recovery plan needs to be more consistent in its treatment of the sequential megafaunal collapse hypothesis, which is thoroughly discounted at one point and then resurrected (p. 110) as though it had not been discounted. The possibility that climate-related changes in the prey base have served as a significant forcing function in SSL population changes is dismissed too quickly (p. 86), particularly given evidence for such changes in seabird data. **Greater consistency and less repetition are encouraged.**

The SSC suggests that the recovery plan could be improved by inclusion of a table comparing the hypotheses with any additional data to date. (See for example the NRC 2003 report,) Appendix 2A cites a Table 1, which was not included. Table 111-2 (p. 93) may be related to the missing table.

The SSC remains supportive of the development and implementation of an adaptive management program, but recognizes the difficulties in constructing and implementing such a plan. The problem with the current recovery plan is that it requires that the implementation of an adaptive management plan is "necessary to prevent extinction" but provides no rationale for this requirement. The SSC does not agree **that an adaptive management program should be a required element of the recovery plan. Nevertheless, we continue to strongly support the design of experiments at small but meaningful spatial scales with the appropriate level of monitoring to document effects of fishing on target and incidental species and habitats as well as sea lion response to those effects. The focus of the experiments should be to determine the level of fishing in the vicinity of rookeries that has a detectable effect on vital rates and population status of SSL.**

Efficacy of Past Management Measures

There needs to be better quantitative assessment of the efficacy of management measures and population increases and benefits. The recovery plan is very vague in this regard but mainly points to management measures in the 1990s as being responsible for the population stabilization observed. The plan needs to be more specific about the exact measures and when they were put in place and the timing of observed population stabilization, along with an analysis, couched in terms of time-lags associated with SSL population dynamics, that examines the concordance of in population-level responses with implementation of those measures. A table with a chronology of management actions would be a helpful starting point.

Critical Habitat Designation

When NMFS adopted the 20-nm buffers in 1993 (federal rule 50 CFR Part 226), they stated:

> *"It is important to emphasize that in designating these extended aquatic zones, NMFS is not attempting to justify or prove that these areas, in fact, actually do need special management or special regulation, but rather that these areas may be in need of management."*

NMFS went on to say:

> *"If and when specific management measures are proposed, it is anticipated that the proposed rule will explain the scientific basis and justification for the measures."*

Regarding the need for scientific justification, NMFS pointed out that new research was planned on sea lion foraging behavior including satellite telemetry studies and that

"Modification of critical habitat designation or specific management measures may be considered based upon this research."

Given the extensive research that has ensued in the past 13 years, it would be expected that the basis for designating critical habitats would have a stronger scientific basis. Critical habitat designations should be reviewed and adjusted to better reflect research findings.

Threats Assessments

The ranking of impacts of threats appears to be subjective. For example, the medium rank for toxic substances seems high given the information on toxin levels reported in the recovery plan; however, as learned in discussion, the medium ranking is due to concerns for toxins in Russian waters. **It would be helpful to have the basis for this and other ranking to be better clarified in the plan.**

Although rankings for incidental take in fisheries are based on the available data, some of those data seem ripe for reconsideration. For example, the take estimate for the Prince William Sound gillnet fishery has been carried forward from an extrapolated estimate that is likely too high; whereas takes in unobserved fisheries may not be adequately accounted for.

Priorities for Plan Actions

The plan provides a long list of priority actions (p. 157-163) that must be taken. The requirement to take action on tasks under all three priority levels seems implausible given the extensive and varied list of actions. **If the language used to define the priorities is based on a NMFS standard and is required for this purpose, then this should be clearly described for the reader's benefit.**

Other Specific Comments

The following comments are offered for consideration when the final revision of the SSL Recovery Plan is prepared.

1. The SSL Recovery plan should include estimates of the costs (foregone net revenues) to industry of existing SSL conservation measures and the relative distribution of costs across industry sectors and regions, especially for IRFA small entities.

