Seasonal Migration of Bearded Seals Between Intensive Foraging Patches

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Movement

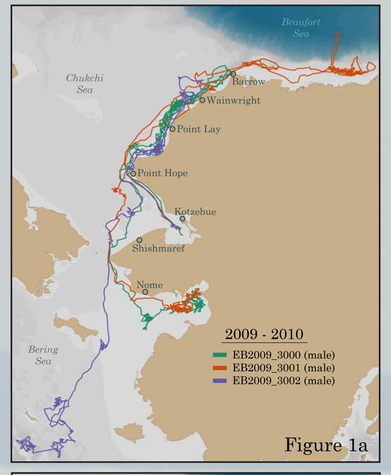

Figure 1a

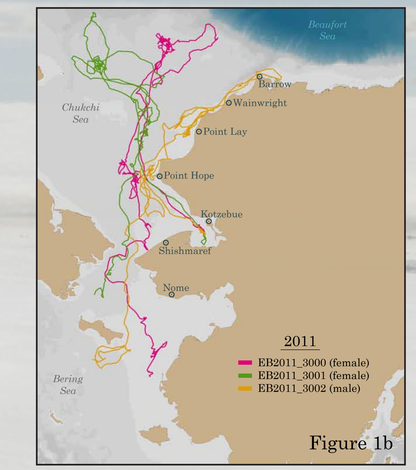

Figure 1b

Behavior (Foraging/Resting)

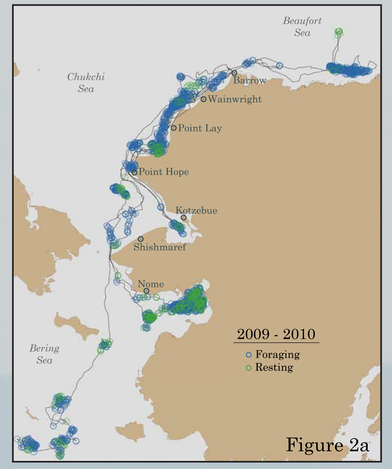

Figure 2a

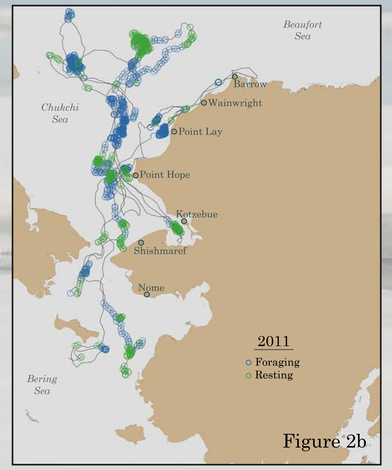

Figure 2b

Movement

In 2009, all three individuals (males) moved rapidly north, staying near the coast, to summering locales in the Chukchi (2) or Beaufort (1) Sea (Fig. 1a). One individual tagged in 2011 (male), undertook a coastal northward migrations to the Chukchi Sea (Fig. 1b), nearly identical to those observed in 2009. The other two individuals tagged in 2011 (female) moved to summering areas much farther from shore in the Chukchi Sea (Fig. 1b).

Behavior (Foraging/Resting)

As an initial step toward describing and quantifying habitat use by bearded seals, we fit the movement and diving data from the tagged seals to a multi-state random walk model (McClintock *et al. In review.*). The model allows for transitions between states of movement behavior (*e.g.*, foraging, traveling, resting) as animals are affected by their internal and external environmental conditions. The model results, particularly from 2009, indicated that northward and southward movements through the northern Bering Sea, Bering Strait, and the southern Chukchi Sea were mostly directed, migration-like movements with relatively little foraging and resting, compared to summer movements in the Chukchi and Beaufort seas, and winter movements in the Bering Sea (Figs. 2a-b).

Background

Bearded seals (*Erignathus barbatus*) are one of the most important nutritional and cultural resources for northern Alaska coastal communities, where they are known as *ugruk*. They may be at risk from loss of, or shifts in their sea-ice breeding habitat, and from other ecological consequences of climate warming. We tagged six bearded seals with satellite-linked geo-locators and dive recorders in Kotzebue Sound when the seasonal sea ice was rapidly melting in June of 2009 and 2011. All six seals were sub-adults (5) or adult (1) at the time of tagging.

Winter Site Fidelity

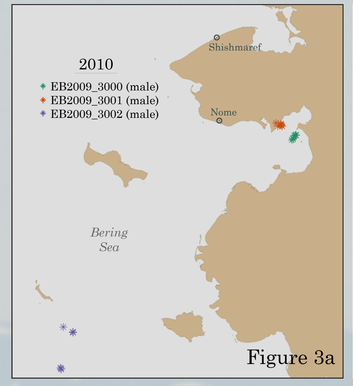

Figure 3a

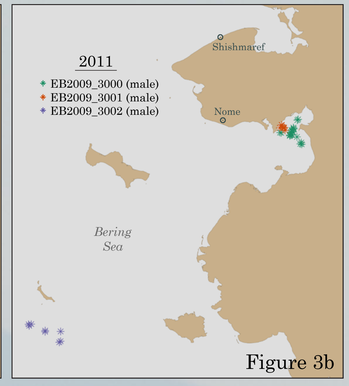

Figure 3b

Using miniature satellite tracking tags attached to the hind-flippers of the seals tagged in 2009, we were able to continue to monitor the positions at a coarse temporal scale after the main (glued-on) transmitters were shed during the pelage molt. The flipper-mounted tags provided locations only when the seals were hauled out, but the data clearly indicated that each individual returned to the same area in winter of 2011 that he had used in winter of 2010 (Figs. 3a-b).

Conclusions

- Six bearded seals tracked by satellite telemetry undertook rapid northward migrations from Kotzebue Sound to the Chukchi and Beaufort seas during July as the sea ice receded, and southward migrations to the Bering Sea as the ice advanced during autumn.
- Between these directed seasonal movements, a large portion of the seals' time was spent in small areas, foraging intensively as indicated by the frequency of dives and the limited scope of movements.
- The bearded seals tagged in 2009 returned to the same or nearly the same winter foraging patches in 2011 that they had used in the previous winter of 2010; we predict that the seals tagged in 2011 will also show strong winter site fidelity.
- These spatial characteristics of bearded seal foraging patterns, while not unexpected for a predominantly-benthic forager, may have implications for individuals' resilience to shifting ice distributions in response to climate warming and to impacts from industrial activities.

McClintock B.T., R. King, L. Thomas, J. Matthiopoulos, B.J. McConnell, and J.M. Morales. *In review.* A general modeling framework for animal movement and migration using multi-state random walks. *Ecological Monographs.*

(See also Alaska Marine Science Symposium poster by McClintock *et al.*)

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