

Review of the

DRAFT REVISED STELLER SEA LION RECOVERY PLAN

Eastern and Western Distinct Population Segments

(Eumetopias jubatus)

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for
Center for Independent Experts

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Executive summary:

The Plan provides a comprehensive assessment of what is known about potential threats to both the eastern and western populations of Steller sea lion (SSL). I know of no other significant threats to the species. The evidence presented in the Recovery Plan has been well used by the team to develop their threats assessment. To me, the most important point to emerge from the preliminary sections was the high degree of uncertainty associated our knowledge of many key aspects of this species biology. The consequences that this uncertainty has on the ability of scientists and managers to make informed decisions are quite profound. The obvious course of action for the Plan is to act to reduce this uncertainty through targeted and carefully prioritized research.

As a general point, the Plan needs to encourage the adoption of modern and emerging techniques wherever possible. The recent research into SSL biology has been at the forefront of the development of some new technologies and techniques, but there are also many developments occurring in other studies and even other disciplines that are relevant to this species. The Plan should highlight the development on new techniques to deal with previously intractable problems as a high priority. This could be statistical or technological and I have tried to highlight areas where I think this may be particularly advantageous.

The ecological and biological information presented in the Plan is comprehensive, adequate, and scientifically defensible. Where there are divergent views within the scientific community, this is identified and a balanced account of all views presented. There were some areas that would have benefited from additional detail, but these were not common.

The team has designed a recovery strategy for the eastern and western populations of Steller sea lion that is ecologically and biologically defensible. The recovery strategy highlights the design and implementation of an adaptive management program to evaluate fishery conservation measures and key action. The large number of sea lion rookeries spread over their range sets the scene for some nice experimental designs. These could be done sensitively to ensure no long-term detriment to the overall recovery of the species, and therefore consistent with the aims of the recovery plan. I argue strongly for this as it is perhaps the only way to remove some of the uncertainty around some of the major causal factors.

The recovery actions described within the Plan are appropriate to meet the recovery goals, and the recovery actions are consistent with the SSL life history information and population dynamics. I have identified a few additional recovery actions primarily associated with survey design and interpretation the team might consider.

The recovery tasks in the Plan's Implementation Schedule are generally appropriately prioritized, but I recommend that the development of an adaptive management approach be elevated to Priority 1. I also have made a number of other suggestions for changes in priorities, but these are relatively minor.

Introduction and background:

I preface this review by commending the Steller Sea Lion Recovery Team on their production of this Draft Steller Sea Lion Recovery Plan (hereafter referred to as the Plan). Any review of a document of this size and complexity will inevitably identify omissions, errors of fact and difference of opinion. Happily, in this plan these were relatively few, and I endorse the plan's overall scope and direction. The review that follows focuses on those points that I hope will be constructive and help the Team refine the Plan.

Of the three areas of expertise requested for reviewers of this draft, I regard my self to best fit with "In depth expertise in the biology and management of marine and/or other large mammals; specifically population dynamics, reproductive and foraging biology and physiological ecology". I have also had some experience with the development of recovery plans, having been on the Recovery Team for the Southern Elephant seal and Sub-Antarctic Fur Seal Recovery Plan for The Australian Federal Government (Department of Environment and Heritage). I have relatively little experience with the US Endangered Species Act (ESA), and will confine my comments largely to the biological and scientific aspects of the Plan.

I have structured my report to address each of the six questions (Terms of Reference) identified by National Marine Fisheries Service (NMFS), specifically:

- Does the Plan thoroughly describe what is known about potential threats to both the eastern and western populations of Steller sea lion? Are there additional significant threats to the species? Does the evidence presented in the Recovery Plan support the threats assessment?
- Is the ecological and biological information presented in the Plan adequate, thorough, and scientifically defensible?
- Does the Plan adequately present an ecologically and biologically defensible recovery strategy for the eastern and western populations of Steller sea lion? Describe any shortcomings in the recovery strategy.
- Are the recovery actions described within the Plan appropriate to meet recovery goals? Are the recovery actions consistent with the SSL life history information, population dynamics and threats assessment presented in the Plan? Are there other recovery actions that have not been included in the Plan that should be included to achieve recovery?
- Are the recovery tasks in the Plan's Implementation Schedule appropriately prioritized to facilitate recovery?
- Does the information in the Plan appropriately support the recovery criteria described in the Plan? Are the recovery criteria consistent with and do they meet the requirement of the ESA to ensure the conservation of the species (i.e., recovery and ultimate delisting: "conservation" as defined in the ESA 16 USC § 1532 (3))?

Question 1: Does the Plan thoroughly describe what is known about potential threats to both the eastern and western populations of Steller sea lion? Are there additional significant threats to the species? Does the evidence presented in the Recovery Plan support the threats assessment?