2. If a Russian/Asian population segment is included in criteria that affect ESA listing, the Department of Commerce should explore trade measures to ensure that the U.S. industry, which incurs elevated costs to accommodate SSL conservation measures, is not unduly disadvantaged in competition with domestic imports of Russian/Asian product that does not incur comparable costs of SSL conservation measures.

3. Trend Analyses (p. 11-21)

   The trend analyses have several inconsistent or questionable attributes:

   a. In the trend model, parameters are assumed to be fixed as presented in the plan, yet PVA analysis is predicated on the assumption that the parameters are stochastic. To be consistent, the trend analysis should use a random coefficients estimator rather than ordinary least squares.

   b. The trend models assume that the observations are drawn from a homoskedastic distribution, yet some of the observations are composites across multiple years and others (i.e., 2004) have been deflated by an assumed constant (3.64%). It is unreasonable to assume that the variance of observation errors associated with these data are constant. The trend analyses should use a GLS or MLE estimator designed to address heteroscedasticity.

c. The trend models as specified are monotonic and consequently do not allow for density dependence.

d. Some of the trend models omit observations (e.g., trend estimates for St. George Reef, CA omit the observation for 1994). Other trend models include observations that represent incomplete censuses (e.g., the 1990 observation for the Western Aleutian Islands do not include observations from the Gillon Point and Agattu Island). The rationale for these omissions and the inclusion of incomplete observations should be discussed in the text or in footnotes.

e. Because the trend models were estimated as log-transforms of simple exponential models, the default statistics reported in the regression analysis are for the log-transformed relationship. These statistics should be rescaled and expressed in terms of the untransformed data. For example, for St. George Reef, the reported value of R^2 is 0.703 with a p-value for the associated F-statistic equal to 0.009. When rescaled in terms of the untransformed data, the value of R^2 is 0.808 with a p-value for the associated F-statistic equal to 0.002.

f. Because the trend models share a common set of explanatory variables and because the allocation of counts to six regions is arbitrary, there would be strong advantages to using a seemingly unrelated regression (SUR) or other simultaneous equation model to estimate model parameters and to test the statistical significance of differences in the estimated parameters between regions.

g. Autoregression and moving average models or polynomial time-trend models can also be used to estimate or describe trends without imposing the assumption that the trend is constant across the observation period.

h. The use of linear splines to represent hypothetical changes in trends needs to be cautioned: the analysis should explicitly note that the splines were specified rather than fitted and that the same discontinuities were assumed for all regions. If the model is to be represented using linear splines, an MLE technique should be used to select the number of splines and the locus of the discontinuities simultaneous with estimation of the coefficients. In regards to the apparent upswing in growth rates, the SSC recommends an analysis be conducted to evaluate the significance of changes in trends circa 2000.

4. (p. 14, bottom). It was surprising that papers on historical declines such as Causey et al. 2005[1], and others cited in Hunt and Stabeno (2005), most notably Turner (1886) are not cited. Additionally, Nelson (1987) provides useful information on past changes in SSL numbers in the Aleutians:

   Nelson, E.W. 1887. Mammals. Page 267 in H.W. Henshaw, ed. Report upon natural history collections made in Alaska between the years 1877 and 1881. Report III, U.S. Government Printing Office, Washington, D.C.

   Some quotes from this publication include:

   - *Formerly they were abundant all along the Aleutian chain. They are now so scarce among these islands, and the ones that are found there frequent places so difficult to access, that the Aleuts secure very few of them each year. They are still rather common at a few points along the north shore of Unimak Island and the peninsula of Alaska, while small parties are found scattered all along the Aleutian chain, hauling up on certain rocky points and shelves facing the sea, most of which are well known localities to the Aleuts.*

[1] See Fisheries Oceanography 14 (Suppl. 1) 2005.

