

**Report on Special Independent Peer Review of the  
Bearded Seal (*Erignathus barbatus*)  
Status Review Report**

March 2012

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Alaska Region  
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**Executive Summary**

On December 10, 2010, the National Marine Fisheries Service (NMFS) made a 12-month finding on a petition to list the bearded seal as threatened or endangered under the Endangered Species Act (ESA) and proposed to list the Beringia and Okhotsk Distinct Population Segments (DPSs) of the bearded seal as threatened (75 FR 77496). The proposal was informed by a status review report (Cameron et al. 2010) that compiled the best scientific and commercial data available concerning the status of the bearded seal, including the past, present, and future threats to this species. In consideration of substantial disagreement evident in peer review and public comments received on the proposed rule regarding the sufficiency or accuracy of the model projections and analysis of future sea ice habitat for the Beringia DPS, on December 13, 2011, we extended the deadline for the final listing determination by 6 months to June 10, 2012 (76 FR 77467).

To further ensure that our final listing determination is based on the best scientific and commercial data available, we subsequently conducted special independent peer review of the sections of the status review report related to the disagreement. For this special peer review, we recruited three scientists with marine mammal expertise and specific knowledge of bearded seals to review these sections of the status review report and provide responses to specific review questions. We also asked the reviewers to comment on a supplemental analysis of the sea ice projections. This analysis summarized the projected changes in areas of suitable bearded seal habitat (based on sea ice concentration and bathymetry criteria) between 2010 and 2090 during the months of reproduction and molting, both including and excluding areas of potential habitat “gains.” Habitat gains occur in areas where sea ice concentrations are currently too dense to be considered suitable, but where projected future concentrations fall within the suitable range.

We received comments from two of the three reviewers. We have carefully reviewed these comments, and the primary points raised in response to the review questions are summarized below. We note that there were some points raised by one, but not both, of the

reviewers. This should not be construed as disagreement or tacit disagreement by the other reviewer, but rather the other reviewer made no comment on these points. The reviewers' comments are described in greater detail in the main body of this peer review report.

*Question 1: Do you find that the uncertainties associated with the projections of changes in sea ice cover are reasonably identified and characterized?*—One of the reviewers commented that the uncertainties associated with the model projections of sea ice cover were well identified and characterized. The other reviewer found that the identified components of uncertainty in the sea ice projections were not particularly well explained. He also suggested that additional detail could be provided regarding the relative size of the uncertainty components, and how maximum and minimum concentrations were defined when considering projections from several models, averaged over 11-year periods, with presumably a range of starting conditions, and under at least two different emissions scenarios.

*Question 2: Do you find that the criteria used to define areas of projected sea ice concentrations suitable for bearded seal whelping, nursing, and molting are reasonable and based on the best scientific and commercial data available?*—Both of the reviewers noted that the relationship between sea ice characteristics and habitat selection by bearded seals is undoubtedly more complex than the simple sea ice concentration and bathymetry criteria considered in the status review report. One of the reviewers found the cut-off criteria reasonable, and the other reviewer thought the criteria probably provided an adequate basis for estimating changes in the amount of available habitat. However, one of the reviewers also posed the question of whether a more complex definition of suitable habitat could be supported by the available data, and commented that this question was not fully explored in the status review report. This reviewer also expressed doubt that the conclusions reached are sensitive to the ice cover criteria, noting that in support of this, there is good evidence that bearded seals are associated with unconsolidated ice and make seasonal migrations in the Bering-Chukchi-Beaufort to stay with the loose ice zone as it shifts seasonally. In addition, he questioned whether a 500 m depth limit is too deep, and suggested that an analysis of how sensitive the conclusions might be to the choice of depth limit would be appropriate.

*Question 3: Are there other scientific or commercial data available that we have not considered that you believe could better inform our assessment of the impacts of the projected changes in sea ice habitat on bearded seals?*—Neither of the reviewers was aware of any other scientific or commercial data that could better inform the assessment of bearded seal sea ice relationships.