By and large, the Plan provided an excellent and comprehensive review of the current state of knowledge of Steller Seal Lion (SSL) biology population status, the factors influencing the historical population changes and potential future threats. There has been an enormous amount of research into these questions in the last 10 years, and the team has done well to bring it all together as lucidly as they have.

I found the summary tables and maps in the background section generally helpful, in particular the summaries of data gaps for each of the Potential Biological Effects. There were some minor mis-matches between the text and the tables, such as the Walrus Island counts, but these were relatively minor.

The Plan was generally presented in a logical and structured manner. There were a few instances where this was not the case, however. For example the description of the nutritional stress hypotheses at Point 11 in the “Factors Affecting Steller Sea Lions” section seemed a little odd (structure wise). To me this would more naturally sit in the food web section. Likewise, the killer whale material (trophic cascades) could also have logically been included there.

Some aspects received more emphasis than I thought was warranted (such as the debate on the role of killer whales), but I must also acknowledge that the data required to test many of the hypotheses are still lacking (despite the recent research activity) and that a large amount of controversy and divergent opinion exists regarding the underlying factors effecting the populations and the relative importance of those factors.

I would have liked to see some additional methodological background to the long-term census data. Why are non-pups the preferred object of these long-term counts? To most biologists this would seem a little odd, as counts of pups are generally more accurate. Is the long lactation period a problem in this regard? When they have been done concurrently, do the counts of pups and non-pups show the same trends, and does one have lower errors associated with the population trends? It is likely that there are good methodological reasons for the focus on non-pups but these were not clear from the information provided.

Throughout the document (e.g. p. 23), estimates of stocks and population sizes are presented without their associated errors. I was unsure if this was because none had been calculated, or whether they were left out for the sake of brevity. I always find the inclusion of error estimates to be immensely helpful however.

On a similar point I note that the trend analyses described in the background (p. 21) were conducted using linear regression of natural logs of the counts. There have been some recent improvements in the analysis of population trends using General Additive Models (GAMS) (De Little, Bradshaw et al. 2007; Van den Hoff, Burton et al. 2007) which should be explored.

On page 27 there is a P value of 0.302 provided, but I am not sure to what it refers.

On page 31 the importance of density dependant responses in the demographic parameters is identified as an important issue, with which I agree. Currently, few of the SSL models incorporate density dependence, even though they are likely to exist and they are very likely to influence estimates of extinction times from these models. I would rate this as a high research priority, but also note that these data can be difficult and time consuming to collect. However, this is an area that would benefit from some focus small scale experiments associated with the Adaptive Management Plan – see my comments in Question 5.

The management actions taken during the 1990s to reduce anthropogenic effects (*e.g.* shooting harassment and incidental take) may have had a significant effect on the rate of decline in the Western DPS. To me this suggests that these factors should be rated much more highly as potential causal agents. However, from the detail provided in the Plan it was difficult to determine what these measures actually were or how they implemented. This in turn made it difficult for me to assess how significant a role this played in reducing SSL mortalities.

On a similar point on page 81 when existing fisheries conservation measures are described, I would like to see some additional detail, specifically data on by catch (incidental take) in the two DPS relative to the PBR.

On page 75, the need for an assessment of the adequacy and effectiveness of the current fisheries regulations is highlighted. This is undoubtedly true, but as a reviewer I found the lack of information on what these regulations currently are to be quite problematic, particularly when assessing the future research and action priorities.

Conclusion:

The Plan provides a comprehensive assessment of what is known about potential threats to both the eastern and western populations of Steller sea lion. I know of no other significant threats to the species. The evidence presented in the Recovery Plan has been well used by the team to develop their threats assessment. To me, the most important point to emerge from the preliminary sections was the high degree of uncertainty associated with our knowledge of many key aspects of this species biology. The consequences that this uncertainty has on the ability of scientists and managers to make informed decisions are quite profound. The obvious course of action for the Plan is to act to reduce this uncertainty through targeted and carefully prioritized research. I will return to this point when addressing Questions 4 and 5.

As a general point, the Plan needs to encourage the adoption of modern and emerging techniques wherever possible. The recent research into SSL biology has been at the forefront of the development of some new technologies and techniques, but there are also many developments occurring in other studies and even other disciplines. The Plan should highlight the development on new techniques to deal with previously intractable problems as a high priority. This could be statistical or technical, and I have tried to highlight areas where I think this may be particularly advantageous below.

Question 2: Is the ecological and biological information presented in the Plan adequate, thorough, and scientifically defensible?

