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Testimony
NOAA'S STELLER SEA LION SEA LION SCIENCE AND FISHERY MANAGEMENT RESTRICTIONS: DOES THE SCIENCE SUPPORT THE DECISIONS?

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We are two of four scientists who recently completed an independent scientific review of the NMFS November 2010 Biological Opinion of the Fisheries Management Plan for the Bering Sea/Aleutian Islands Management Areas. This written testimony provides background information about our review, followed by the Executive Summary of our report.

Background of our Review

Our review was jointly funded by the States of Alaska and Washington in response to widely-expressed concerns about the science in NMFS' 2010 Biological Opinion (the BiOp). In April 2011, the Alaska Department of Fish and Game (ADFG) and the Washington Department of Fish and Wildlife WDFW developed initial terms of reference for the review and selected two panel co-chairs, who in turn selected two additional panel members. We developed the final terms of reference, timeline for our work, and format of our report.

The panel members were:

- Dr. David Bernard (co-chair), a fisheries scientist, biometrician, and private consultant with over 30 years post-graduate experience involving management of commercial and recreational fisheries for salmon and non-salmon species in the Pacific Northwest.
- Mr. Steven Jeffries (co-chair), a Research Scientist and marine mammal specialist for the Washington Department of Fish and Wildlife, with more than 30 years of experience working on a variety of Northwest marine mammal issues.
- Dr. Andrew Trites, Professor and Director of the Marine Mammal Research Unit in the Fisheries Centre at the University of British Columbia, who has conducted extensive research on the ecology, population biology and bioenergetics of marine mammals.
- Dr. Gunnar Knapp, Professor of Economics at the University of Alaska Anchorage Institute of Social and Economic Research, who has been engaged in research on fisheries management, seafood markets, and the Alaska economy for the past 30 years.

We conducted our review fully independently. The conclusions expressed are our own and represent our consensus. None of us are federal employees. None of us had any role in

developing the BiOp or the FMP. None of us have any personal or financial involvement in any fisheries involved in the BiOp.

We brought a variety of backgrounds and perspectives to our review. One member of the panel (Dr. Trites) has an extensive background in Steller sea lion research, is widely cited in the BiOp, and commented on the draft BiOp and final BiOp. One member (Mr. Jeffries) has extensive experience in sea lion research, marine mammal fishery interactions, and is a member of the Pacific Scientific Review Group. Two members of the panel (Dr. Bernard and Dr. Knapp) had no previous background in or knowledge of Steller sea lion research. Three members of the panel (Dr. Bernard, Mr. Jeffries and Dr. Knapp) had never seen the BiOp prior to beginning work on this review.

Various parties are now involved in litigation relating to the BiOp. Our review has no relationship to that litigation, and we expressed no opinions about the litigation in this review, or about any legal questions related to the BiOp or the EA/RIR (Environmental Assessment/ Regulatory Impact Review). We focused strictly on the scientific questions in our Terms of Reference.

We held two public hearings to provide an opportunity for the public to provide comments for our consideration. We also invited and received written comments.

Our full 111-page review is posted on the website of the Washington Department of Fish and Wildlife at: http://wdfw.wa.gov/conservation/steller_sealions/

Summary of our Independent Scientific Review of the Biological Opinion

We were charged as a review panel to answer a series of questions concerning the BiOp and its central conclusion of jeopardy:

> *"After reviewing the current status of critical habitat that has been designated for the western population of Steller sea lions, the environmental baseline for the action area, the proposed action for Alaska Groundfish in the Bering Sea and Aleutian Islands and Gulf of Alaska, and the cumulative effects, it is NMFS' biological opinion that the action, as proposed, is likely to adversely modify the designated critical habitat for the western DPS of Steller sea lion."* [BiOp, xxxiv]

We answered each of the specific questions in our terms of reference (see Chapter 10). For this Executive Summary, however, we have grouped our findings into four categories pertaining to:

- the finding of jeopardy of extinction or of adverse modification of habitat (collectively JAM) for groundfish fisheries in the western and central Aleutian Islands;
- the effectiveness of reasonable and prudent alternatives (RPAs) to the federal action under consultation;
- the requirement under the Environmental Policy Act (EPA) that RPAs in the BiOp be the least-cost choice from all efficacious RPAs; and
- consideration of public and peer comment in the writing of the BiOp.

