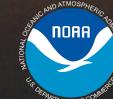


Will Global Warming Result in Habitat Gains for Ice-breeding Bearded Seals?

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INTRODUCTION

Global warming has dramatically reduced Arctic sea ice during the past several decades and is projected to do so at an increasing rate in the future (Figure 1). Ice-breeding phocids such as bearded seals (*Erignathus barbatus*) rely on sea ice as a platform for whelping and rearing their pups during spring, and molting their coats during early summer. Loss of sea-ice habitat during this critical period could have serious impacts on their recruitment and health. The goal of this analysis was to use the best available scientific information to predict habitat changes during this century for the two recognized bearded seal subspecies: *E. b. barbatus* in the Atlantic sector of the Arctic, and *E. b. nauticus* in the Pacific sector, which we subdivided into the Beringia and Okhotsk populations (Cameron et al. 2010).

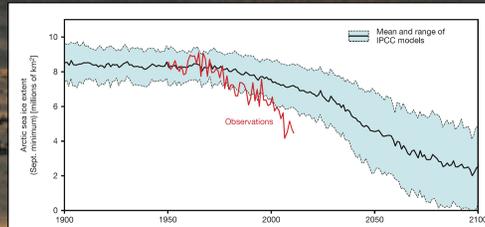


Figure 1. Observations (1950-2011) and IPCC climate model projections (to 2100) of September minimum sea-ice extent in the Arctic.

METHODS

- Based on limited data documenting their preferred ice concentrations (Simpkins et al. 2003, Ver Hoef et al. *In review*) and maximum diving depths (Gjertz et al. 2000), we defined bearded seals' habitat as: areas of sea ice with concentrations of 25-90% in April and May (during whelping and pup rearing) or 15-90% in June (during molting) that occur in water depths less than 500 m.
- We obtained climate model projections of Arctic sea-ice concentrations for the months of April, May, and June averaged over the decades centered on 2010 and 2090 and mapped this data in a GIS over bathymetry.
- For each month, we applied our definition of habitat to the sea-ice and bathymetry data and compared the results between 2010 and 2090 to identify areas of habitat loss, gain, and no change in status over that period (Figure 2). We then calculated the percent net change in habitat area for each bearded seal population by month (Table 1).

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RESULTS

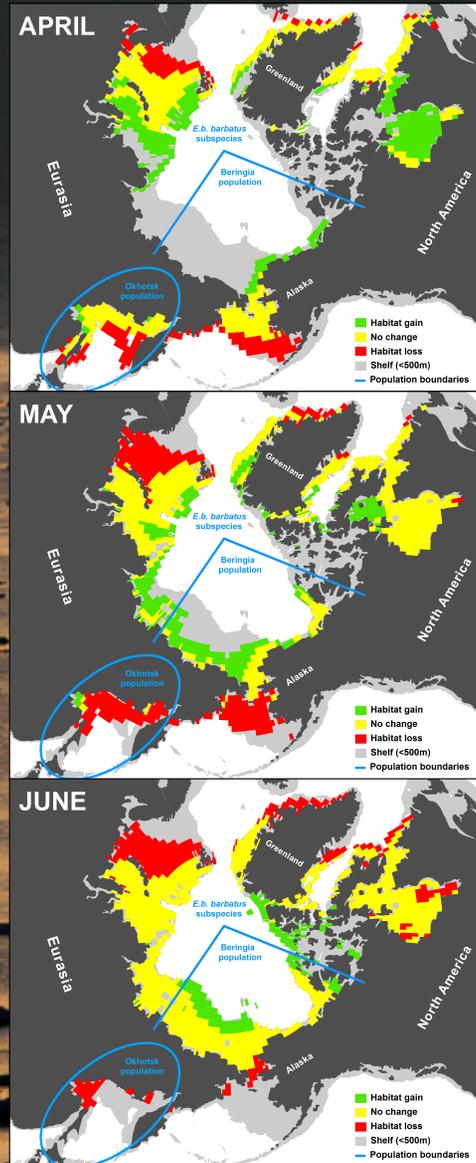


Figure 2. Maps showing areas of predicted habitat loss, gain, or no change in status from 2010 to 2090 for three bearded seal populations by month.

Table 1. Predicted percent net change in habitat area from 2010 to 2090 for three bearded seal populations by month.

	APRIL	MAY	JUNE
<i>E.b. barbatus</i>	+50%	+1%	-21%
Beringia pop.	-24%	+7%	+26%
Okhotsk pop.	-36%	-89%	-100%

CONCLUSIONS

- For *E. b. barbatus* and the Beringia population, habitat gains could offset or even exceed habitat losses in some months by 2090. Bearded seals currently inhabiting the Bering and Barents Seas and southern Greenland, where habitat losses are predicted to be greatest, may be forced to shift northward and/or laterally by 2090 to make use of areas of remaining or gained habitat. However, the likelihood of this occurring is uncertain as it depends on several unknown or unpredictable factors such as changes in distributions or densities of predator, prey, and competitor species; the location and intensity of human uses of the Arctic (e.g., petroleum exploration and development, commercial fisheries, and shipping); and bearded seals' plasticity to rapid environmental change. Due to these uncertainties, as well as our simplistic and perhaps inaccurate characterization of habitat, we advise precaution when using these results for management decisions.
- For the Okhotsk population, habitat losses are predicted to be extensive in all three months by 2090. It seems very unlikely that bearded seals will be able to compensate for these losses by shifting their range.
- Additional monitoring and analysis of bearded seals' habitat preferences, distributions, and movements will be required to improve our ability to predict both habitat changes and population responses in this rapidly changing environment.



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