*Question 4: Do you find that the 90% sea ice concentration used as the upper limit for suitable habitat in the additional analysis discussed above is reasonably supported by the best scientific and commercial data available (see page 113 of the status review report regarding Simpkins et al. 2003)?*—One of the reviewers found the 90% upper limit reasonable given that bearded seals are very rarely seen in extensive areas of unbroken ice. The other reviewer expressed doubt that the 90% cut-off on its own was an accurate model of how bearded seals

view habitat potential. He also noted that the 90% cut-off is clearly an approximation, but that he doubted there are any data available to refine it.

*Question 5: Do you find the additional analysis provides information that is not readily inferred from the analysis presented in the status review report?*—Both reviewers found that the additional analysis showed how much and where breeding habitat may be gained and lost in terms of suitable sea ice concentrations, which Reviewer 1 commented was only generally discussed in the status review report. However, Reviewer 1 expressed the opinion that while it is reasonable to ask the question of whether or not there would be habitat gains with projected changes in ice cover, the more important question is what types and quantities of food would be available in those areas gained. This reviewer found the additional analysis misleading because: (1) in most cases what was actually projected is earlier access in the season to some areas currently used somewhat later; and (2) comparing areas with suitable sea ice concentrations lost and gained is only informative if the areas are of equal value for supporting bearded seal foraging, or there is some way to scale their relative values. He noted that two of the areas where habitat was projected to be lost are in the Bering and Barents seas, which are regions that are among the most productive for bearded seal prey species; while in contrast, areas of projected gains in the Beaufort and Kara seas and along the shelf break of the Arctic basin are not known to be highly productive. He therefore concluded that based on these ice projections, bearded seals will lose highly productive habitat in southern regions, and probably gain access earlier in the spring to low productivity areas. Reviewer 2 commented that it appears clear from this additional analysis that if the Beringia DPS were to persist, it would do so only under a drastically altered distribution and migratory scheme. This reviewer also pointed out that how readily a species with a generation time of probably about 11 years would adapt to such a requirement is only poorly known.

*Question 6: In light of the additional analysis, do you find that the status review report reasonably identifies and characterizes the uncertainties associated with the projected sea ice changes?*—One of the reviewers commented that the status review report did not explicitly consider uncertainties associated with whether or not areas of habitat “gained” will offset impacts of habitat lost (see related comments under Question 5). The other reviewer commented that the additional analysis did not do much at all with the uncertainty of the sea ice projections. This reviewer expressed the opinion that to be at all quantitative about projections of conditions 80 year in the future is a bit of stretch, but to consider it possible to be quantitative about the uncertainty of these projections is ambitious. He noted that the additional analysis is useful in explicitly illustrating the uncertainty in translating ice cover projections into bearded seal habitat projections. He concluded that there must remain large uncertainty in predicting how, or whether, bearded seals might cope with such a large redistribution of available habitat.

## Introduction

On March 28, 2008, the National Marine Fisheries Service (NMFS) initiated status reviews of bearded, ringed (*Phoca hispida*), and spotted seals (*Phoca largha*) under the Endangered Species Act of 1973, as amended (ESA) (73 FR 16617). On May 28, 2008, we received a petition from the Center for Biological Diversity to list these three species of seals as threatened or endangered under the ESA, primarily due to concerns about threats to their habitat from climate warming and loss of sea ice. The Petitioner also requested that critical habitat be designated for these species concurrent with listing under the ESA. In response to the petition, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (73 FR 51615; September 4, 2008). Accordingly, we proceeded with the status reviews of bearded, ringed, and spotted seals and solicited information pertaining to them.

Following completion of a status review report and 12-month finding for spotted seals in October 2009 (74 FR 53683, October 20, 2009; see also, 75 FR 65239; October 22, 2010), we established Biological Review Teams (BRT) to prepare status review reports for bearded and ringed seals. The status review report of the bearded seal is a compilation of the best scientific and commercial data available concerning the status of the species, including the past, present, and future threats to this species. After the status review report was completed by the BRT (Cameron et al. 2010), on December 10, 2010, we made a 12-month finding and proposed to list the Beringia and Okhotsk Distinct Population Segments (DPSs) of the bearded seal as threatened (75 FR 77496). Long-term model projections of diminished sea ice during the 21<sup>st</sup> century were a primary determinant in this listing proposal. We published our 12-month finding for ringed seals as a separate notification concurrently with this finding (75 FR 77476; December 10, 2010).