In our review, we looked for consistencies and inconsistencies between data and conclusions in the BiOp based on our experience, knowledge of the relevant scientific literature, and relevant

public comments. Besides information referenced in the BiOp, we considered recently published scientific papers, recent stock assessments, and recent groundfish surveys. We also considered comments by industry, scientists, and the North Pacific Management Council through their Scientific and Statistical Committee concerning the BiOp in general and specific modifications to RPAs, as well as comments submitted to us at public hearings held 2 June, 2011 in Seattle and in Anchorage on 22 August, 2011 and by e-mail.

The Finding of Jeopardy

We do not agree with the finding of JAM (jeopardy of extinction and adverse modification of habitat) for Steller sea lions in the western and central Aleutian Islands as concluded in the BiOp for the FMP. We find that NMFS misinterpreted crucial evidence from statistical studies of relationships between fishing and sea lion demographics. NMFS also failed to scientifically support their explanation of how fisheries affected sea lions (fishery-driven nutritional stress), and disregarded or misreported evidence that refutes the fishery-driven nutritional stress hypothesis. And finally, NMFS did not seriously consider alternative ecologically mediated explanations for declines in sea lion numbers not involving fisheries (environmentally-driven nutritional stress and the killer whale predation hypotheses).

Statistical analyses are the starting point for examining the relationship between fishing and Steller sea lions. If fisheries adversely affect sea lion numbers, statistically significant negative associations should be detectable between measures of fishing and measures of sea lion numbers. Failing to find any such associations should lead to a conclusion that there is no adverse effect unless there are clear reasons why the effects would not be observable in the data (*e.g.* measurement error, insufficient variation, or low power). Eight studies looking for such statistical associations were cited in the BiOp. NMFS concluded results from these studies to be "*equivocal*" and that "*it is not possible … to conclude that commercial fisheries are not having a significant impact on the recovery of* [sea lions]*"*. We found these studies insightful and their results hardly "*equivocal*".

We undertook a meta-analysis of the eight statistical studies cited in the BiOp plus two additional studies. The tests in earlier studies were based on a few years of data, and as expected, resulted in mostly non-significant outcomes with a few negative and a few positive associations being statistically significant. These results can be considered equivocal. Studies published after 2000 involved more years and consequently had more power to detect an association between fisheries and Steller sea lions. Results from these studies for years prior to 2000 were less equivocal in that 40% of tests produced statistically significant associations that were scientifically consistent with fisheries *having had a negative impact* on Steller sea lions; the remaining tests (60%) had statistical outcomes that were scientifically consistent with fisheries *not having had a negative impact* on sea lions. All of the detected statistical associations for years prior to 2000 were weak. However, results for years after 2000 are unequivocal. *None of these studies found statistically significant associations consistent with harm by fisheries, that is, 100% of the tests resulted in outcomes consistent with the groundfish fisheries having had no effect on sea lion numbers in the last 10-20 years.* Power analyses in these latter studies and the results themselves show that even weak statistical associations would have been detected had they been present. The methodological issues brought forward through comments to the draft BiOp concern statistical significance in tests when significance is not warranted. None of the issues would make an association less likely to be detected.

For a specific scientific hypothesis that fisheries negatively impact sea lion numbers, significant negative associations between fishery and sea lion statistics are evidence that this hypothesis is *possibly true*. Non-significant and statistically significant positive associations are evidence this hypothesis is *probably false*. What the meta-analysis provides is evidence that a scientific hypothesis that fisheries had a negative impact on Steller sea lions of the WDPS in general, and specifically on sea lions in the western and central Aleutian Islands, was *possibly true* in the past, but in the last 10-20 years, this hypothesis is *probably false*. On this basis we find that not only is it possible "*that commercial fisheries are not having a significant impact on the recovery of* [sea lions]", but the proposition that fisheries are not negatively affecting Steller sea lions is highly likely.