- *From the Aleutian Islands eastward and southward they occur all along the coast to California, where their range overlaps that of the southern species.*

- *The natives of the Seal Islands (Pribilof Islands) claim that nearly seventy years ago the sea lions alone occupied nearly all of the shore line of Saint George Island, and numbered several hundred thousand individuals. By direction of the Russians they were driven off repeatedly until they left the place, and the shore was then occupied by fur seals.*

- *Like the fur seal they have a dreaded enemy in the Killer Whale, which pursues and captures them at sea and about their rocky resorts. The native hunters when at sea frequently see them leaping high out of the water in useless endeavor to escape their pursuers. At such times they say it is dangerous for an umiak or other small boat to be in the vicinity, as the animal, in its terror, will sometimes leap into and wreck the boat. They are hunted with gun and spear in the Aleutian Islands, but, unlike most seals, if shot in the water in summer they will sink at once, owing to the small amount of fat on them at that season. In common with the fur seal, this species has the habit of swallowing stones. Mr. Elliott found stones weighing a pound or two in their stomachs, and preserved one stomach containing over 10 pounds of such stones.*

5. (p. 16). The description of population trends in Russian waters is presented in an odd way. First, there is the good news of recent increases, then discussions of earlier declines, with the reader left with the impression that these populations are not recovering. Table 1-4 suggests very strong recovery. What, if any, special protections are in place to aid this population segment?

6. (p. 17). Nearly all increases in pup numbers in SE Alaska have been in new rookeries. Is the size of rookeries in SE Alaska determined by prey availability or the availability of suitable terrestrial space?

7. (p. 17, bottom, to p. 18, top). It was surprising to see no mention about shooting of Steller sea lions at salmon net pens in British Columbia, particularly in the late 1990s. A timeline of management measure implementation in BC would be a useful addition to the plan.

8. (p. 31). Herring is listed as an important prey in many areas, but Bering Sea populations of this fish have not recovered from heavy fishing pressure in earlier decades. Likewise capelin populations are down in the Bering Sea /Aleutian Islands. How does the seasonal availability of these fish fit with periods when juvenile Steller sea lions are weaning?

9. (p. 35-36). Discussion of ecosystem interactions for the western DPS should reference recently published work on the marine ecosystem in the central and eastern Aleutians (e.g., 2005 Fisheries Oceanography, supplement).

10. (p. 61-62). As noted in the NAS (2003) report, elimination of the provision to use lethal deterrence in commercial fisheries in 1990 and the reduction in the rate of the sea lion population decline starting in 1990 are unlikely to be mere coincidence. The number of shootings is not well documented, but anecdotal reports suggest that it may have been substantial. Much shooting of sea lions was reported in conjunction with the pollock roe-stripping fishery in Shelikof in the mid to late 1980s.

11. (p. 62). The historical review of conservation measures regarding incidental takes is rather weak. For instance, the thousands of sea lions that were 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. The section does not mention that NMFS observers are confined to groundfish vessels and does not report the large number of small vessels lacking coverage, nor the lack of observers on salmon and herring vessels, for instance. 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.

12. (p. 75-76). The review of orca predation is thorough. However, regarding sharks, it is difficult to fully rule out the possibility of sleeper shark predation on sea lions as only one study examined the diets of sleeper sharks near rookeries. Hulbert et al. (2006) found sleeper sharks to be an ambush predator with significant depth and geographic overlap with sea lions; they concluded that predation potential exists. Documentation of harbor seal remains in sleeper shark stomachs by Sigler et al. (2006) demonstrates that sleeper sharks are capable of consuming mammals of the size of sea lion pups or juveniles. Finally, a congener, the Greenland shark, has been implicated to inflict significant mortality on harbor seals on Sable Island, Nova Scotia, so population-level effects of shark predation are possible. Given this information, it seems premature to fully discount sleeper shark predation on Steller sea lions.

13. (p. 76). 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 consume 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. Discards may also benefit SSL.

14. (p. 76). It is puzzling why, in the discussion of the impact of commercial harvests on pinnipeds, there is no discussion of what has happened with northern fur seals since the early 1900s.

