

Development of animal-borne dissolved oxygen loggers to examine the foraging behavior of northern elephant seals in the oxygen-limited mesopelagic zone.

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The ocean's mesopelagic zone (200-1000 m) holds large fish biomass and is a critical foraging habitat for deep-diving marine mammals. The mesopelagic zone is characterized by decreasing dissolved oxygen (DO) concentration with depth, but mid- and deep-water DO levels often vary spatially. Understanding the foraging behavior of deep-diving marine mammals relative to variability in midwater DO levels will provide insight into the ecological effects of climate change on the mesopelagic zone. Deep-diving northern elephant seals are hypothesized to feed on sluggish fish in mesopelagic oxygen minimum zones (Naito et al., 2017 *Ecol Evol*). However, it has been challenging to obtain in situ midwater DO levels where marine mammals forage due to a lack of suitable animal-borne devices. Here, we report preliminary results on the relationship between midwater DO levels and feeding behavior of northern elephant seals, by using newly developed animal-borne DO loggers together with other behavioral loggers. We obtained data on midwater DO levels from female northern elephant seals ($n = 5$) during a portion (1-7 days) of their post-breeding trips from back-mounted DO loggers (PRE1300-ODT, manufactured by Little Leonardo Ltd.). We also investigated concurrent measurements of feeding events from jaw-mounted accelerometers and movement tracks from head-mounted satellite transmitters. Our results showed that seals fed at different depths and therefore experienced different DO levels between daytime and nighttime dives. They fed at mean depths of 557-609 m and 337-440 m (mean DO: 0.55-1.51 mg/L and 1.74-3.54 mg/L) during daytime and nighttime, respectively. DO levels at mean feeding depths were lower than upper DO thresholds of oxygen-limited zone (OLZ: 2 mg/L) and oxygen minimum zone (OMZ: 0.7 mg/L) for 93.5% and 14.0% of all daytime feeding dives ($n = 399$ dives), respectively. In comparison, DO levels at mean feeding depths were lower than upper DO thresholds of OLZ and OMZ only for 23.1% and 1.6% of all nighttime feeding dives ($n = 707$ dives), respectively. Nighttime dives had slightly more feeding events per dive (12.6- 20.9 events / dive) and more feeding events per unit dive time (0.010- 0.021 / s) than daytime dives (8.2- 14.0 events / dive, and 0.007- 0.010 / s). Further investigations are required if seals target on prey of larger size or different types to compensate for apparently fewer feeding events in deep daytime dives in OLZ.