In our judgment, the fishery-driven nutritional stress hypothesis proffered by NMFS as an explanation for population declines in the western and central Aleutian Islands should be scientifically rejected. We base our conclusion on the process and conditions specified in the decision trees given in the BiOp for determining the risk of exposure and subsequent nutritional stress [BiOp; Figures 4.24, 4.25]. The BiOp drew some incorrect conclusions as it navigated through its own decision tree to arrive at the finding Atka mackerel and Pacific cod fisheries were fisheries of concern. The BiOp also ignored evidence contradicting the hypothesis of fishery-driven nutritional stress.

The available data and analyses indicate that current harvest rates of Atka mackerel have been too low, and the population of Pacific cod has been too small for the fishery on either species to cause nutritional stress in sea lions. Modeling efforts by NMFS reported in the BiOp support this observation, especially the lack of an effect of the Pacific cod fishery on sea lion biomass. Attempts in the BiOp to show spatial overlap between catches in fisheries and diets of sea lions, and hence local depletion of prey, failed to convincingly do so. Uncertainty in estimates of forage biomass is large and was ignored in the BiOp. Other measures of possible competition between fisheries and sea lions (*e.g.*, size overlap, temporal overlap, depth overlap) were specified in the BiOp, but not investigated. We provide data that were not presented in the BiOp showing limited overlap in sizes of fish taken in fisheries and by sea lions, especially limited in regards to Pacific cod. Steller sea lions ate younger, smaller fish than fisheries caught.

Arguments presented in the BiOp that Steller sea lions are experiencing nutritional stress caused by a lack of groundfish are not convincing. Forage ratios of groundfish to sea lions were higher in the western and central Aleutians than in regions where sea lions are recovering, thereby indicating a quantity of groundfish area-wide sufficient for sea lions to avoid nutritional stress. Sea lions in the eastern Bering Sea and the Gulf of Alaska (GOA) show no signs of nutritional stress despite having forage ratios within critical habitat that are lower than in the western and central Aleutian Islands.

Direct evidence of sea lions being in nutritional stress is lacking in the BiOp. We compared the signs of fishery-driven nutritional stress listed in Figure 4.26 of the BiOp with data provided in Table 3.17 of the BiOp. Of the eight general conditions consistent with fishery-driven nutritional stress in sea lions, no recent information (after 2000) was available on four. Nutritional stress was not indicated for three conditions (sea lions were not emaciated, body size was not reduced, and survival was not reduced). Information on the final general condition (reduced reproduction) was contradictory.

Considering the compelling evidence that the amounts of prey are sufficient to support sea lions in the western and central Aleutian Islands specifically, and for the western population in general, it should not be surprising that direct evidence for fishery-driven nutritional stress could not be found as posited. Making two "yes" decisions at the only two operable decision points of the decision process laid out in Figure 4.25 of the BiOp should have ended in a decision of "No Nutritional Stress". Such a decision would have been consistent with the results of the meta-analysis on statistical studies described above.

Of the two leading alternate hypotheses to explain the reduced numbers of Steller sea lions in the western and central Aleutian Islands, we conclude that neither the hypotheses of environmentally-driven nutritional stress (the *"junk food"* hypothesis) or killer whale predation can be scientifically rejected with available data. Both hypotheses remain viable explanations of sea lion demographics. Of the five necessary conditions for acceptance of the *"junk food"* hypothesis, there is evidence supporting one (good pup condition) in the western and central Aleutian Islands. There is no information on three of the other necessary conditions (good adult body condition, short foraging trips, and older age at weaning for pups) and ambiguity on the fourth (low birth rates).

While the BiOp contained no conclusion as to rejecting or not rejecting the *"junk food"* hypothesis, the BiOp did state "*killer whale predation can be an important factor in either causing continued declines or contributing to a robust recovery* [of sea lions]*."* We interpret this statement as implying that the killer whale predation hypothesis cannot be rejected at this time. We concur.

