PRESENT AND PAST IMPACTS OF ANIMAL POPULATIONS ON THE NUTRIENT AND CONTAMINATION STATUS OF FRESHWATER LAKES ON BYLOT ISLAND, NUNAVUT

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BACKGROUND

The Bylot Island Migratory Bird Sanctuary (73° 13' 00" N - 78° 34' 00" W) was established in 1965 by Parks Canada to protect the nesting grounds of large concentrations of bird populations (Thick-billed Murres, Black-legged Kittiwakes and Greater Snow Geese) (figure 1).

Due to protection measures and changes in the overwintering habitat, the population of breeding Snow Geese (*Chen caerulescens atlantica*) on Bylot Island has increased dramatically over recent years (Giroux et al., 1998) (figure 2).

As a result, the nutrient load originating from faecal goose droppings has increased, which may profoundly change the relative concentrations of C, N and P in the usually dilute and unproductive (oligotrophic) arctic lakes (Van Geest et al., 2003). Both nutrient loading (due to increased numbers of birds) and temperature elevation (due to rapid warming of high latitude regions) may cause large shifts in the composition and functioning of these tundra lakes.

Figure 1 : Location of study site

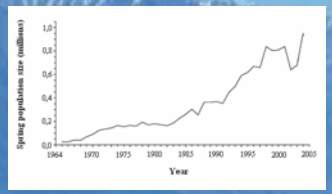


Figure 2: Snow Geese population evolution (1964-2003) based on surveys in the St. Lawrence River region

RESEARCH OBJECTIVES

1) track short- and long-term changes in lake nutrient (trophic) status and contamination
2) compare trophic history of lakes with known changes in bird population size
3) track long-term changes in the size of past goose populations.
4) assess water quality and the impact of animal populations

METHODOLOGY

A paleolimnological approach will be used for this research (figure 3). Paleolimnology is a multidisciplinary science that studies the history of lakes using the biological, chemical and physical information preserved in the sediments on the bottom of lakes and ponds.

• Extraction of sediment cores from lakes near breeding bird colonies.
• Reconstruction of past levels of trophic state (nutrients like P and N) using algal (diatoms), invertebrate (chironomids, cladocerans, ostracods) and pigment fossils and stable isotopes (δ15N).
• Sediment and water samples collected from the study sites will be analyzed for nutrients and contaminants at the National Laboratory for Environmental Testing (D. Muir, Burlington, Ontario).
• Development of transfer functions for the quantification of past trophic levels.

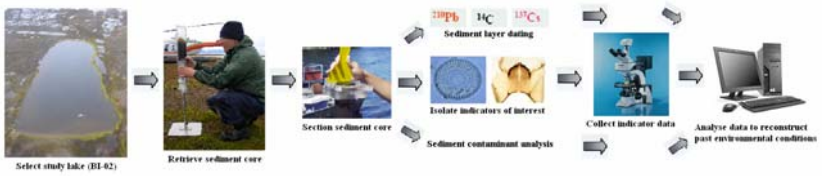


Figure 3 : Paleolimnological approach

SAMPLING – SUMMER 2005

From the 15th until the 19th of July 2005, 10 sites that seemed heavily impacted by goose dropping enrichment (figure 4) were visited to collect :

1) Surface sediments (modern diatoms, chironomids, ostracods)
2) Chemical data (pH, dissolved oxygen, conductivity, etc.)
3) Physical data (depth, transparency)
4) Sediment contamination data

Figure 4 : Concentration of Snow geese droppings in the catchment of lake BI-02

Figure 5 : Subsampling on lake BI-02 shore

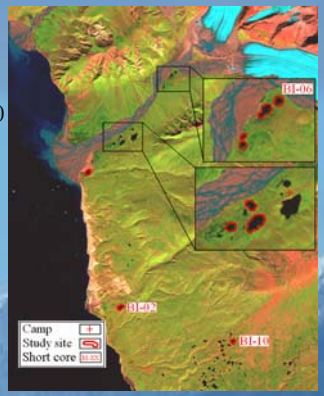
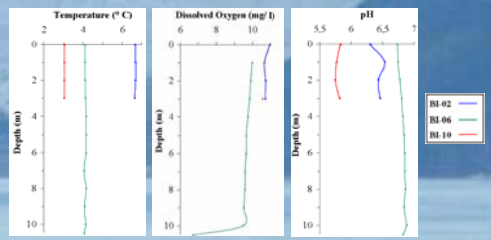


Figure 6 : Study sites

Three short cores (BI-02 : 21,25 cm, BI-06 : 21,50 cm, BI-10 : 31,00 cm) were also sampled to obtain information on the evolution of past trophic status in 3 lakes. Cores were subsampled at 0,25 cm intervals to get high temporal resolution needed for this study.

Limnological data :

Figure 7 : BI-02 lake



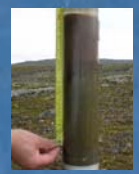


Figure 8 : BI-10 short core

Limnological data show conditions that are typical of high arctic lakes : shallow, cold, well-mixed and well-oxygenated systems.

Figure 9 : Snow goose

IN THE FUTURE …

With the sediment cores extracted from lakes near breeding bird colonies, we will use paleolimnological techniques to track short- and long-term changes in lake nutrient (trophic) status, primary production rate and contamination. Reconstructions of past levels of trophic state (nutrients like P and N) using algal (diatoms) and invertebrate (chironomids, cladocerans, ostracods) fossils and stable isotopes (δ15N) will also allow us to determine if there is a correlation between our data and the known changes in bird population size over the past 30 years. By identifying this correlation, we will eventually be able to track long-term changes in the size of past goose populations. The limnological and water quality data provided by this study will also serve as a temporal reference (baseline) against wich to assess limnological changes brought about by climate warming in the Arctic.

Giroux, J.-F., G. Gauthier, G. Costanzo & A. Reed. 1998. Impact of geese on natural habitats. Pp. 32-57 *in* The greater snow goose: report of the Arctic Goose Habitat Working Group, B.D.J. Batt ed. Arctic Goose Joint Venture Special Publication. U.S. Fish and Wildlife Service, Washington D.C. and Canadian Wildlife Service, Ottawa, Ont. ISBN 0-9617279-4-2.
Van Geest, G.J., Van Donk, E. & Hessen, D.O. 2003. How do goose droppings and temperature elevation affect plankton in arctic lakes? NORLAKE Symposium, Silkeborg, Denmark, November 2003.

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