The proposed rule announced a 60-day comment period to close on February 8, 2011. On February 8, 2011, we extended the comment period 45 days to March 25, 2011 (76 FR 6755). Three public hearings were held in Alaska in Anchorage, Barrow, and Nome (76 FR 9734, February 22, 2011; 76 FR 14883, March 18, 2011).

In accordance with our July 1, 1994, Interagency Cooperative Policy on Peer Review (59 FR 34270), we requested the expert opinion of four independent scientists with expertise in seal biology and/or Arctic sea ice and climate change regarding the pertinent scientific data and assumptions concerning the biological and ecological information used in the proposed rule. The purpose of the review was to ensure that the best biological and commercial information was used in the decision-making process, including input of appropriate experts and specialists. We received comments from three of the reviewers.

There was significant disagreement among the peer reviewers regarding the magnitude and immediacy of the threat posed to the Beringia DPS by the projected changes in sea ice habitat. This disagreement was also evident in public comments. In consideration of the disagreement regarding the sufficiency or accuracy of the model projections and analysis of

future sea ice habitat for the Beringia DPS, on December 13, 2011, we extended the deadline for the final listing determination by 6 months to June 10, 2012 (76 FR 77467).

To further ensure that our final determination is based on the best scientific and commercial data available and address the disagreement, we subsequently conducted special independent peer review of the sections of the status review report (Cameron et al., 2010) related to the disagreement. For this special peer review, we recruited three scientists with marine mammal expertise and specific knowledge of bearded seals to review these sections of the status review report and to provide responses to specific review questions (Appendix). We also asked the reviewers to comment on a supplemental analysis of the sea ice projections. This analysis summarized the projected changes in areas of suitable bearded seal habitat (based on sea ice concentration and bathymetry criteria) between 2010 and 2090 during the months of reproduction and molting, both including and excluding areas of potential habitat “gains” (see Appendix). Habitat gains occur in areas where sea ice concentrations are currently too dense to be considered suitable, but where projected future concentrations fall within the suitable range.

We received comments from two of the three reviewers. We carefully reviewed these comments, and have consolidated them in this report. Where individual reviewers offered conflicting comments, this report includes the viewpoints of both reviewers. There were some points raised by one, but not both, of the reviewers. This should not be construed as disagreement or tacit agreement by the other reviewer, but rather the other reviewer made no comment on these points.

We note that special independent peer review was also conducted for the ringed seal status review report. As part of this review, two physical scientists with expertise in climate change and Arctic sea ice and snow were asked to review sections of the ringed seal status review report related to observations or projections of Arctic sea ice and snow cover on sea ice. The Arctic sea ice observations and projections considered in the ringed seal status review report were also considered in the bearded seal status review report. Therefore, the climate scientists’ comments related to Arctic sea ice will also be considered in developing our final listing determination for bearded seals. Readers should consult the ringed seal special peer review report for these comments. We will announce in the **Federal Register** instructions for obtaining a copy of the ringed seal special peer review report and the dates of a new public comment period to accept comments on this report when its availability is known.

## Issues Raised in the Special Independent Peer Review Comments

### Bearded seal status review report

***Question 1: Do you find that the uncertainties associated with the projections of changes in sea ice cover are reasonably identified and characterized?***

Both reviewers similarly qualified their comments related to the sea ice projections by noting that they are not experts in sea ice/climate science.

Reviewer 1 found that the uncertainties associated with the projections of changes in sea ice cover were well identified and characterized. He noted that in addition, steps were taken to reduce modeling uncertainty by culling models that did not meet specific performance criteria for reproducing known characteristics of recent sea ice conditions.

