# Energetic bottleneck factors in catastrophic winter seabird losses

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It's a terrible sight: hundreds of dead seabirds washed up on the seashore. These catastrophic events occur in the winter and are known as winter wrecks. No one knows why the birds perish, and it is almost impossible to study the animals out in stormy winter seas to find out how they meet their fate.

With the birds' tough life style in mind, Jérôme Fort and David Grémillet from the CNRS Centre d'Ecologie Fonctionnelle et Evolutive in France decided to try to estimate the energetic demands placed on two alcid species (little auks and Brünnich's guillemots) by their aquatic lifestyle to find out whether battling the harsh conditions may simply be too energetically demanding for the little seafarers. Fort and his colleagues publish their discovery that winter wreck victims may not be able to eat enough to survive the harsh winter conditions in the *Journal of Experimental Biology* on 17 July 2009.

As it is impossible to gain access to the offshore birds in winter to directly measure their energy requirements, Fort and Gremillet teamed up with Warren Porter, who models the effects of environmental conditions on terrestrial animals, to estimate the birds' metabolic demands. Adjusting Porter's Niche MapperTM computational model to take account of the ocean environment and the birds' physiology, the team included environmental data for two regions of the Atlantic Ocean (off Newfoundland and Greenland) occupied by little auks and Brünnich's guillemots. They also detailed the plumage, physiology and behaviour of individual birds and calculated the animals' metabolic

demands for the months from September to March.

The results were startling. Both species' energy demands were relatively low during the months of September and October, but rocketed by 16□□% in November and remained high for the rest of the winter. The team realised that an energy demand of 430kJ/day for the tiny, 150g little auks and 1306kJ/day for the Brünnich's guillemots must place the animals under enormous strain as they battle the environment. And when the trio converted the birds' caloric requirements into the amount of food that each animal would have to find and consume daily, it came out at a colossal 289g of zooplankton for the little auks (almost twice their own body weight) and 547g of fish and crustaceans for Brünnich's guillemots (just over half of their body weight).

Fort says 'For seabirds, this is an energetic bottleneck'. He explains that as the winter sets in, increased wind speeds, low temperatures and vicious winter storms all conspire to raise the birds' metabolic demands. At the same time food becomes scarce and more difficult to capture. Coupled with the increase in their energy demands, the birds only carry limited reserves, placing them at an increased risk of starvation.

Given that most winter wrecks occur in November and December, Fort and his colleagues suspect that the energetic bottleneck could be a major contributory factor to the mass loss of life. Having modelled the effects of the climate on individual animals, the team is eager to look at the environment's impact on alcid populations and the effects on the food stocks that the birds depend upon. They are also keen to find out whether other ocean going species suffer the same catastrophic increase in energy demand as little auks and Brünnich's guillemots, raising their risk of succumbing to winter wrecks as the days draw in.

More information: Fort, J., Porter, W. P. and Grémillet, D. (2009). Thermodynamic modelling predicts energetic bottleneck for seabirds

wintering in the northwest Atlantic. *J. Exp. Biol.* 212, 2483-2490.
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