The team has collated a great deal of data on a wide variety of aspects of the ecology and biology of SSL. In many instances there is no consensus about how these data are to be interpreted in terms of their significance to the population trends, and these areas of dispute are given a balanced and fair assessment, no doubt due in part to the diverse range of views held by members of the team. My one criticism of this aspect of the Plan is that it was very much centered on SSL and the North Pacific, which is quite understandable. However, I always find it helpful to look more widely, and in this instance a brief review of other declines was needed. In particular, the changes in populations of a number of Antarctic predators after a possible regime shift in the Southern Ocean seem quite pertinent.

On page 79, the Plan notes that unlike the direct take of a species, indirect take through competitive interactions is nearly impossible to either prove or disprove. This is a point well taken, and this is an area that should be highlighted in future research priorities. If these linkages cannot be elucidated in the Northern Pacific after all of the intense research conducted there at all levels of the ecosystem, there is little hope of doing it anywhere else! The Adaptive Management Approach will help to elucidate these factors, and under question 5, I outline my reasoning for making this a high research priority. If the magnitude of these indirect ecological interactions can be determined using this approach it will be a huge benefit for the management of the species.

In discussion of the top-down threats on page 81, it is noted that if these were an important factor impeding the recovery of the western DPS, low rates of juvenile and adult survival would be observed, with no changes in natality or condition. As this is not the case, the implication is that top-down factors are not likely to be important. Further, on P89, there is an analysis of the data gaps for assessing the role of top-down (specifically killer whale predation on the SSL populations. However, it seems to me that the demographic data go a long way to ruling out killer whales as a key factor. Although these gaps exist I wouldn't give them high priority in the research plan.

The analysis of toxic substances (p. 96) acknowledges that the primary knowledge gap is the understanding of what levels of contaminants affect seal lion health. I would argue that this is also true for any other marine mammal. This is a good example of potentially synergistic or value added research that will be of much potentially much wider relevance. I see the broader application of work focused on SSL as something that the Plan needs to foster, so that benefits of research can go beyond SSL and contribute to our broader understanding of a range of issues in the northern Pacific marine ecosystem.

On page 110, the Plan notes that the patterns and time series of fish abundance, fish recruitment, and sea lion food habits did not support the hypothesis that the 1976-77 regime shift triggered changes in the prey community that would have been deleterious to Steller sea lions. This is a fairly important conclusion, which is effectively saying that the regime shift was not solely

responsible for the decline. To me, it seems odd that it is buried away and not given greater credence. I will return to this point below.

I was surprised to read that “many of the areas fished by the Atka mackerel fishery in the Aleutian Islands and all of the Pacific cod fishery data analyzed by Fritz and Brown (2005) were collected within designated sea lion critical habitat” (p. 112). Why can they fish in critical habitat? Again the lack of detail, about the fisheries regulation and implementation, is hampering my understanding of some of these issues.

On page 114, the Plan discusses the importance of inter-specific competition as a potential threat under the nutritional stress section. This needs to be considered in the same way as fisheries, *i.e.* at appropriate spatial and temporal scales.

Conclusion:

The ecological and biological information presented in the Plan is comprehensive, adequate, and scientifically defensible. Where there are divergent views within the scientific community, these are identified and a balanced account of all views presented. There were some areas that would have benefited from additional detail, but these were not common.

Question 3: Does the Plan adequately present an ecologically and biologically defensible recovery strategy for the eastern and western populations of Steller sea lion? Describe any shortcomings in the recovery strategy.

A key aspect of the Plan was the assessment of the relative impact of each threat or factor outlined in the preceding sections (*i.e.* up to page 118). I found that the approach was logical and took all of the available information into account. The inherent difficulties in this process are illustrated by the fact that the team could not reach agreement about the relative impact of two of the most prominent threats, environmental variability and competition with fisheries. The Plan therefore adopted a precautionary approach, and made the recommendation of conducting research which would reduce uncertainties and help resolve these problems in the future. This really highlighted how much needs to be learned about this species and the ecosystem that they inhabit if a Recovery Plan is to be successful.

It is important to note that a similar regime shift has also been proposed for the Southern Ocean at about the same time (1970s) (Weimerskirch, Inchausti et al. 2003), and it might have been helpful if the Team had been familiar with this hypothesis, as I think this highlights the global nature of some of the issues being considered. Considerable evidence suggests that similar regime shifts may be expected in the future. On-going monitoring of key demographic parameters that span future changes will be invaluable in assessing the importance of, and nature of, environmental variation on this and other species. Also I felt that this section needed to include anthropogenic climate change. This is a very real problem for high latitude ecosystems within the time frame of the recovery plan. At least it needs to be acknowledged and suitable monitoring needs to be put in place.

