

Mammals of Nova Scotia: monitoring change in communities and ecosystems



Dr Christina Buesching and Dr Chris Newman

Background

The wilderness areas of Nova Scotia are home to many species that have long been locally extinct in many parts of industrialised Europe, such as bear, moose and beaver. This peninsular province located on the Atlantic coast of Canada harbours a diversity of habitats owing to its unique geographical location on the mid-temperate zone where southern deciduous forest regions make the transition into northern coniferous boreal zones (figure 1).

Nova Scotia is likely to be particularly susceptible to climate change impacts, since its warm, continental climate is heavily influenced by the ocean currents around it. Changes to these currents will lead to changing climatic conditions in the province itself, which will in turn have profound impacts on flora and fauna found in the province. Human activities such as forestry and road building are also increasingly impacting the native wildlife.

Understanding how such local and global scale environmental changes will affect the endemic mammal populations and landscapes in these temperate areas is crucial to developing effective management strategies for their conservation.

The primary research site is inland at Cook's Lake, and 2007 saw the development of a second field site for comparison, at the coast near Eastport Medway. Climatic and geological conditions at the two sites are both typical for Nova Scotia, but very different to each other, thus the research team expects to find differences in their ecology. Cook's Lake, an inland

site of 134 ha, comprises a diversity of habitats ranging from mixed coniferous and deciduous woodland, hay meadows, ponds, streams, and wetlands, whereas the site at Eastport is dominated by glacial erratics (rocks that differ from the size and type of rock native to the area in which it rests), which are covered by a very thin layer of top soil, thus posing very different ecological challenges to fauna and flora.

Project overview

The project, led by Drs Christina Buesching and Chris Newman, monitors how climate change affects the wildlife in Nova Scotia, in an effort to develop effective management strategies. Started in 2007, the research is building on the scientists' previous work on the Earthwatch *Mammal Monitoring project in Wytham Woods*, Oxfordshire, UK, which monitored various species to determine how they are affected by environmental and climatic change. In Nova Scotia, the scientists study the distribution and abundance of a multitude of different species, as well as their inter-specific interactions. Detailed species lists are constantly being added to for both Canadian sites, which will eventually include all plant and animal taxa, with the focus to date being on mammals, reptiles, amphibians and birds.

Objectives include:

- Setting up long-term monitoring sites
- Establishing baseline data to reveal population trends
- Investigating population responses of mammal species to local management regimes
- Optimising the use of non-professional volunteers in scientific data collection

As small mammals are the preferred prey for many avian and mammalian predators, monitoring their abundance is crucial to assess the health of an ecosystem. How their numbers are impacted by forest management strategies is especially important in an area where forestry and paper-mulch production are the most important remaining industries. By monitoring small mammal abundance and diversity in natural forests, compared to areas previously cleared for forestry and replanted with a native mixture of trees in 1992, the scientists hope to establish how these management procedures impact biodiversity in the long term, thus providing the means to refine forest management strategies in the future.

Animal monitoring is a time-consuming task for a small group of researchers, who have to check live trapping sites and camera traps, monitor plots, conduct field sign survey and animal dropping counts. On this project, Earthwatch volunteers have contributed their efforts to all of these tasks, helping to increase research capacity after they have been carefully trained to

