

Crepuscular foraging by king penguins : behavioral adjustment to the diel vertical migration of prey

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Foraging success of diving seabirds, which seems mostly to rely on vision to forage their prey, is influenced by the diel vertical distribution of prey as well as ambient light intensity. In the open ocean, mesopelagic fish generally distributes near the surface at night. As a consequence, visually guided birds mostly fail to detect and pursue their prey at this time. Therefore, many diving seabirds, including penguins, are known to feed much more successfully in deep dives during the day than at night. However, there are few reports on the crepuscular foraging activity of diving seabirds. During dawn, their prey is migrating from shallow water to deep water and vice versa during dusk. In these periods, birds might forage effectively on their prey accessible at a shallower depth, if the light intensity is enough for detecting prey. However, it also seems possible that their foraging might be less effective because their prey has dispersed in the water column and more active than during the day. In this study, we examined how the foraging success of free-ranging king penguins changes through the diel cycle, using multi-channel data loggers (W1000L-3MPD3GT, Little Leonardo). The loggers were attached on birds breeding at Possession Island, Crozet Archipelago (46°25'S, 51°45'E) from late January to early March in 2011 to record swimming speed and 3D dive paths during foraging trips. We defined a rapid change in swimming speed as a feeding attempt, and feeding rate (number of feeding attempts/dive duration) was calculated to compare among nocturnal, crepuscular, and diurnal dives. The results showed that feeding rate was higher, and feeding depth was shallower in dives during twilight than in diurnal dives. Distance between positions of consecutive feeding attempts estimated from 3D dive paths was often (> 60%) less than 15 m with no significant difference between day and twilight. In addition, time spent diving per hour was higher during the twilight period than the daytime period. These results suggest that the foraging of king penguins is more successful during twilight than daytime, possibly because of the shallow distribution of aggregated prey and their high diving effort. King penguins appeared to adjust their foraging effort in response to the diel vertical migration of their prey.