The recovery strategy highlights the design and implementation of an adaptive management program to evaluate fishery conservation measures and key action. The large number of sea lion rookeries spread over their range sets the scene for some nice experimental designs. These could be done sensitively to ensure no long-term detriment to the overall recovery of the species, and therefore consistent with the aims of the recovery plan. I'd argue strongly for this as it is perhaps the only way to remove some of the uncertainty around some of the major causal factors.

The Plan correctly identifies that much of the telemetry data collected to date is from juvenile sea lions less than two years of age, some of which will not be completely weaned. As these data play a key role in defining exclusion areas around breeding sites this is an area that needs urgent attention.

Conclusion:

The team has designed a recovery strategy for the eastern and western populations of Steller sea lion that is ecologically and biologically defensible. The recovery strategy highlights the design and implementation of an adaptive management program to evaluate fishery conservation measures and key action. The large number of sea lion rookeries spread over their range sets the scene for some nice experimental designs. These could be done sensitively to ensure no long-term detriment to the overall recovery of the species, and therefore consistent with the aims of

the recovery plan. I'd argue strongly for this as it is perhaps the only way to remove some of the uncertainty around some of the major causal factors.

Question 4: Are the recovery actions described within the Plan appropriate to meet recovery goals? Are the recovery actions consistent with the SSL life history information, population dynamics and threats assessment presented in the Plan? Are there other recovery actions that have not been included in the Plan that should be included to achieve recovery?

The Team made a considered definition of the term “recovery” and the criteria required to re-assess the level and possible de-listing or down-grading of the threat level. I did notice however that the criteria that were eventually settled on were relatively conservative when compared to generic criteria used by the IUCN (10% probability of extinction over 100 years for “Threatened” status and 20% probability of extinction in 10 generations for “Endangered” status). However, I am also conscious of the need to develop species (or population) specific criteria and was satisfied with the justifications provided.

When describing the demographic criteria for altering the list of SSL the Plan states “the trends in non-pups in at least 5 of the 7 sub-regions are consistent with the trend observed under criterion #1. The population trend in any two adjacent sub-regions can not be declining significantly” (p. 139). This seems reasonable enough, but I wonder if the requirement for no two adjacent sub-regions to be declining is too restrictive?

I add a final, slightly philosophical point regarding the criteria. A key part of this process is “eliminating or controlling the threats” (p. 139). However, I don't see how you can eliminate or control regime shifts or other natural process (or even if one should), but these are listed a threatening process. This raises the question of including natural processes as threatening agents. Is it even sensible? It implies that in the absence of humans a species might become extinct. Intervention would therefore be “unnatural”. My take on this is that the natural factors should be regarded as a baseline condition, and that the plan should act to minimize any anthropogenic factor acting in addition to it. Similar questions could be asked about killer whales - also a natural problem, although potentially exacerbated by human activity

The use of PVAs by a number of researchers, including the one specifically commissioned by NMFS has been a very important feature of the previous research effort. PVAs are an invaluable management tool that not only enable estimates of extinction probability under various scenarios, but also help identify weaknesses in the existing demographic data sets. To my mind the PVAs performed to date have been much more informative in the latter of these two functions. I think that NMFS needs to be careful to not discount the future use of PVAs to help guide their management decision, just because these early attempts were inconclusive. Population viability analysis is often an iterative process: developing models, identifying weaknesses or gaps in the knowledge, subsequent collection of data to rectify these shortcomings and then further development of the models. The PVAs done to date can provide very clear direction in terms of what improvements need to be made in the input demographic data, such as data concerning sub-populations.

A number of limitations to the PVA were identified, and all were reasonable. However, I'd be reluctant to see these used as a reason for abandoning the PVA approach. These limitations are

not terminal. For example although the importance of data on pup harvests and illegal shooting is unknown, performing suitable sensitivity analyses can help assess these issues.

Regarding the PVA in the appendix, I was unclear if the model was run on the historical data (*i.e.* hind-casting) to validate the model. If there are sufficient data this can be very valuable exercise. Also, given the known decal scale of changes in the north Pacific it seems a pity that it wasn't a major feature of the PVA

Why are non-pups to be the primary census target? Commonly in other species, it is pups that are counted as they represent the production that year. I understand that historically non-pup counts have been used and that these therefore represent the longest time series. However, given the mobility and foraging habits of this group of animals there will be considerable error associated with any counts. Imprecision in the counts will reduce the power of any time series analysis to detect trends in the data. Given the importance of confidently detecting trends when making assessments regarding changes to the listings of this species, I recommend adopting a survey methodology that maximizes precision and statistical power. This would require starting pup counts, conducting surveys every year, and researching new emerging statistical approaches for the analysis of temporal trend data (such as Bayesian statistics). Given the importance of the existing time series data, I would also advocate maintaining the biennial non-pup counts, to maintain the integrity of this data set.

