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Title:
Ontogeny of muscle physiology in arctic seals

Abstract:

Marine mammals must store and efficiently use oxygen while diving. Although oxygen is distributed across lung, blood, and muscle reservoirs, skeletal muscles play a substantial role in defining diving capacities. In general, locomotor muscles of marine mammals have large oxygen reserves to fuel aerobic metabolism at depth, but must also be capable of managing the buildup of anaerobic byproducts. Further, pups are not born with the same physiological capacities as adults, with aerobic and anaerobic abilities typically developing at the onset of independent foraging. Knowledge of species- and age-specific skeletal muscle physiology can inform understanding of diving constraints and behavioral flexibility. We examined myoglobin content ([Mb]) and non-bicarbonate buffering capacity (β) of a major locomotor muscle, the longissimus dorsi, in three Arctic seal species. Samples were obtained from ringed (*Pusa hispida*; n=11), bearded (*Erignathus barbatus*; n=37), and spotted (*Phoca largha*; n=12) seals in collaboration with native Alaskan subsistence hunters. We found adult ringed seal muscle [Mb] to be 6.4±0.5 g Mb 100 g wet tissue^{-1}, while adult spotted seal muscle [Mb] was 5.5±0.5 g Mb 100 g wet tissue^{-1}. These data agree with previously reported values for other phocid species. In contrast, adult bearded seals had much lower muscle [Mb] (4.6±0.4 g Mb 100 g wet tissue^{-1}), making their muscle physiology more similar to benthically foraging walruses than to other phocids. Overall, we documented increasing ontogenetic trends in [Mb] and β for all three species; however, bearded seals exhibited more subtle developmental patterns. Our data suggest a strong link between muscle physiology, life-history strategies, and foraging behavior, and provide insight into the ontogeny of diving capacities and limitations in data-deficient species.