15. (p. 76-77). In addition to subsistence hunting by natives, non-natives also hunted sea lions as a cheap source of protein on fox farms. Also, shooting sea lions was considered great sport in the time when such shooting was not only legal, but encouraged by state and territorial governments.

16. (p. 78-79). The total incidental take of sea lions by the joint-venture trawl fishery in Shelikof Strait in the 1980s is underestimated by observer counts of sea lions taken in trawl cod ends transferred to motherships. Anecdotal estimates indicate that a similar number of sea lions were shot as fishermen tried to protect their nets and catches when nets were dragged near the surface by boats that were in cue for delivery to the motherships.

17. (p. 80). When attempting to estimate rates of sea lion entanglement in fishing gear, it should be noted that a significant proportion of sea lions sink immediately after death, thus reducing the probability of recovering carcasses on beach surveys.

18. (p. 86). The description of groundfish harvest strategy for the North Pacific is oversimplified and misleading. A $F_{40\%}$ harvest strategy is not exactly a MSY harvest strategy; a $F_{35\%}$ harvest strategy results in harvests somewhat less than those that would result from a 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.

19. (p. 88-89). Much of the argument about diet overlap with other apex predators seems irrelevant. Seabirds take a trivial proportion of the prey biomass that might be of use to sea lions, and grey whales use small benthic invertebrates that they sieve from the mud. If forage fish are acknowledged to be of critical importance to sea lions, then increasing numbers of humpback and fin whales may be significant competitors. If this issue is to be invoked, why not examine the spatial relationship between the distributions of these two whale species and the diets/population trajectories of the sea

lions? Competition for forage fish from adult pollock and cod may be substantial and should be discussed.

20. (p. 95). The discussion of Grebmeier's paper seems irrelevant given the types of benthic invertebrates that she is discussing and the region where she is working.

21. (p. 97 on). There seemed to be much repetition in this section of material covered in Section III. The new presentations in Section IV, however, did not always follow the flavor of those in Section III, which was confusing. It would have been useful for this section to focus on the interpretations of the threats. At the end of section 1. Direct Threats, and 2. Indirect Threats on page 98, one would like to know what these findings meant.

22. (p.97-98). Classification of direct and indirect threats is not entirely clear. It is stated that *direct effects* are those that kill individuals and reduce survival rate and that *indirect* effects are those that reduce body condition. Most animal species can die of diseases and lethal doses of toxins, however, these two sources are place in the *indirect threats.* Conversely, disturbance is listed as *direct*. This is understandable, if a disturbed animal tramples a pup or is consumed by a killer whale, but one would expect most disturbed animals to simply increase their activity rate, perhaps lowering their body condition (unless they caught a nice juicy salmon while in the water). In sum, the black/white distinction of direct/indirect is not likely to be so sharp; some threats fit into both categories as currently defined.

23. (p. 97, bottom to p. 98, top). The plan says,

    If one or more direct threats were major impediments to recovery for the western DPS, continued low rates of juvenile and/or adult survivorship would be expected or observed, potentially with little or no change in fecundity, birth rates or condition. Current estimates of sea lion vital rates do not follow these expected trends.

    This seems to be a sweeping, unsubstantiated conclusion. There is an unsubstantiated statement on p. 90 saying,

    However, total birth rates at some rookeries and overall survival rates appeared to be lower in the 1990s.

    These are examples of internal inconsistencies. Also, one does not expect all threats to be 100% or 0%; that is, reduction, but not elimination, of illegal shooting could have increased survivorship modestly, but not to full potential that would be associated with an absence of shooting.

24. (p. 102 top). The invocation of the precautionary approach here seems strange. From a management prospective, the precautionary approach would be to dismiss the role of killer whales and focus on the potential role of fisheries, which is the only area in which we can take precautionary action.

25. (p. 102 middle). 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.