Specific action items:

1.1.1 Estimate trends for pups and non-pups via aerial surveys. I would like to see this considerably enhanced, as it really does underpin everything else. Some additional objectives such as 'evaluate survey methodology' would ensure the survey work was the best possible, and more importantly will deliver data that can better inform the management process. Development or adoption of alternative methods that allow annual monitoring would also be very important.

1.3.1. Examine the effects of season, age, and sex on body condition. I'm not clear on what "sampling" means here, or what is being measured to assess condition.

2.1. Maintain, and modify as needed, critical habitat designations. I worry that simply identifying core usage areas and setting these as exclusion zones is too naive. It assumes that prey are relatively static. However, it is possible that fisherman targeting areas outside the exclusion zones can still reduce fish inside them. This all depends on movement and dynamics of the prey. Shouldn't this also be identified as a research question?

Also, it is not clear how this has been used in the past in terms of legislation, or how it is implemented. Nor are there any clear indications of future implementation of regulations associated with these habitats. Will there be complete exclusion of fisheries?

2.3.2 Develop stable isotope and fatty acid methodologies to assess prey consumption. Include DNA techniques. These have been used in a number of laboratory based studies

(including some on SSL) where they have been shown to work (Jarman et al. 2004; Deagle et al. 2005; Casper et al. 2006). These new techniques need to be incorporated into the plan.

2.3.3. Deploy instruments to obtain fine scale data on sea lion foraging habitat. This should be more specific regarding the scale. Presumably this refers to sub kilometer resolution, so should there be specific mention of GPS technology?

2.3.4. Evaluate all information on sea lion foraging areas and develop a description of foraging needs. This is no trivial matter and will require dedicated staff appointments of people with specific database and statistical skills. Is this identified in the budget?

2.4.1. Assess the relationships between oceanographic profiles or features and sea lion foraging ecology. The aim here is to assess the relationships between oceanographic profiles or features and sea lion foraging ecology. To me, this research aspect needs to be broader as it is unrealistic to expect strong relationships between physical oceanography and higher predators, particularly at fine scales. Perhaps there should be more emphasis on more proximal factors such as prey and primary production. In order to address this question it would be sensible to use tags to collect oceanographic data on the seals (Lydersen et al. 2002; Lydersen et al. 2004). This will provide oceanographic data at the location and at scale of the seals feeding. These tags will also give data on the structure of water column, information that is unavailable from satellite images.

2.4.3. Distinguish how natural and anthropogenic factors influence marine ecosystem dynamics and subsequently sea lion population dynamics. There should be some mention of the adaptive management plan here. This will provide an invaluable opportunity to quantify some of these possibilities.

2.6.6 Evaluate and implement appropriate fishery regulations to protect foraging habitat and prey resources for sea lions. The Plan mentions “additional conservation measures were implemented to avoid jeopardy and adverse modification” (p. 75). It would be nice to know what these were, and how they would be implemented into the future.

3.2.2 Reduce threat of illegal shooting by developing and promoting use of non-lethal deterrents for commercial fisherman. This is the subject of a great deal of on-going research around the world. The Plan needs to identify the need (and ways of facilitating) of interactions with other nations to increase the rate of progress made in these issues.

4.1 Protect Steller sea lions from disease. Monitoring is not the same as protecting. I am not sure how one would actually protect wild animals from disease.

Conclusion:

The recovery actions described within the Plan are appropriate to meet the recovery goals, and the recovery actions are consistent with the SSL life history information and population dynamics. I have identified a few additional recovery actions primarily associated with survey design and interpretation the team might consider.

Question 5: Are the recovery tasks in the Plan's Implementation Schedule appropriately prioritized to facilitate recovery?

Again I found the use of the summary tables very helpful when assessing this question. Table IV-1 (the threats, their relative importance to recovery and the feasibility to mitigation), was particularly informative about the team's decision making process. I thought that the analyses reflected in this section were very good. Identifying the cause of the decline will obviously play a large role in determining where recovery efforts need to be made. For example, if natural changes in prey distribution and abundance due to regime shifts are important, it will require a very different approach to a fisheries-based decline. At present the considerable uncertainties, highlighted by the PVA, mean that resolving these two factors remains impossible. Therefore, action which will reduce uncertainty will ultimately be money well spent.

There is a lot of discussion regarding the importance of ecological factors in the background material, but its real importance in the decline is unclear, as is demonstrated in the Teams inability to rank it as a threatening process. For what it is worth, I would say there is a lot of evidence, such as different rates of change in the eastern and western DSPs during the widespread oceanographic changes in the 1970s, which calls the whole regime shift idea into question. The seals have evolved their foraging and life history traits in an environment that apparently contains decadal-scale changes in climate and prey base. Further, the observed changes in population trajectories in the western stock since fisheries control measures have been implemented illustrate that these interactions were an important contributing factor. Admittedly, there may be fundamental differences in environmental factors between the western and eastern stocks, but to me this seems less likely than fisheries being the under-pinning causal factor in the decline. I believe that focusing on fisheries related factors will be the best value for money.

