

## Searching for prey in a dark ocean: deep-diving seals expand whiskers for active prey-sensing

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Visual sense in diving predators is often of limited use underwater, especially in the deep, dark marine environment. Therefore, pinnipeds, which do not echolocate as odontocete cetaceans do, are expected to rely largely on vibrissal system to locate prey by following hydrodynamic trails. However, it remains unclear whether pinnipeds use vibrissal system in nature. Here, we monitored whisker movements of deep-diving pinnipeds, female northern elephant seals, by deploying newly-developed video cameras on the cheek of the seals. We also attached newly-developed mandible accelerometers that incorporate light sensors to another six seals, considering the effect of bioluminescence (visual cue of prey) to foraging success. The movie covered for 5.4 hrs in total, including 18 dives (up to 760 m) during oceanic migrations. Seals mostly kept whiskers closed at shallow depths (for 99.2% of time at < 200 m) where no sign of prey appeared in the movies. Seals often expanded whiskers at deeper depths (for 20.2% of time at > 200 m), suggesting that they started to use vibrissal system for active prey-sensing once reaching a certain depth. In fact, this depth matches where prey footage appeared (e.g. escaping fish with or without bioluminescence) although only 0.2% of movie frames included the prey footage. The importance of vibrissal system for prey-sensing in the dark environment is also corroborated by another results from the mandible accelerometers that show only 20% of feeding events accompanied bioluminescence although most bioluminescence (> 90%) occurred with feeding events, suggesting the occasional contribution of bioluminescence as visual cue to foraging success. Our results demonstrate that seals rely on the active prey-sensing using vibrissal system, probably in addition to visual sense in the occasional existence of bioluminescence, giving an important implication for the sensory modality of pinnipeds that exploit the deep, dark ocean.