Reviewer 2 summarized his understanding of three components of uncertainty in the sea ice projections as: (1) variability in model trajectories associated with selection of starting conditions; (2) across-model uncertainty, mostly due to computational differences between the models (the reviewer noted that if true, this would be cause for some concern and that including some diversity of views on the physics might be reassuring); and (3) uncertainty in the forecasts of greenhouse gas emissions as drivers in the models, particularly beyond the year 2050. This reviewer commented that it would not be surprising if there are other components of uncertainty that were not identified. He expressed the view that trying to be too quantitative about the uncertainty of 80-year forward projections of Arctic sea ice cover in a changing climate is probably a mistake, in the sense that quantitative statements about the uncertainty probably large underestimates and likely to produce spurious confidence in predictions. He found that the identified components of uncertainty in the sea ice projections were not particularly well explained, and also that the status review report was not specific about: (1) the relative size of the components of uncertainty or about how these were addressed in the assessment (e.g., selection of starting conditions); and (2) how maximums and minimums were defined when considering sea ice projections from several models, averaged over 11-year periods, with presumably a range of starting conditions, and under at least two different emissions scenarios. Finally, he pointed out that some models predicted several times more Arctic sea ice than others (e.g., between 2040 and 2070); but, it was unclear whether this was addressed by simply averaging over the models, or whether to do so was correct.

***Question 2: Do you find that the criteria used to define areas of projected sea ice concentrations suitable for bearded seal whelping, nursing, and molting are reasonable and based on the best scientific and commercial data available?***

Both of the reviewers discussed that the relationship between sea ice characteristics and habitat selection by bearded seals is undoubtedly more complex than the simple sea ice concentration and bathymetry criteria considered in the status review assessment. Reviewer 1 commented that the status review report provided a good explanation for why sea ice is

particularly important for whelping, nursing, and molting and that it is appropriate to focus on these time periods in evaluating the potential impacts of changes in sea ice. While noting that few data are available to quantitatively determine bearded seal sea ice coverage requirements, this reviewer found the ice concentration cut-off values reasonable based on personal field observations.

Reviewer 2 posed the question of whether a more complex definition of suitable habitat could be supported by the available data, and noted that the status review report did not fully explore this question. Still, this reviewer commented that the ice concentration criteria probably provide an adequate basis for estimating changes in the amount of available habitat. He also expressed doubt that the conclusions reached are sensitive to the ice cover criteria, noting that the assessment would have to deviate unreasonably far from the criteria cut-off values to arrive at significantly different conclusions. In support of this, Reviewer 2 noted that there appears to be good evidence that bearded seals are associated with unconsolidated ice and make seasonal migrations in the Bering-Chukchi-Beaufort to stay with the loose ice zone as it shifts seasonally. However, he also argued that in view of the available data, the 500 m depth limit is too deep, and suggested that an analysis of how sensitive the conclusions might be to this choice of depth limit would be appropriate (e.g., by progressively increasing the depth limit from 250 to 500 m and seeing what effect this has on calculations of suitable habitat).

***Question 3: Are there other scientific or commercial data available that we have not considered that you believe could better inform our assessment of the impacts of the projected changes in sea ice habitat on bearded seals?***

Reviewer 1 acknowledged that many aerial survey projects have been conducted in the Bering and Chukchi seas during which marine mammal sightings were recorded, but noted that none of them focused particularly on bearded seals. This reviewer expressed doubt that results from these surveys contain information that could substantively improve the assessment of bearded seal sea ice relationships. Reviewer 2 commented that he was not aware of any other data that could better inform the assessment. This reviewer discussed that better assessing the effect of changes in sea ice cover or condition, at the population level, on bearded seals would require more, and more detailed, studies on bearded seal behavior and habitat preferences than appear to have been carried out to date. Similarly, Reviewer 1 suggested that studies could probably be designed to examine bearded seal sea ice relationships in a multivariate context, but that it would be difficult and take considerable time to gather appropriate data. Both of the reviewers also noted that it is particularly difficult to determine bearded seal habitat preferences because they are widely distributed at low densities in remote areas of loose ice.

## **Additional sea ice analysis**

***Question 4: Do you find that the 90% sea ice concentration used as the upper limit for suitable habitat in the additional analysis discussed above is reasonably supported by the best scientific and commercial data available (see page 113 of the status review report regarding Simpkins et al. 2003)?***

Reviewer 1 found the 90% upper limit for this analysis reasonable given that bearded seals are very rarely seen in extensive areas of unbroken ice. Reviewer 2 observed that a 90% cut-off is clearly an approximation. He expressed doubt that there are any data available to refine it, or that the assessment would be much different if it were replaced with some other similar value (e.g., 86%, 92%, etc.). He again noted that there is good information to support the thesis that bearded seals are associated with zones of unconsolidated ice and migrate to stay with them.

