

Long-term and wide-range research on sea ice ecosystem changes in East Antarctica: Observations by top predators

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Antarctic coastal areas are home to abundant marine top predators and presumed to be vulnerable to environmental change. Thus top predators are sensitive indicators of local marine ecosystem changes, such as sea ice distribution, ocean temperature, and prey species. Especially the coastal areas from Syowa station to Enderby Land, East Antarctica, is an important area to understand how sea ice-dependent top predators respond to marine environmental changes as these areas exhibit a large inter-annual and seasonal variation in seasonal and land-fast ice. Through the past Japanese Antarctic Research Projects, we have been focusing on the behavioral ecology of Adélie penguins near Syowa station by using animal-borne data loggers to reveal fine scale foraging behavior and wintering areas (1, 2, 3). However, so far, our past projects had relatively limited geographical coverage with relatively short time-series on a limited number of species, to fully capture how changes in sea ice conditions affect top predators in East Antarctica. Recently we successfully tracked a few Weddell seals during winter (Fig. 1) and Adélie penguins during austral spring in detail that migrate long distances and thus may reflect sea ice conditions in broader spatial and temporal scales. Nevertheless, we had not conducted such observations extensively yet, according to limitations in field access and/or data recovery. If we handle these challenges, tracking top predators can be an effective method to monitor marine environments as well as their behavior covering wide ranges and long duration. In this context, we propose the following future research plans to study behavior of top predators and surrounding marine environments in a wide range and a long duration along the coast near Syowa station (Fig. 2), to reveal physical and biological processes affecting marine ecosystem changes.

(1) Long-term monitoring on marine environment and feeding behavior by Weddell seals: Miniaturized CTD tags as well as behavioral recorders will be attached on Weddell seals during autumn (February to March) after annual moult near Syowa station. Parts of these data are transmitted by satellites, and some others are required to be retrieved in the next spring. On the retrieval, feeding conditions and prey contents of the seals will be studied by sampling and analyzing blood/whiskers.

(2) Long-term monitoring on marine environment and feeding behavior by emperor penguins: Satellite transmitters will be attached on adults and fledgelings of emperor penguins during early summer (December) on the coast of Enderby Land. All data, may be including oceanographic and behavioral parameters, will be transmitted by satellites until the feather moults.

(3) Simultaneous monitoring on Adélie penguins among multiple colonies: There are several Adélie penguin colonies that face distinctly different sea ice conditions around Syowa station. In these different colonies, GPS trackers and behavioral recorders will be attached on Adélie penguins during spring (October) that covers feeding trips during incubation. The data will be recovered through remote base station.

To conduct these field studies, logistic supports including use of Dronning Maud Land Air Network (DROMLAN) to deploy/retrieve researchers from earlier to later in the summer season, use of helicopters on board icebreaker on the way to/back from Syowa station, and renewal of field facilities are required. Also, technologies to miniaturize environmental sensors and to transmit data remotely should be established. Through these field studies, we could reveal what is the key factor for survival of top predators and changes in the Antarctic coastal marine ecosystem. Furthermore, we could collect large amount of oceanographic data in extensive sea ice conditions that complement ship-based studies. Such studies will enhance interdisciplinary investigations to reveal ocean thermal circulation in the Antarctic coastal areas or basal melt of Antarctic glaciers that closely relates to global climate change.

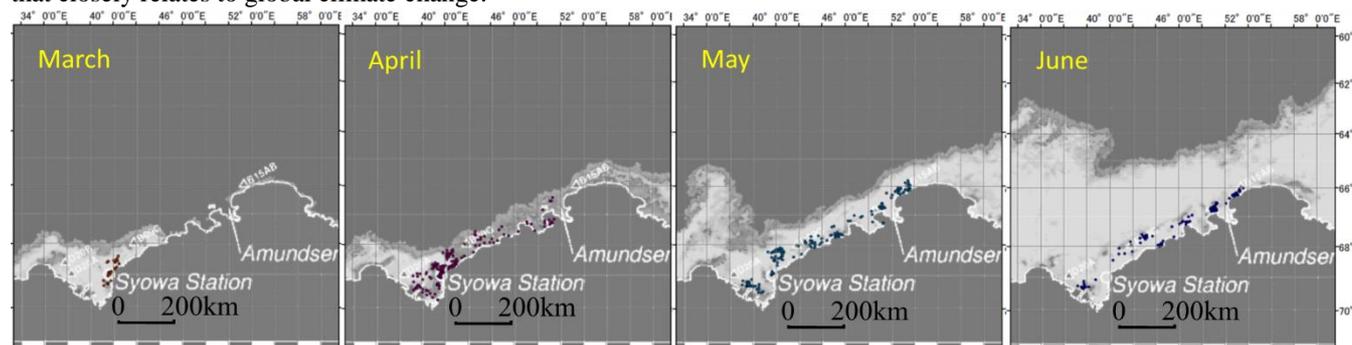


Fig. 1. An example of tracking data of Weddell seals deployed near Syowa station, East Antarctica, in 2017 austral winter season. Tracking

data are overlaid on sea ice concentration.

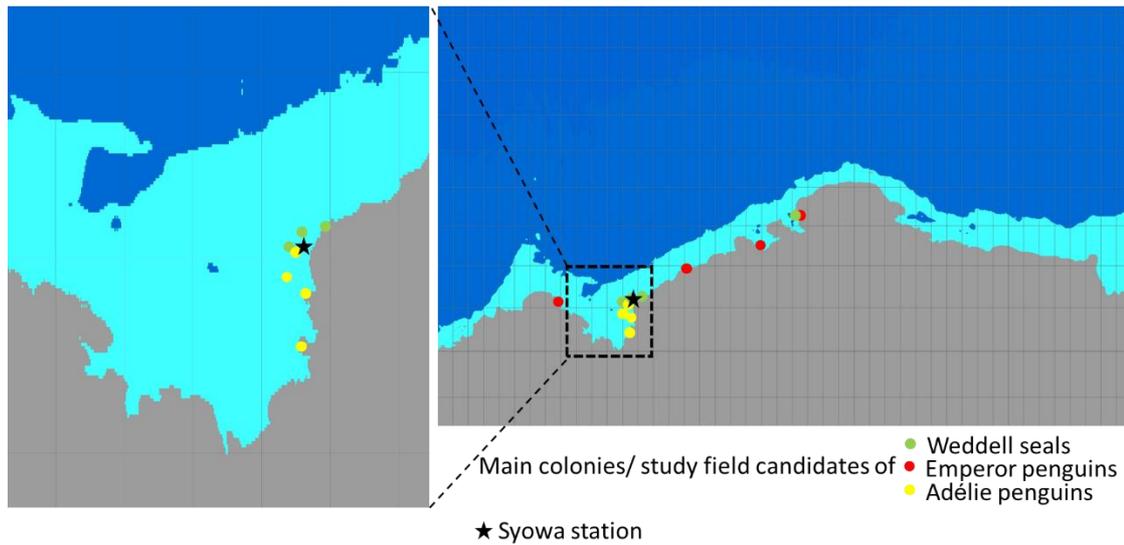


Fig. 2. Target species and location of the proposed study plan.

References

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