Effectiveness of RPAs

Based on the evidence presented in the BiOp, we conclude that the proposed RPAs will not arrest the decline in the numbers of sea lions in the western and central Aleutian Islands. Evidence presented in this BiOp from multispecies modeling indicates that any future increase or stabilization in sea lion biomass in the western and central Aleutian Islands will *not* be due to restricting fisheries for Pacific cod. There is some modeling evidence in the BiOp indicating that halting fishing for Atka mackerel in the western and central Aleutian Islands might cause sea lion biomass to increase, but it is inconsistent with the data on forage ratios showing greater declines of sea lions are associated with greater relative biomasses of groundfish. The BiOp does not consider this possibility—that increased amounts of groundfish might have negative consequences to sea lions as postulated by the *"junk food"* hypothesis.

Aydin (2010) predicted a 6% increase in sea lion biomass with a 10% reduction in the mortality rate for Atka mackerel. His model assumed that sea lions can assimilate the increase in Atka mackerel biomass, but did not consider that young sea lions can become full on low-energy diets before they have attained enough energy to meet their daily needs (see Rosen and Trites 2004).

The virtual 10 percentage point reduction in Atka mortality projected by Aydin (2010) represents closure of the fishery (which harvests 8% of the stock) plus an additional two percentage point reduction in the mortality rate for this species. Unfortunately certain critical bits of information relative to evaluating this finding were not included in the BiOp. Most notably, the BiOp did not explain or discuss:

- How could mortality rates on Atka mackerel be further reduced beyond the closure of the virtual fishery?

- How many years would be needed to realize virtual increases in sea lion biomass?
- Would these virtual increases persist?
- What would the virtual effect of closing both cod and mackerel fisheries be on sea lion biomass?

Without such information, the relevance of these simulations involving closing the Atka mackerel fishery cannot be fully evaluated. However, this full evaluation would probably be of marginal value, considering the lack of evidence for the fishery-driven nutritional stress hypothesis (our Chapter 4) and the meta-analysis of statistical studies we described in Chapter 3 showing no negative effects of fishing for Atka mackerel in the western and central Aleutian Islands on sea lion demographics in the last 20 years.

Results from multispecies models can provide insights into the effectiveness of RPAs even though the models used in the BiOp were not well explained. The food web containing fish, fisheries, and sea lions must be modeled as a whole if the best ecological information (scientific data) is to be used. While such modeling is at the edge of current understanding of the ecosystem in the Aleutian Islands, such modeling directly addresses the objective of the consultation, which is the response of sea lions to implementation of the RPAs.

In the BiOp, NMFS appears to have eschewed multispecies modeling in favor of the simple dictum that "what worked there and then, will work here and now"—with the "there" being the Gulf of Alaska, the "then" being when RPAs from two previous BiOps were implemented, and the "here" being the western and central Aleutians. Such a simple approach is empirical in that it depends on personal experience and belief, and does not use the scientific method. In other words, the expectation that the RPAs will result in increased numbers of Steller sea lions was not determined using science.

Sea lion numbers in the Gulf of Alaska (GOA) increased following implementation of RPAs in the 1990 and early in the last decade. However, no evidence was given in the BiOp that this increase in sea lions was other than coincidental with management actions. Evidence in the BiOp from multispecies modeling for the GOA indicate that the increase in sea lion numbers was a coincidence in the last decade and was not due to fishery restrictions. While NMFS did use single-species modeling of prey species to show the effectiveness of proposed RPAs—their results were preordained by the model they chose. Thus the models do not support the unscientific premise of the BiOp that RPAs had worked in the past, and would therefore continue to be effective if implemented elsewhere. There is insufficient evidence that past RPAs were ever effective.