On page 31, the importance of density dependant responses in the demographic parameters is identified as a significant issue. I agree with this finding. Currently few of the SSL model incorporate density dependence, even though they are likely to exist and are very likely to influence estimates of extinction times from these models. I would rate this as a high research priority, but also note that these data can be difficult and time consuming to collect. However, this is another area that would benefit from some focus small scale experiments associated with an adaptive management plan

Specific Action Items:

1.3.2 Develop improved indices of health, body condition, and reproductive status using chemical methods (e.g., hematology serum chemistries, and endocrine monitoring). I rate this as a low priority unless animals are being caught anyway. This is because the large number of captures required to do this properly may be quite prohibitive in terms of disturbance and resources. Awareness of the importance of emergent wildlife disease is increasing, but for now there is little evidence that this represents a problem for this species.

1.4.1. Develop improved live capture techniques for general research needs. This should be given a very high priority as it will enable access to key components of the population, thereby reducing one of the key sources of uncertainty.

1.4.2 Develop improved non-lethal sampling techniques to assess health. Chemical immobilization is something that is quite fundamental to many of the field procedures identified in the Plan. These techniques need to be made as safe as possible, so perhaps development of safe chemical sedation techniques could be identified as a priority.

2.3.2. Develop stable isotope and fatty acid methodologies to assess prey consumption. I agree with the incorporation of fatty acid signature analysis (FASA) techniques, but there are still many unresolved issues with FASA. I would like to see an effort to improve this situation as a part of this study. This is another effort that will have synergistic spin-offs for studies around the world.

2.4.2. Examine the influence of ecosystem variability on non-commercial prey species as an index to sea lion carrying capacity. I would have rated this as a high priority as it is the important link between oceanography and seals feeding. Again this is about reducing uncertainty in existing data and is a key part of the information required to develop better PVAs.

2.5.1. Determine the physiological diving capabilities and evaluate how this limits the ability to forage successfully. This action seems a little odd at one level. Steller sea lion diving ability has evolved over many generations and presumably is well suited to their foraging needs, even when these changes are due to regime shifts. I would imagine that diving capability would only be a problem if anthropogenic issues radically alter prey distribution and behavior. I would give this a low priority.

2.6.4 Assess effectiveness of sea lion closure zones around rookeries and haul-outs using small-scale experiments. See my comments below on the importance of an adaptive management approach. This work should part of that framework and given a high priority.

2.6.8 Design and implement an adaptive management program for fisheries, climate. To my mind this is the highest priority after the baseline monitoring. Without an experimental approach to understand these key issues we will not be much better off in five years time than we are now. At present only one of all the plan tasks has been given a Priority 1. Given the wide-ranging benefits that an adaptive management program would have in terms of our understanding of the key threatening processes, I would like to see this also elevated to a Priority 1. I also admit that such a plan would be very difficult, technically, logistically and politically, but really do see this as a powerful way forward.

3.5.1 Coordinate research efforts to reduce potential for unnecessary or duplicative research-related takes. The plan should have some specific studies to assess effects of handling, branding, carrying TDRs etc. Where these studies have been done elsewhere (see SES work) there are generally few or no adverse effects (Engelhard et al. 2001; Engelhard et al. 2002; Field et al. 2002; McMahan et al. 2005). But being able to say this with a sound scientific

grounding is invaluable. I do not think the importance of this work in today's climate of external scrutiny can be emphasized enough. I think this should also be given elevated priority.

4.2 Protect sea lions from contaminants. At present all four actions under this heading are given a 2a rating – second only to on-going monitoring. While undoubtedly important, my view is that the ultimate sources of contaminants are from factors well outside the direct influence of this Plan, and therefore the Plan has a very low expectation of bringing about a change. I would downgrade them to 2b.

5.7.2 Support Alaska Native subsistence use information programs. These could also be down-graded. Even though the successful outcomes of these actions have a very high probability of success, at present none of these activities really affects the SSL populations.

5.8 Improve the effectiveness of research for Steller sea lion recovery by instituting a “fast track” process for expediting NMFS research permits for Steller sea lions. This is a really nice idea if adequate oversight and transparency of process can be assured. Again, given the high degree of public scrutiny of this and other wildlife programs, we need to ensure that there is no room for criticism.

