Energyscapes and prey fields shape little auk wintering hotspots under climate change

Françoise Amélineau*†[1], Jérôme Fort[2], Paul Mathewson[3], Douglas Speirs[4], Nicolas Courbin[1], Warren Porter[3], Robert Wilson[4], and David Grémillet[1]

[1]Centre d'écologie fonctionnelle et évolutive (CEFE) – CNRS : UMR5175 – Campus CNRS - 1919 route de Mende - 34293 Montpellier cedex 5, France

[2]LIttoral ENvironnement et Sociétés [La Rochelle] (LIENSs) – CNRS : UMR7266, Université de La Rochelle – Bâtiment Marie Curie Avenue Michel Crépeau 17 042 La Rochelle cx1 - Bâtiment ILE 2, rue Olympe de Gouges 17 000 La Rochelle, France

[3]University of Wisconsin (UW) – Zoology, Madison, Wisconsin, United States

[4]University of Strathclyde – 16 Richmond Street, Glasgow G1 1XQ, Scotland, UK, United Kingdom

Abstract

Arctic species are particularly vulnerable to the drastic climate changes occurring in this part of the world. Most of the birds nesting at high latitudes migrate during the non-breeding season, therefore knowing the impacts of environmental changes outside the Arctic, during winter, is also crucial to understand the threats that they are facing. Little auks (*Alle alle*) from East Greenland breed in the High Arctic and migrate off Newfoundland, where many other seabird species spend the winter. Our aim was to understand how little auks optimize their energy balance during the winter in order to predict their energetic niches according to IPCC climatic predictions. Nearly 100 birds were equipped with geolocators to know their wintering grounds. We calculated their daily energy requirements with a mechanistic niche modelling, using the Niche MapperTM software along the North Atlantic Ocean. This spatial thermodynamic model took into account local climate, and the physiology and the behavior of the studied species, leading to the definition of energyscapes. Second, we constructed a resource selection function by coupling the energyscape with the modelled winter surface distribution of one of their prey, *Calanus finmarchicus*. We found that little auks wintering off Newfoundland faced a trade-off between prey densities and energetic requirements. Their predicted energyscapes for 2050 and 2100 showed a decrease in energy requirements for their current wintering grounds. Further investigations are required, to determine whether local productivity will be sufficient to sustain current little auk wintering hotspots in the future.

Keywords: bioenergetics, biologging, seabird, spatial ecology, habitat modelling

*Speaker

†Corresponding author: francoise.amelineau@gmail.com