THERMODYNAMIC MODELLING PREDICTS ENERGETIC BOTTLENECK FOR SEABIRDS WINTERING IN THE NORTHWEST ATLANTIC

Fort Jérôme[1], Warren P. Porter[2] and David Grémillet[1]

[1] Centre d'Ecologie Fonctionnelle et Evolutive, UMR CNRS 5175. 1919 Route de Mende, F-34293 Montpellier cedex 5, France
Email: jerome.fort@cefe.cnrs.fr

[2] Department of Zoology, University of Wisconsin, 250 N. Mills Street, Madison, Wisconsin 53706, USA

Studying the energetics of marine top predators such as seabirds is essential to understand processes underlying adult winter survival and its impact on population dynamics. Winter survival is assumed to be the single most important life-history parameter in long-lived species, but its actual drivers are still mysterious. Seabirds being usually offshore during the winter period, conventional metabolic studies are extremely challenging and new approaches are needed. We updated and used a new spatially- and temporally-explicit model based on the first principles of thermodynamics, Niche Mapper™, to predict energy expenditure and food requirements of the two main seabird species wintering in the northwest Atlantic: little auks *Alle alle* and Brünnich's guillemots *Uria lomvia*. For both species, our model predicts a sharp increase in energy expenditure between November and December, primarily driven by climatic factors such as air temperature and wind speed. These findings strongly suggest the existence of an energetic bottleneck for north Atlantic seabirds towards the end of the year, a challenging energetic phase which might explain recurrent events of winter mass-mortality, so called 'seabird winter wrecks'. Our study therefore emphasizes the relevance of this generic thermodynamic model to investigate the energy balance of wintering marine top-predators and its interplay with survival and population dynamics in the context of global change.