Conclusions:

The recovery tasks in the Plan's Implementation Schedule are generally appropriately prioritized, but I recommend that the development of an adaptive management approach be elevated to Priority 1. I also have made a number of other suggestions for changes in priorities, but these are relatively minor.

Question 6: Does the information in the Plan appropriately support the recovery criteria described in the Plan? Are the recovery criteria consistent with and do they meet the requirement of the ESA to ensure the conservation of the species (i.e., recovery and ultimate delisting: “conservation” as defined in the ESA 16 USC § 1532 (3))?

The decision of whether or not to keep the eastern DPS on the threatened species list depends entirely on when one begins to monitor the population. If the data from the 1970s are used the population has recovered sufficiently to be de-listed (according to the criteria listed), i.e. increased at 3% per year for 30 years. It is nice however, to see de-listing of the eastern DPS discussed as a real possibility.

Bibliography:

- Casper, R. M., N. J. Gales, et al. (2006). "Diet estimation based on an integrated mixed prey feeding experiment using *Arctocephalus* seals." Journal of Experimental Marine Biology and Ecology **328**(2): 228-239.
- De Little, S. C., C. J. A. Bradshaw, et al. (2007). "Complex interplay between intrinsic and extrinsic drivers of long-term survival trends in southern elephant seals." BMC Ecology **7**(3).
- Deagle, B. E., D. J. Tollit, et al. (2005). "Molecular scatology as a tool to study diet: analysis of prey DNA in scats from captive Steller sea lions." Molecular Ecology **14**(6): 1831-1842.
- Engelhard, G. H., S. M. J. M. Brasseur, et al. (2002). "Adrenocortical responsiveness in southern elephant seals mothers and pups during lactation and the effect of scientific handling." Journal of Comparative Physiology B **172**: 315-328.
- Engelhard, G. H., J. van den Hoff, et al. (2001). "Mass of weaned elephant seal pups in areas of low and high human presence." Polar Biology **24**(4): 244-251.
- Field, I. C., C. J. A. Bradshaw, et al. (2002). "Effects of age, size and condition of elephant seals (*Mirounga leonina*) on their intravenous anaesthesia with tiletamine and zolazepam." Veterinary Record **151**(8): 235-240.
- Jarman, S. N., B. E. Deagle, et al. (2004). "Group-specific polymerase chain reaction for DNA-based analysis of species diversity and identity in dietary samples." Molecular Ecology **13**(5): 1313-1322.
- Lydersen, C., O. A. Nost, et al. (2004). "Temperature data from Norwegian and Russian waters of the northern Barents Sea collected by free-living ringed seals." Journal of Marine Systems **46**(1-4): 99-108.
- Lydersen, C., O. A. Nost, et al. (2002). "Salinity and temperature structure of a freezing Arctic fjord - monitored by white whales (*Delphinapterus leucas*)." Geophysical Research Letters **29**(23).
- McMahon, C., J. Van Den Hoff, et al. (2005). "Handling intensity and the short- and long-term survival of elephant seals: Addressing and quantifying research effects on wild animals." Ambio **34**(6): 426-429.
- Van den Hoff, J., H. Burton, et al. (2007). "the population trend of southern elephant seals (*Mirounga leonina* L.) at Macquarie Island (1952-2004)." Polar Biology DOI **10.1007/s00300-007-0288-9**.
- Weimerskirch, H., P. Inchausti, et al. (2003). "Trends in bird and seal populations as indicators of a system shift in the Southern Ocean." Antarctic Science **15**(2): 249-256.

Appendix 1: Background material

National Marine Fisheries Service 2007. Draft Revised Recovery Plan for the Steller sea lion (*Eumatopius jubatus*). National Marine Fisheries Service, Silver Spring, MD. 305pp

Appendix 2: Statement of Work

Consulting Agreement between the University of Miami and Dr. Mark Hindell

Statement of Work

June 14, 2007

The first Steller Sea Lion (SSL) Recovery Plan was completed in 1992 and provided recovery guidance to the National Marine Fisheries Service (NMFS) for the species, which at that time was listed range-wide as threatened.

NMFS organized a new SSL Recovery Team in January 2002, and charged the new Team with writing a revised Plan to reflect the current view of stock structure and the differences in stock status under the ESA (eastern Distinct Population Segment (DPS) listed as threatened, and western DPS listed as endangered). The Team completed its draft of the second Plan in February 2006, at which time the Team sought an external peer review from 5 highly qualified experts (see Attachment 1).

Upon receipt of the peer reviewer comments, the Team revised the Plan and submitted it to NMFS. NMFS released the Plan for public review in May 2006 and received detailed written comments from 18 parties or individuals. Based on these comments and those of the expert reviewers listed above, NMFS revised the Plan into the document being presented to the Center for Independent Experts (CIE) for an additional peer review (document dated May 2007).

