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## Responding to Climate Change: Adélie Penguins confront astronomical and ocean boundaries

Long-distance migration enables many organisms to take advantage of lucrative breeding and feeding opportunities during summer at high latitudes and then to move to lower, more temperate latitudes for the remainder of the year. The latitudinal range of the Adélie penguin spans  $\sim 22^\circ$ . Penguins from northern colonies may not migrate, but due to the high latitude of Ross Island, Antarctica, colonies, these penguins almost certainly undertake the longest migrations for the species.

In a paper published in *Ecology*, we collaborated with researchers from H.T. Harvey and Associates, Stanford University, NASA, and the British Antarctic Survey over a 3-yr period to document characteristics of migratory routes and wintering locations of Adélie Penguins.

We studied penguins from two colonies of very different size on Ross Island, Ross Sea, the southernmost colonies for any penguin. We acquired data from 3-16 Geolocation Sensors affixed to penguins each year at both colonies. Data were collected from 2003 to 2005.

Migrations averaged 12,760 km, with the longest being 17,600 km, and were in part facilitated by pack ice movement. Trip distances varied annually, but not by colony. Penguins rarely traveled north of the main sea ice pack, and used areas with high sea-ice concentration, ranging from 75-85%, about 500 km inward from the ice edge. They also used locations where there was some twilight (2-7 hr with sun  $< 6^\circ$  below horizon).

We report the present Adélie Penguin migration pattern and conjecture on how it likely has changed over the past  $\sim 12,000$  years as the West Antarctic Ice Sheet withdrew southward across the Ross Sea,

a situation that no other Adélie penguin population has had to confront. As sea-ice extent in the Ross Sea sector decreases in the near future as predicted by climate models, we can expect further changes in the migration patterns of the Ross Sea penguins.

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### Main Points

- This is the first study to show the migratory and wintering locations of Adélie Penguins
- Penguins require both high concentrations of sea ice and some amount of daylight in their wintering locations
- These penguins use ocean currents to facilitate annual migrations averaging  $> 12,000$  km
- Climate change will likely force Adélies to winter farther and farther south, in increasingly dark locations where they may not be able to find food

### Paper citation:

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