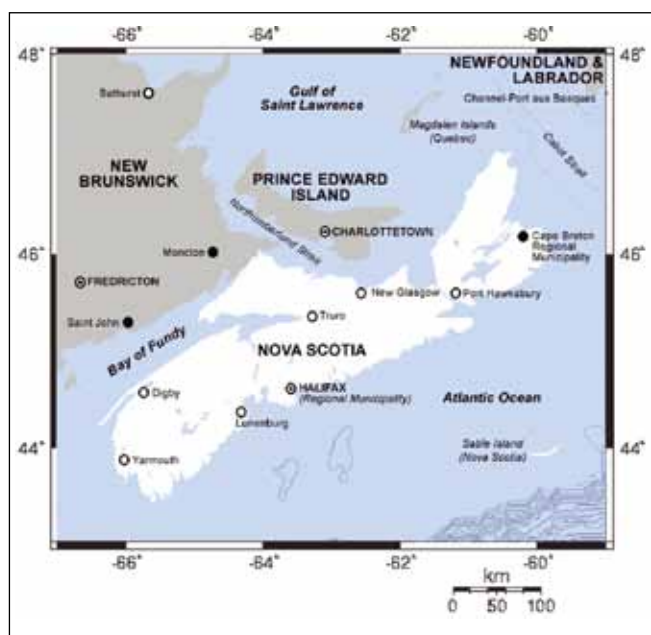


Figure 1. The province of Nova Scotia showing study site.

identify animals and their field signs. Besides collecting valuable baseline data for a variety of species, the volunteers have helped to establish the monitoring sites by expanding trail networks, have set up nearly 50 bat boxes for future bat surveys, and have mapped environmental features using a GPS device.

Research to increase knowledge of landscape scale management for adaptation to climate change is a part of Earthwatch's Climate Change Research Area.

Outcomes and actions

The site-specific species lists of mammals, reptiles and amphibians are an important prerequisite for ecological monitoring and help relate changes in species distribution to environmental factors in a given ecosystem. Significant progress has been made in collecting baseline data on 11 different species of small mammals, as well as charismatic species such as black bear (*Ursus americanus*); beaver (*Castor canadensis*); and species of porcupine. Special attention is given to the food web of snowshoe hare (*Lepus americanus*); white-tailed deer (*Odocoileus virginianus*), which arrived in the province around 100 years ago due to milder winters with thinner snow cover; and their predators, the native red fox (*Vulpes vulpes*); and the newly arrived Eastern coyote (*Canis latrans var.*), which followed the white-tailed deer into Nova Scotia as recently as 30 years ago and is now competing with the red fox for food resources. These baselines will be compared with long-term monitoring data to assess how species' distribution and abundance is related to environmental factors such as habitat changes resulting from forestry operations, or climate change.

An important discovery has been the rise in white-tailed deer populations as a result of warmer climate and reduced snow cover. White-tailed deer compete with moose (*Alces americanus*) for food resources in the area. They also carry an infectious nematode worm, which can be fatal to moose. Moose are now listed as threatened locally, although globally they are listed as Least Concern (IUCN Red



List). Censuses suggest that the average deer density in the area is 17-fold higher than official figures from 2003, which has important management implications in an area where white-tailed deer numbers have reached a point where the species cannot stably co-exist with moose.

At Cook's Lake, this year's research has added substantially to the understanding of long-term effects of clear cutting on small mammal populations, as well as site recovery. A large amount of geographical and environmental data have been collected to produce a multi-layered Geographical Information Systems (GIS) Map, mapping specific environmental features and expanding it to include newly established trail and bat box locations, as well as adding important mammal field signs, such as a hibernation sites, droppings, latrines, and kills. At Eastport, a basic geographical map was completed, depicting site boundaries and important habitat features. First estimates of deer and snowshoe hare densities are confirming the expectation of differences in ecology between the two research sites, as, although both species are present at both sites, there are pronounced differences in relative abundance, with hare prevailing at the coast and deer inland.

In addition to collecting long-term species-specific monitoring data, the project also aims to evaluate the use of amateur volunteers as a tool in



conservation research. For example, field sign transects are widely accepted as a suitable method to survey large areas for presence/absence of a variety of mammal species. However, the field signs of some mammal species are easier to detect and identify reliably than those of other species, and of course, some surveyors are better than others. Field sign transects at Eastport are being used to evaluate efficiency of different training methods, suitability of field sign transects for different mammal species, and individual-specific factors that influence quality and reliability of data. An evaluation was carried out this year, comparing accurate and up-to-date knowledge of which field signs can be found from scientist surveys, with results from volunteer teams along the same survey routes. This evaluation suggests that the method works well with volunteers for some species (e.g. snowshoe hare, white-tailed deer, porcupine and coyote signs were 100% recorded), but not others (e.g. eastern red squirrel, american mink and bobcat were $\leq 25\%$ recorded).



