Eating in the dark: Ross Sea Adélie Penguin Foraging Habitat

Grant Ballard
gballard@pointblue.org

Understanding where penguins find food, the physical characteristics of these locations, and how this changes through time helps us understand the relative importance of different habitat types in polar marine ecosystems. We report results from a study that used small devices attached to Adélie penguins to record at-sea locations, high resolution diving data, light availability, and temperature. Utilizing the data that the tags collected as well as data collected by satellites for the same locations we characterized aspects of more successful or less successful foraging locations. Satellite-based data included sea-surface temperature, chlorophyll concentration, and sea ice concentration.

We retrieved data from 162 Adélie penguins breeding at Cape Crozier over five years, 2005-2008 and 2012. We created an index of penguin foraging success using the diving data: dives that had a lot of "wiggles" and with extended bottom time indicated that penguins were pursuing prey.

We used a machine-learning approach to characterize the relationship between the number of wiggles and the oceanographic conditions at that specific location.

We found that most oceanographic features measured by satellites were not predictive of foraging success, but that light availability and the change in temperature, as measured by the devices on the penguins, were both relatively strong predictors. Our results suggest that an optimum light level exists for foraging penguins: too much light, and the prey see the penguins coming and escape, too little light and the penguins cannot see their prey.

Contrary to suggestions from previous studies, we found that sea ice concentration was not an important predictor of foraging success. We also confirmed that penguins traveled farther to achieve the same foraging success later in the season, despite consistent oceanographic features in the foraging area, indicating that prey become depleted as the

breeding season progresses at this very large penguin colony.

Our findings suggest that finer spatial and temporal scale data, including from underwater, are necessary to accurately describe the environmental variables that correlate with penguin foraging success, reinforcing the promise of small, animal-borne sensors for evaluating ecosystem processes.

Main Points

Devices attached to penguins can tell us more about the Antarctic ocean than satellite-based sensors – especially about what is happening under the sea surface.

Penguins were successful at finding food for their chicks across the full geography of our study area – i.e., the entire place is a "hot spot."

Underwater light availability and temperature gradients were the strongest predictors of penguin foraging success.

Ballard, G., A. Schmidt, V. Toniolo, S. Veloz, D. Jongsomjit, K.R. Arrigo, D.G. Ainley. 2019. Fine-scale oceanographic features characterizing successful Adélie penguin foraging in the SW Ross Sea. Mar Ecol Prog Ser 608:263-277.