Stable isotope model predicts foraging habitat of northern fur seals (Callorhinus ursinus) in Alaska

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Objectives:
The objective of this study was to develop a model that uses carbon (δ13C) and nitrogen (δ15N) stable isotope values of blood to predict on-shelf or off-shelf habitat use by adult female northern fur seals (Callorhinus ursinus) from breeding colonies in Alaska. To assess the feasibility of this model, we compared individual stable carbon and nitrogen isotope values from red blood cells (RBC) and plasma with individual satellite location and time-depth recorder dive data collected in 2006. Independent data collected in 2008 was used to test the performance of the model and determine whether it could account for annual differences in stable isotope values.

Methods:
In 2006, female northern fur seals were captured at three breeding colonies in Alaska (Bogoslof Island and Reef and Vostochni rookeries on St. Paul Island). In 2008, females were captured at Reef and Vostochni rookeries on St. Paul Island. All study sites are located close to the North Pacific continental shelf, providing distinct foraging habitats (on-shelf vs. off-shelf; Fig. 1). In both years instruments were deployed in July and blood was collected when animals were recaptured in October.

Animals were categorized by foraging strategy: on-shelf foragers exclusively utilized the on-shelf habitat, off-shelf foragers consistently traveled beyond the 200m isobath to the off-shelf habitat, and mixed-shelf foragers utilized both on- and off-shelf habitat.

During both years, animals from each breeding site made foraging trips to distinct habitats in the Bering Sea that allowed for categorization of their foraging strategies (Fig. 2). For plasma and RBC, δ13C and δ15N isotope values of animals foraging on-shelf were enriched in comparison to off-shelf values for both plasma and RBC (Fig. 4). The model did not perform as well in predicting foraging habitat from plasma and RBC. Stable isotope model predicts foraging habitat of northern fur seals by foraging strategy.

Results:
In 2006, Argos location data were collected from 31 females and dive data were collected from 28 females (Table 1). In both 2006 and 2008, the model accurately predicted on-shelf or off-shelf habitat use by adult female northern fur seals using blood isotopes that is validated with an additional year of data.

Conclusions:
- Using carbon (δ13C) and nitrogen (δ15N) stable isotope values of blood, we developed an innovative model to predict on-shelf or off-shelf habitat use by adult female northern fur seals from breeding colonies in Alaska.
- Our model is the first to accurately predict individual foraging habitat of northern fur seals for large sample sizes of top marine predators at relatively low cost.
- This approach provides the opportunity to quantify habitat use for large sample sizes of top marine predators at relatively low cost.