The CIE experts' comments will assist NMFS in making recovery decisions for the Steller sea lion based upon the best scientific and commercial data available (as required by the Endangered Species Act of 1973, as amended).

Reviewer Requirements

The CIE shall provide three expert reviewers. Each reviewer's duties shall require a maximum of six days of effort, including time to read the relevant document and to produce an individual written report consisting of his/her comments and recommendations. No travel is required; each reviewer shall work from his/her home location. Each reviewer's report shall reflect his/her area(s) of expertise, and no consensus opinion (or report) will be required.

As a group, the panel of CIE reviewers must possess expertise in the areas listed below.

* Familiarity with relevant sections of the Endangered Species Act (http://www4.law.cornell.edu/uscode/html/uscode16/usc_sup_01_16_10_35.html), and as applicable, the Marine Mammal Protection Act, and related wildlife management legislation (e.g, NEPA).

In particular,

* Experience as a Recovery Team member, contributor, or reviewer of Recovery Plans developed for other listed species; as a current or recently retired employee of a federal or state agency holding a position implementing ESA regulations; or from an academic position that has focused on ESA statutes and implementation.

* In depth expertise in the biology and management of marine and/or other large mammals; specifically population dynamics, reproductive and foraging biology and physiological ecology.

At least two of the reviewers must have in-depth experience with the ESA and recovery plans, and one reviewer must have in-depth knowledge of marine mammals. Former reviewers and former SSL Recovery Team members and support staff shall be excluded from consideration as reviewers of this document. See Attachment 1, below.

Specific Reviewer Tasks and Schedule

The Alaska Region shall provide the CIE with copies of the May 2007 draft revised SSL Recovery Plan for the review, or a link to it, by May 31, 2007. Delay in meeting this schedule will result in a minimum of an equivalent delay in delivering the final CIE reviews. The document to be reviewed will be approximately 200 pages in length.

1. The CIE reviewers shall read and assess the May 2007 draft revised Steller Sea Lion (*Eumetopias jubatus*) Recovery Plan.
2. The CIE reviewers shall focus on and address the following questions in their review reports:
 - Does the Plan thoroughly describe what is known about potential threats to both the eastern and western populations of Steller sea lion? Are there additional significant threats to the species? Does the evidence presented in the Recovery Plan support the threats assessment?
 - Is the ecological and biological information presented in the Plan adequate, thorough, and scientifically defensible?
 - Does the Plan adequately present an ecologically and biologically defensible recovery strategy for the eastern and western populations of Steller sea lion? Describe any shortcomings in the recovery strategy.
 - Are the recovery actions described within the Plan appropriate to meet recovery goals? Are the recovery actions consistent with the SSL life history information, population dynamics and threats assessment presented in the Plan? Are there other recovery actions that have not been included in the Plan that should be included to achieve recovery?
 - Are the recovery tasks in the Plan's Implementation Schedule appropriately prioritized to facilitate recovery?
 - Does the information in the Plan appropriately support the recovery criteria described in the Plan? Are the recovery criteria consistent with and do they meet the requirement of

the ESA to ensure the conservation of the species (i.e., recovery and ultimate delisting: “conservation” as defined in the ESA 16 USC § 1532 (3))?

3. No later than June 29, 2007 each CIE reviewer shall submit a written report¹ to the CIE that addresses the points in item 2 above. See Annex I for additional details on the report outline. Each report shall be sent to Dr. David Die, via email at ddie@rsmas.miami.edu, and to Mr. Manoj Shivilani, via email at mshivilani@rsmas.miami.edu

Submission and Acceptance of CIE Reports

The CIE shall provide the final individual reviewer reports for review for compliance with this Statement of Work and approval by NOAA Fisheries to the COTR, Dr. Stephen K. Brown (Stephen.K.Brown@noaa.gov), no later than July 13, 2007. The COTR shall notify the CIE via e-mail regarding acceptance of the reviewers’ reports. Following the COTR’s approval, the CIE shall provide pdf format copies of the reviewers’ reports to the COTR.

¹ Each written report will undergo an internal CIE review before it is considered final.

ATTACHMENT 1.

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ANNEX 1. Contents of CIE Reviewer's Report

1. The reviewer's report shall be prefaced with an executive summary of findings and/or recommendations.
2. The main body of the reviewer's report shall consist of a background, description of the review, summary of findings, and conclusions/recommendations. The summary of findings shall address each Term of Reference.
3. The reviewer's report shall include as separate appendices the bibliography of materials provided for the review and a copy of the CIE Statement of Work.

Please refer to the following website for additional information on report generation:

<http://www.rsmas.miami.edu/groups/cie/cierevrep.htm>