Both reviewers reiterated that bearded seal sea ice relationships are undoubtedly more complex than a simple cut-off value for maximum sea ice concentration. Reviewer 2 expressed doubt that the 90% cut-off on its own is an accurate model of how bearded seals view habitat potential, noting for example, that 90% cover of heavy pressure-ridged late-winter ice is not the same as 90% cover of thinning, rotten, melting-out flat first-year ice in early summer. However, this reviewer also acknowledged that it is unlikely data exist to explore or define habitat preferences based on other ice characteristics.

***Question 5: Do you find the additional analysis provides information that is not readily inferred from the analysis presented in the status review report?***

Reviewer 1 commented that the status report made only general mention of the possibility of additional breeding habitat being created and did not show how much or where this would occur; whereas, the additional analysis shows where this would happen and how much area is would be affected. However, this reviewer expressed the opinion that while it is reasonable to ask the question of whether or not there would be habitat gains with projected changes in ice cover, the more important question is what types and quantities of food would be available in those areas gained. He found that considering the question of habitat lost and gained is misleading from the point of view of feeding opportunities because: (1) in most cases what is projected is not a habitat gain, but rather, possible earlier access in the season to an area that is currently used somewhat later; and (2) comparing areas of gains and losses is only informative if the areas are of equal value for supporting bearded seal foraging, or if there is some way to scale their relative values. He noted that two of the areas where habitat is projected to be lost are in the Bering and Barents seas, which are regions that are among the most productive to bearded seal prey species; while in contrast, areas of projected gains in the Beaufort and Kara seas and along the shelf break of the Arctic basin are not known to be highly productive. He therefore concluded that the projections indicate bearded seals will lose highly productive habitat in southern regions, and probably gain access earlier in the spring to low productivity areas.



Reviewer 2 found the additional analysis presents the information rather more succinctly, and commented that this analysis makes it clear that there will be habitat losses, and while there may be offsetting habitat gains, this is by no means certain. This reviewer commented that it appears clear from this additional analysis that if the Beringia DPS were to persist, it would do so only under a drastically altered distribution and migratory scheme. He also pointed out that how readily a species with a generation time of probably about 11 years would adapt to such a requirement is only poorly known.

***Question 6: In light of the additional analysis, do you find that the status review report reasonably identifies and characterizes the uncertainties associated with the projected sea ice changes?***

Reviewer 1 found that the status review report did not explicitly consider uncertainties associated with whether or not areas of habitat “gained” will offset impacts of habitat lost (see related comments under Question 5). Reviewer 2 commented that the additional analysis did not do much at all with the uncertainty of the sea ice projections. He expressed the opinion that to be at all quantitative about projections of conditions 80 year in the future is a bit of stretch, but to consider it possible to be quantitative about the uncertainty of these projections is ambitious. He noted that the additional analysis is useful in explicitly illustrating the uncertainty in translating ice cover projections into bearded seal habitat projections. He concluded that there must remain large uncertainty in predicting how, or whether, bearded seals might cope with such a large redistribution of available habitat.

## **Citations**

- Cameron, M.F., J. L. Bengston, P. L. Boveng, J. K. Jansen, B. P. Kelly, S. P. Dahle, E. A. Logerwell, J. E. Overland, C. L. Sabine, G. T. Waring, and J. M. Wilder. 2010. Status review of the bearded seal (*Erignathus barbatus*). U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-211. 246 p. Available at <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-211.pdf>.
- Wang, M. Y., and J. E. Overland. 2009. A sea ice free summer Arctic within 30 years? *Geophysical Research Letters* 36:1-5.

**Appendix: Peer Review Request for Special Independent Peer Review of the  
Bearded Seal Status Review Report**

The National Marine Fisheries Service (NMFS) has proposed to list the Beringia Distinct Population Segment (DPS) of the bearded seal as threatened under the U.S. Endangered Species Act (ESA), primarily due to the threat posed by projected changes in sea ice habitat (75 FR 77496; December 10, 2010). The ESA status review was conducted by a Biological Review Team, who prepared a status review of the best scientific and commercial data available concerning the status of the bearded seal, including the past, present, and future threats to this species (Cameron et al., 2010; Enclosure 1).