26. (p. 102). 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. Qualitatively, looking at Table I-13 on p.49, it almost looks like squid and octopus were significant portions of the diet before the decline in the 1940s to 1970s and again in the late 90s and 00s. Apparent increases in squid bycatch in the pollock fishery in Shelikof Strait in recent years and EBS this year makes one wonder whether squid abundance has increased or their distribution has shifted to favor feeding by sea lions. Perhaps the relative abundances of squid and octopus have changed over time; they do seem to be important to the diet of sea lions.

27. (p. 103 middle). The issue of a 60% reduction of biomass in multiple prey species is invoked, but it is not clear that this is the case in the Bering Sea Aleutian Islands. Circumstances in SE, the Gulf of Alaska, Aleutians and Bering Sea are all quite different. There is a need to be explicit about which area is being referred to, and how well information from one area can be extrapolated to another.

28. (p. 109, Summary and Scenarios). The statement is made that, *Steller sea lions had adapted to and accommodated fluctuations in the carrying capacity ... and apparently maintained, on average, a relatively large population size.* Again, published accounts from Nelson (1887) directly contradict this statement; apparently the western stock of sea lions had experienced a dramatic decline to low abundance by the 1880s before substantial fisheries developed. To reiterate, a relevant quote from Nelson (1887) is: *Formerly they were abundant all along the Aleutian chain. They are now so scarce among these islands, and the ones that are found there frequent places so difficult to access, that the Aleuts secure very few of them each year.* Of course, there could be a role of subsistence harvests in this decline, so former declines may not be fully attributable to natural causes.

29. (p. 109, Summary and Scenarios). These scenarios come across as rather speculative, although there is a substantial literature that evaluated roles of predation, fisheries, and multiple factors on the sea lion population; this literature should have been better cited when making statements and drawing conclusions.

30. (p. 114). The argument that the current measures should be maintained because "apparent population stability in the last 6 years is correlated with comprehensive fishery management measures implemented since the late 1990s" is spurious. Correlation cannot be equated with causation. This can be demonstrated by the observation that *"apparent population stability in the last 6 years"* is also positively correlated with the magnitude of SSL research expenditures, the average salary of SSL researchers, and the decline of tropical rainforest cover.

31. (p. 116). The statement is made that the eastern DPS has been recovering for nearly 30 years. Yet, no information was presented to suggest that the eastern DPS has ever been as abundant as it is now. Thus, the term "recovering" is unjustified.

32. (p. 117). The choice of statistically significant increase over 15 years appears arbitrary and subjective. There are no statements about what "statistically significant" means. With a enough data points, an increase of 0.01% is significant. Most real populations increase and decrease over different periods. So, the way in which the increase is calculated will determine the outcome of the significance test. Conditions (2) and (3) are vague and highly subjective. Similar reasoning was used to leave the eastern DPS as "threatened" in 1997 even though, in hindsight, the basis for listing is not strongly motivated.

33. (p. 118). The statement is made 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 appears to be the first place in the

document where it is indicated that the sea lion's habitat has been modified. Citations and supportive information are necessary prior to making such a statement.

34. (p. 119). Why would the risks of disease increase if the population declined further? If the animals are less crowded, transmission may decline, though clearly, as a population declines, each death has a greater proportional effect.

35. The recovery plan does not address any actions or planning for the possibility of future decreases in SSL abundance. Given the historical population trend, and the lack of understanding of what is driving the trend, an argument could be made that further poor performance is not unlikely in the future, and it will not be possible to assign impacts to anthropogenic versus natural causes. Explicit planning for this occurrence, and rationale for any management response should be present in the document.

36. Misc. errors:
    p. 113 misspelling of discrete
    p. 117 item 2: "determine that whether" – wording problem
    p. 132 misspelling of implementation.
    p. 132, item 5: "examines possibly effects" – some wording problem here
    p. 136: misspelling of Ecosim.
    p. 157: The threats legend for this table does not describe what "M" is.