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Title:
A fine-scale and longitudinal assessment of energy requirements for Arctic seals

Abstract:

Ice-dependent Arctic seals use sea ice as a substrate for various critical functions including rest, pupping, molting, and predator avoidance. These activities may become disrupted or more energetically costly in the absence of sea ice. For example, during the annual molt seals shed several layers of epidermis and fur, and regenerate a new coat. To facilitate this process, seals haul out for extended periods, increase blood flow to the skin, and maintain elevated skin temperatures. Molting is energetically costly, and associated costs are predicted to increase if appropriate haul-out substrate is unavailable. Similarly, energetic costs may increase if haul out platforms and foraging areas are spatially separated. Measures of resting metabolism can be used to evaluate the potential impact of environmental changes on seasonal energy requirements. Working with eight highly trained Arctic seals, encompassing three species [bearded (*Erignathus barbatus*), ringed (*Pusa hispida*), and spotted (*Phoca largha*) seals], we used open-flow respirometry to track fine-scale changes in the resting metabolic rate (RMR) of individual seals for up to three years. Further, we examined the relative importance of key variables such as air and water temperature, photoperiod, age, body condition, and physiological state on documented changes in RMR. Our data reveal clear seasonal patterns in energy demands that relate to the molting strategies of each species. For species that molt over a relatively short interval (spotted: 36±4.6 days, ringed: 29±2.5 days), RMR increased sharply (range: 26-47%) across the molt. In contrast, molting over a longer interval (bearded: 107±14.8 days) appeared to limit energetic costs as indicated by a more stable annual RMR. Our findings reveal a previously unknown relationship between molting strategy and seasonal energy requirements and provide quantitative data that can be used to predict how sea ice loss and associated environmental changes may alter energetic balance in Arctic seals.