The reason given in the BiOp for forgoing a scientific investigation in favor of an unscientific argument is that multi-species modeling is too complex and subject to too much error. We disagree. By its very nature, the fishery-driven nutritional stress hypothesis requires consideration of the fishery and sea lion food webs. Ecosystem considerations and modeling of the food web is a must for developing RPAs if the BiOp accepts the fishery-driven nutritional stress hypothesis. Such modeling is complex and does have uncertainty in outcomes. However, a good scientific investigation would include measures of uncertainty in parameters, in initial conditions, and in environmental conditions. It would also include an analysis of the sensitivity of results to model structure; and would report results in probabilistic terms.

We believe that NMFS has the resources to conduct ecosystem modeling, yet relied on the simplest of arguments to support the RPAs they proposed. Arguing that sea lions must be nutritionally stressed because fishing has occurred where sea lions have declined is prone to error in the most obvious of ways by confusing cause with coincidence.

Economic Analysis of RPAs

In general, the analysis described in the Environmental Assessment and Regulatory Impact Review (EA/RIR) of economic impacts of the chosen set of RPAs is reasonably complete, scientifically valid and adequate. It addresses most of the questions it should have addressed in an objective and reasonable manner given the limits of available data and confidentiality restrictions. It supports the conclusion that "*…this action will impose relatively heavy costs on the fishing and processing industry that targets Atka mackerel and Pacific cod in the Aleutian Islands*." More detailed analysis might have strengthened but not have changed this fundamental conclusion.

The EA/RIR includes an analysis of the economic benefits of full Steller sea lion recovery. This is not an analysis of the economic benefits attributable to the uncertain effects of the alternatives. The EA/RIR does not provide a cost-benefit analysis of the alternatives.

The BiOp and RIR failed to demonstrate that the RPAs minimize economic and social impacts compared with potential alternatives which would achieve the same benefit for Steller sea lion recovery. Neither document could demonstrate this because neither demonstrated what the benefits of the RPAs would be for sea lion recovery, or demonstrated an effort to identify alternatives that would have the same level of benefit but lower economic and social impact.

Standard for Likelihood of Jeopardy

The BiOp responds to the mandate in the ESA that *"Each Federal agency shall . . . ensure that any action . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat…"* In reaching or evaluating any conclusion about jeopardy, a key issue is what standard of scientific evidence is required to conclude that an action is "likely" to jeopardize the continued existence of an endangered species or result in the destruction or adverse modification of its habitat.

There is no formal scientific standard for "likely." Given a high degree of uncertainty about whether fishing jeopardizes Steller sea lions, we contend that most scientists would define a *scientific* standard for "likely" based on their interpretation of the *preponderance of available evidence*. This is the standard we used for our review.

The BiOp does not explicitly define its standard for "likely." Implicitly, it uses a standard which is significantly weaker than the scientific standard of preponderance of evidence.

Representatives of NMFS argue that the Endangered Species Act mandates a precautionary standard for "likely" and that evidence that adverse effects of fishing on Steller sea lions "may exist" requires a conclusion of jeopardy. We claim no expertise as to the appropriate *legal* standard for a conclusion of jeopardy. However, whatever the standard, it should be explicitly defined, and the scientific evidence should meet that standard.

Peer and Public Comment

The BiOp was prepared by NMFS without active interaction with scientists outside the agency or with people in the fishing industry that could have provided useful insights. The period of time provided by NMFS for comment on the draft BiOp was insufficient for serious peer and public review. The time between the receipt of review comments and NMFS's self-imposed deadline for release of the final document was also insufficient for adequate consideration of review comments or any substantial revision of the BiOp in response to comments. There is little evidence that comments on the draft BiOp's finding of jeopardy were seriously considered when developing the final BiOp. There is evidence that comments on RPAs in the draft BiOp were considered in developing the final RPAs, although responses to these comments were very brief and most suggested changes were rejected. NMFS did not summarize or address comments received on the draft BiOp as had been promised, nor has it scheduled a formal independent review as promised. In contrast, the Regulatory Impact Review (RIR) clearly addressed and was strengthened by consideration of public and peer comments on the economic analysis.