We requested the expert opinion of four independent scientists with expertise in seal biology and/or Arctic sea ice and climate change regarding the pertinent scientific data and assumptions concerning the biological and ecological information used in the proposed listing rule. We received comments from three of the reviewers.

There was significant disagreement among these reviewers and among members of the public who commented on the proposed listing concerning the sufficiency or accuracy of the analysis of model projections of future sea ice habitat, and the magnitude and immediacy of the threats posed to this DPS by the projected changes in habitat. The bearded seal status review defines areas of projected sea ice habitat suitable for whelping, nursing, and molting using criteria that were developed from two studies that estimated bearded seal preference for sea ice concentrations using aerial survey data. Based on these criteria, we concluded that bearded seals in the Beringia DPS would likely have to shift their nursing, rearing, and molting areas to ice-covered seas north of the Bering Strait by the end of the century. We also discussed in the status review and the proposed listing rule that the projected changes in sea ice are expected to make some parts of range of the Beringia DPS unsuitable in terms of sea ice concentration, while potentially improving suitability in other areas. We concluded that the net difference between sea ice related habitat creation and loss will be likely be negative, especially because other factors such as ocean warming and ocean acidification are likely to impact habitat.

To address the disagreement and further ensure that our decision is based upon the best scientific and commercial data available, we are conducting additional peer review of the abovementioned aspects of the status review report. This special peer review will involve individual review by several experts of the relevant sections of the status review report (see below). A report summarizing the special peer review comments received will be made available for public comment. It should be noted that if NMFS receives a Freedom of Information Act request, anonymity of comments cannot be guaranteed.

You have been identified as an independent specialist with appropriate expertise to contribute to the special peer review. Your participation would greatly assist our determination on this listing action. We request your review of the sections of the status review report identified in the

enclosed outline (Enclosure 2), and your specific responses to the following questions. Please also feel free to consult other sections of the report in conducting this review.

- (1) Do you find that the uncertainties associated with the projections of changes in sea ice cover are reasonably identified and characterized?
- (2) Do you find that the criteria used to define areas of projected sea ice concentrations suitable for bearded seal whelping, nursing, and molting are reasonable and based on the best scientific and commercial data available?
- (3) Are there other scientific or commercial data available that we have not considered that you believe could better inform our assessment of the impacts of the projected changes in sea ice habitat on bearded seals?

Since the status review was completed, an additional analysis has been prepared that summarizes the projected percent change in average suitable bearded seal habitat (based on the climate model projections of sea ice concentration used in the status review) between 2010 and 2090, both including and excluding potential “gains” (Enclosure 3). Potential gains in habitat would occur in areas where sea ice is currently found in concentrations greater than 90%, but where the projected future concentrations fall within the suitable range of 25-90% (April-May) or 15-90% (June). This additional analysis further highlights the importance of the ice concentration criteria used to define suitable habitat, as well as other uncertainties associated with assessing future habitat conditions. For example, for the Beringia DPS, during the month of May there is a 64% loss of habitat predicted if potential gains are excluded, versus essentially little change if projected “gains” are included. With regard to this additional analysis:

- (4) Do you find that the 90% sea ice concentration used as the upper limit for suitable habitat in the additional analysis discussed above is reasonably supported by the best scientific and commercial data available (see page 113 of the status review report regarding Simpkins et al., 2003)?
- (5) Do you find the additional analysis provides information that is not readily inferred from the analysis presented in the status review report?
- (6) In light of the additional analysis, do you find that the status review report reasonably identifies and characterizes the uncertainties associated with the projected sea ice changes?

Your inclusion in this special peer review is very important to the listing process. We appreciate your assistance in this special peer review and request that you submit written comments...

