Arctic - Mammals

Metabolic Costs of Stationary Diving and Submerged Swimming in Bearded Seals (*Erignathus barbatus*)

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The bearded seal (*Erignathus barbatus*) is a threatened species due to its dependence on sea ice, a resource that is rapidly disappearing in a warming Arctic. To more accurately predict the consequences of sea ice loss on free-ranging bearded seals, physiological source data are needed to parameterize bioenergetic and population models. In particular, species-specific estimates of metabolism when resting, diving, and swimming are central to quantifying the energetic costs of behavioral changes brought about by environmental change. The PHOCAS (Physiology and Health of Cooperating Arctic Seals) research program uses a unique resource of non-releasable seals studied in human care to fill data gaps that cannot be addressed by studying wild seals. Here, we used open-flow respirometry to directly measure stationary diving and submerged swimming metabolic rates, as well as metabolism while resting at the surface, with one adult male and one juvenile female bearded seal housed at Long Marine Laboratory in Santa Cruz, CA. Individuals were trained to voluntarily participate in research activities. During diving trials, seals rested at the bottom of saltwater pools on a single breath hold for one of five consecutive treatment durations: 1, 3, 5, 7, and 1 min. Five measurements were obtained for each treatment before moving on to the next. During swimming trials, seals swam the perimeter of circular pools at preferred swimming speeds while submerged and without breathing for set intervals up to five minutes. The cost of diving was consistent across treatment durations for the adult male, averaging 3.26±0.13 ml O2 min-1 kg-1; this value was comparable to his metabolic rate while resting and breathing calmly at the surface (3.10±0.16 ml O2 min-1 kg-1). The largest variability was observed across the 1 min treatments and may reflect a cognitive component to the dive response. The adult male's average submerged swimming metabolic rate was 4.26±0.90 ml O2 min-1 kg-1 when traveling at approximately 0.9 m/sec. The juvenile female displayed a higher mass-specific resting metabolic rate (4.91±0.42 ml O2 min-1 kg-1) than the adult male, conforming to established ontogenetic trends. Diving and swimming trials with the juvenile female are ongoing, with initial diving metabolic rates being similar to or lower than her resting values at the surface. These emerging physiological data for seals engaged in typical behaviors allow estimation of overall energy budgets and can be used in modeling efforts to assess the consequences of continued Arctic warming on bearded seal populations.