To evaluate suitability of the relatively new technique of camera trapping as a census method for use by volunteers, and to attempt to capture more elusive mammals on film, six camera traps were set over a total of 208 trap nights. 214 photographs captured images of raccoon (54 pictures), deer (31), snowshoe hare (3), chipmunk, squirrel, crow, raven and blue jay. The results confirmed observations from the previous field season, that this seemingly simple monitoring technique requires far more technical explanation and biological field experience than generally assumed. To ensure that more than 75% of volunteers understood and could use the correct method of deployment, the technique was demonstrated step-by-step at a real site in the field, rather than in a mock setting. Training volunteers to recognise suitable camera locations is extremely difficult and appears to require first-hand experience of observing animals in their natural environment.

Trends uncovered by this research so far will be further monitored in coming years. Although it is still too early to take results to policy makers, discussions have begun with landowners and hunters to achieve conservation by raising awareness of the richness of the environment in Nova Scotia. Project results are already informing one of the project's partners, the Mersey Tobeatic Research Institute, as they develop outreach programs to attract eco-tourists to Nova Scotia's national parks. Results

from the project will continue to inform the development of volunteer observation programs in both Canada and abroad. Both project scientists serve on the board of the Tracking Mammals Partnership in the UK, advising other conservation societies on the most effective use of volunteers in scientific data collection. The scientists have also just developed a course on mammal monitoring for the Oxford University's Department of Further Education.

Lead scientist profiles

Dr Christina Buesching is a Research Associate with the Wildlife Conservation Research Unit (WildCRU) at Oxford University, UK, and has been an Earthwatch scientist since 2001. She has an MSc from the German Primate Centre, Göttingen, on reproductive physiology and behaviour of the female lesser mouse lemur, and a DPhil from Oxford University investigating mammalian sociality and communication in badgers. Christina is particularly interested in investigating the socio-political and biological implications of the involvement of volunteers in ecological monitoring. She has university teaching experience in zoology and previously worked as a Science Officer with Earthwatch.

Dr Chris Newman is an Associate with WildCRU at Oxford University, UK, and an experienced Earthwatch scientist. He undertook his DPhil on Population Ecology, Demography and Parasitology at Oxford University and now co-manages

the Mammal Monitoring and Badger Projects for WildCRU. Chris is also Mammals Officer and Senior Animal Care and Welfare Officer for the university's Animal Ethics Committee.

Additional key scientists

- **Bonnie Sutherland** – Program Manager for the Nova Scotia Nature Trust
- **Duncan Bayne** – Land Securement Coordinator, Nova Scotia Nature Trust
- **Dr Amanda Lavers** – Director of the Tobeatic Research Institute
- **Cliff Drysdale** – Science Communication Coordinator for the Tobeatic Research Institute
- **Darien Ure** – Ecosystem Scientist for the Tobeatic Research Institute
- **Dr Samara Eaton** – Program Manager for the Nova Scotia Department of Natural Resources
- **Dr Sherman Boates** – Biodiversity Program Manager for the Nova Scotia Department of Natural Resources

Collaborative organisations

- Oxford University Wildlife Conservation Research Unit (WildCRU), UK

Project website

http://www.earthwatch.org/exped/buesching_research.html

Key publications

Buesching, C.D., Newman, C., Twell, R. & Macdonald, D.W. (2008) Reasons for arboreality in wood mice *Apodemus sylvaticus* and bank voles *Myodes glareolus*. *Mammalian Biology*, **73**: 318-324

Macdonald, D.W., Newman, C., Buesching, C.D. & Nouvellet, P.M. *in press*. Direct and indirect climatic impacts on mammalian population dynamics: Evidence from a Eurasian badger (*Meles meles*) population. *Journal of Mammalogy*

Buesching, C.D. & Macdonald, D.W. (2008) *The Mammals of Wytham Woods*. Blackwell Publishing, Oxford, UK