#### Enclosures

- 1) Status review of the bearded seal
- 2) Outline of bearded seal status review report sections for review
- 3) Additional bearded seal habitat analysis

## **Enclosure 1**

Cameron, M.F., J. L. Bengston, P. L. Boveng, J. K. Jansen, B. P. Kelly, S. P. Dahle, E. A. Logerwell, J. E. Overland, C. L. Sabine, G. T. Waring, and J. M. Wilder. 2010. Status review of the bearded seal (*Erignathus barbatus*). U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-211. 246 p. Available at <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-211.pdf>.

## **Enclosure 2**

### **Bearded seal status review report sections for review**

Highlighted sections contain information pertaining to:

- (1) the physical/biological basis for determining the bearded seal's sea ice cover requirements and core distribution, or
- (2) observations or projections of sea ice cover.

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## **Enclosure 3**

### **Bearded Seal Habitat Analysis**

Climate scientists from NOAA’s Pacific Marine Environmental Lab (PMEL) provided us with Intergovernmental Panel on Climate Change (IPCC) climate model projections of sea-ice concentrations in the Northern Hemisphere for the months of April, May, and June—averaged over each decade for this century—which we incorporated into a geographical information system (GIS). The projected sea ice concentrations are from the 6 best-performing models identified by Wang and Overland (2009) (see Cameron et al., 2010). For the purposes of this case study, “suitable habitat” was simply defined as areas of sea ice with concentrations of 25-90% in April and May (reproductive period) or 15-90% in June (molting period) that are over waters less than 500 m in depth (access to benthic prey). Applying this definition, we calculated the predicted percent change in suitable habitat for each bearded seal population during the months of April, May, and June for each decade between 2010 and 2090, both including and excluding potential “gains” in suitable habitat (from projected reductions in ice concentration in some areas where they are presently greater than 90%) (Table 1).

Based on this analysis, the decision of whether to consider potential gains in suitable habitat has little consequence for the Okhotsk DPS (i.e., there is only a 0-6% difference in predicted habitat changes between the two scenarios); however, for *E. b. barbatus* (April and May) and the Beringia DPS (May and June), this decision has significant implications (i.e., there is up to a 66% difference in predicted habitat changes between the two scenarios). Figures 1-3 show the predicted areas of suitable habitat loss, gain, and no change in status for April, May, and June (respectively) between 2010 and 2090. The areas highlighted green in these figures (“habitat gain”) are currently considered unsuitable (due to having ice concentrations >90%) but are projected to become suitable (due to the thinning of their ice concentrations in the future). We maintain that the most cautious and scientifically-defensible position is to not include these areas in assessments of future suitable habitat for bearded seals based on the uncertainties outlined below.

There are several sources of uncertainty in our analysis: (1) we have limited data/understanding of what constitutes “suitable habitat” for bearded seals; (2) we have limited data/understanding of how future changes in habitat will affect the populations’ vital rates and demography; (3) there are issues with the scale and resolution of the climate models that require careful interpretation of our results; and (4) there are other climate-change related factors that may diminish or preclude the use of any new areas of suitable habitat (e.g., increases in ocean acidification and other changes in the marine regime that could affect bearded seals’ prey base; increased competition with other ice-associated species in a shrinking environment; and increases in human activities in the Arctic such as oil and gas exploration and development, commercial fishing, and shipping), but the likelihood and magnitude of these threats are also uncertain. Together, these uncertainties make it unclear how potential gains in suitable habitat should be treated. For the proposed rule, we supported a precautionary approach of presenting a range of *possible* scenarios of how bearded seals may respond to changes in their habitat, including shifting into new areas of suitable habitat, but stopped short of suggesting that this is a *likely* scenario, given the uncertainties described above.

Table 1. -- Predicted percent change in suitable habitat for 3 populations of bearded seals during the months of April, May, and June between 2010 and 2090, both including and excluding potential gains in suitable habitat.

Bearded seal populations	APRIL		MAY		JUNE	
	with gains	w/out gains	with gains	w/out gains	with gains	w/out gains
<i>E. b. barbatus</i>	+43.99	-21.95	-1.33	-22.01	-20.61	-27.88
Beringia DPS	-33.73	-45.46	+1.66	-64.25	+24.67	-9.98
Okhotsk DPS	-36.46	-41.58	-90.42	-94.13	-100.00	-100.00







