

Differential responses of seabirds to climate variability over two years in the southeast Bering Sea

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The Bering Sea represents productive marine ecosystems, supporting some of the United States' most productive and valuable fisheries and immense populations of marine fauna. Sea-ice cover has been decreasing in duration and concentration over the southeastern Bering Sea shelf which appears to impact the temperature of water column, and, thereby, the ecosystem dynamics in this region. Substantial works linking seabird demography to climate variability have been conducted. However, there is often little evidence that any local or regional current-year climate variables are useful predictors of the reproductive output, probably because seabirds could flexibly change their behaviour against fluctuation in environment. Hence, predicting the effects of climate change on marine top predators is a major challenge. In this study, we investigated the foraging behavior of two different seabird species, red-legged kittiwakes *Rissa brevirostris* (hereafter, RLKI) and thick-billed murre *Uria lomvia* (TBMU) between two years (July-August 2013 and 2014) on St. George Island located on the southeast Bering Sea. At-sea distributions of RLKI and TBMU were recorded using GPS loggers, and blood samples were taken to examine their physiological condition (i.e. stress level) and trophic level in a given year. Between the study years, SSTs around the colony were relatively warmer in 2014 compared to 2013, and Bering Sea Ice Retreat Index (IRI) was higher in 2013 than 2014, representing later sea ice retreat in 2013. In RLKI, on-water locations (i.e. foraging) occurred mostly on the oceanic basin. On the other hand, TBMU foraged mostly over the shelf, but showing a relatively higher use of the shelf break and oceanic basin in 2013. The foraging distances from the colony did not differ in RLKI, but differed in TBMU with farther travel distances in 2013 compared to these in 2014. Also, log-baseline CORT levels did not differ between years in RLKI, but differed in TBMU, showing significantly higher level during a relatively warmer year of 2013. $\delta^{15}\text{N}$ (a proxy of prey) did not differ between the years in both RLKI and TBMU, while $\delta^{13}\text{C}$ (a proxy of location) significantly differed in both species, which might indicate that they foraged on similar prey in different foraging locations between two years. During the study period, the fledgling success of RLKI was much lower in 2013 compared to 2014, whereas TBMU showed a similar success. RLKI consistently used the oceanic basin between two years probably due to their dominant reliance on myctophids that live in deep water of pelagic zone. It may indicate that kittiwakes were unable to buffer food shortages in the ocean basin. On the other hand, TBMU exhibited fluctuations in physiological condition in concert with flexible changes in foraging behaviour in relation to environmental variability. This study suggests that the ecosystem dynamics with climate variability in the southeast Bering Sea may differ between regions, which generates differential responses of seabirds to a possible future climate change.