



Arctic lemmings: keystone species in a changing environment

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A brown lemming (*Lemmus trimucronatus*) near Walker Bay, Nunavut

Lemmings are keystone prey species in the North to predators such as Arctic foxes, snowy owls, weasels and jaegers. The legendary cyclical fluctuations in lemming populations affect their predators: as the lemming populations grow, predator populations increase because of the abundance of food (lemmings).

However, a large population of predators can then lead to overharvesting, which causes a huge decrease in the lemming population. This decrease makes the food supply insufficient for the predators, which causes their populations to decline in turn.

Recently, cycles in lemming populations have become less predictable in northern Europe and Greenland, coincident with an increase in temperature. It is crucial to gather and analyze comparable data on the population dynamics of lemmings in northern Canada. Understanding

whether ongoing climate change will affect lemming population dynamics and their use of habitat in the Canadian Arctic is central to forecasting the future of arctic ecosystems. Consequently, Douglas Morris and Angélique Dupuch are examining lemming populations near Walker Bay on the Kent Peninsula, Nunavut, where two species of lemmings, brown and collared, coexist.

To understand the links among climate, habitat, lemmings and predators, the Morris-Dupuch team analyzed data from Walker Bay dating back to 1996. This is the longest joint record of lemming dynamics and habitat use in the central Canadian Arctic. Researchers have used motion-detecting cameras and live trapping to learn how lemmings interact with their habitat, and ultimately, to predict the future. The data yielded a wealth of information about current and future habitat choice among lemmings, including recent findings discussed here.

Because they are food for numerous predators, one might expect that lemmings would choose habitat that minimizes the predation risk. No particularly safe environment is available to lemmings, although both brown and collared lemmings prefer land patches with protective plant cover. Collared lemmings are more vigilant (standing on hind legs and observing the surroundings intermittently) than brown lemmings but neither species increases vigilance against predators in open environments. Interestingly, both the brown and collared lemmings are more vigilant in the presence of the other species than when they are alone.

The pattern in vigilance hints that an important determinant of habitat choice at Walker Bay is competition between the two species. This is relatively surprising because the two species do not

compete for food: brown lemmings prefer sedges and grasses (which can stunt growth in collared lemmings), while collared lemmings prefer herbs and small shrubs such as mountain avens and willow (which stunt growth in brown lemmings). For lemmings, competition more likely relates to interference and aggression between the two species.

Therefore, when populations are low, the two species rarely interact; collared lemmings tend to occupy relatively dry environments with low-lying shrubs, while avoiding the wetter sedge and grass habitats preferred by brown lemmings. Competition, like a ghost, lurks in the northern Canadian tundra when populations are low, ever present but invisible because the lemmings choose to live in different habitats. However, when populations increase, both species expand into each other's marginally "fit" environments, and this is when the competition between the two species occurs.

Since 1950, temperatures increased in the Walker Bay area on average by 2.1°C, which caused increased shrub growth in a "wetter" landscape. In response to this, over time, both lemming species have altered their habitat use. Researchers are using the climate-induced habitat change to build general models that predict how lemmings and other species will use future habitats. The value of general models is that they can be fine-tuned to fit the findings of future studies on population dynamics and habitat choice under different climate change scenarios.

Northern Canada's harsh, cold climates can be endured by only a few hardy species. Arctic ecosystems are thus less diverse than those in southern climates. Because northern climates are warming, there is great interest in understanding the impact on vegetation and animal species. Studying these ecosystems will give insight into how species dynamics may be affected elsewhere in the world.

Want to learn more?

Dupuch, A., Morris, D.W., Ale, S. B., Wilson, D. J. and Moore, D.E. (2013).

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Morris, D.W., Dupuch, A. and Halliday, W.D. (2012).

"Climate-induced habitat selection predicts future evolutionary strategies of lemmings." *Evolutionary Ecology Research* 14:689-705.

Morris, D.W. and Dupuch, A. (2012).

"Habitat change and the scale of habitat selection: shifting gradients used by coexisting Arctic rodents." *Oikos* 121:975-984.

"Canada, more than any other, is an Arctic nation. Canadians thus have more to gain from Arctic research, and more to lose if they ignore it, than any other people. We hope that our research in Arctic Canada will help to provide the insights Canadians and other people need in order to understand the vastness, fragility and global significance of Canada's North and the rapidity with which it is changing."

– Douglas Morris



Dr. Angélique Dupuch (left), MaryJane Moses (MSc., centre) and Spanish PhD student Rocío Tarjuelo celebrate Canada Day at Walker Bay.