

# King penguins adjust their fine-scale traveling and foraging behavior to spatial and diel changes in feeding opportunities

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Central place foragers such as pelagic seabirds often travel large distances to reach profitable foraging areas. King penguins (*Aptenodytes patagonicus*) are well known for their large-scale foraging movements to the productive Antarctic Polar Front (APF), though their fine-scale traveling and foraging characteristics remain unclear. Here, we investigated the horizontal movements and foraging patterns of king penguins to understand their fine-scale movement decisions during distant foraging trips. We attached multi-channel data loggers that can record depth, speed, tri-axis acceleration, tri-axis magnetism, and environmental temperature to the penguins and obtained data (n=8 birds) on their horizontal movement rates from reconstructed dive paths and their feeding attempts estimated from rapid changes in swim speed. During transit toward main foraging areas, penguins increased the time spent on shallow traveling dives (< 50 m) at night and around mid-day, and increased the time spent on deep foraging dives (≥ 50 m) during crepuscular hours. Once penguins reached to the main foraging areas near or in the APF, they increased the time spent on deep foraging dives (≥ 50 m) throughout the daytime. The horizontal movement rates during deep dives were negatively correlated with maximum dive depths, suggesting that foraging at greater depths is associated with a decreased horizontal traveling speed. Penguins concentrated their foraging efforts (more deep dives and higher rates of feeding attempts) at twilight during transit, when prey may be more accessible due to diel vertical migration, while they traveled rapidly at night and mid-day when prey may be difficult to detect and access. Such behavioral adjustments correspond to a movement strategy adopted by avian deep divers to travel long distances while feeding on prey exhibiting diel vertical migration.