Migratory Bird Research 2018
East Bay Island and Coats Island

Project Overview

We conduct our research at two Environment and Climate Change Canada research stations in the Kivalliq region. The East Bay Island (Mitivik Island) camp primarily conducts research on common eiders, and the Coats Island camp focuses on thick-billed murres. Environment and Climate Change Canada has been conducting research on seabirds and shorebirds at East Bay since 1996 in an effort to understand the factors influencing northern bird populations. Similarly, at Coats Island Environment and Climate Change Canada has been recording the timing of breeding, reproductive success, and diet of individual thick-billed murres on nesting study plots since 1981. We continue to monitor the wildlife at East Bay Island and Coats Island but are also investigating potential impacts of several emerging issues in an effort to inform wildlife management decisions and conservation planning.

Many of the emerging issues that we are currently researching include the influence of climate change and resource development on arctic marine birds. Our research objectives include:

1. Investigating and forecasting relationships between polar bears and eiders as diminishing sea ice influences bear predation on eider nests.

2. Identifying key seabird marine habitats in an effort to mitigate potential issues related to northern industrial development, particularly year-round shipping.

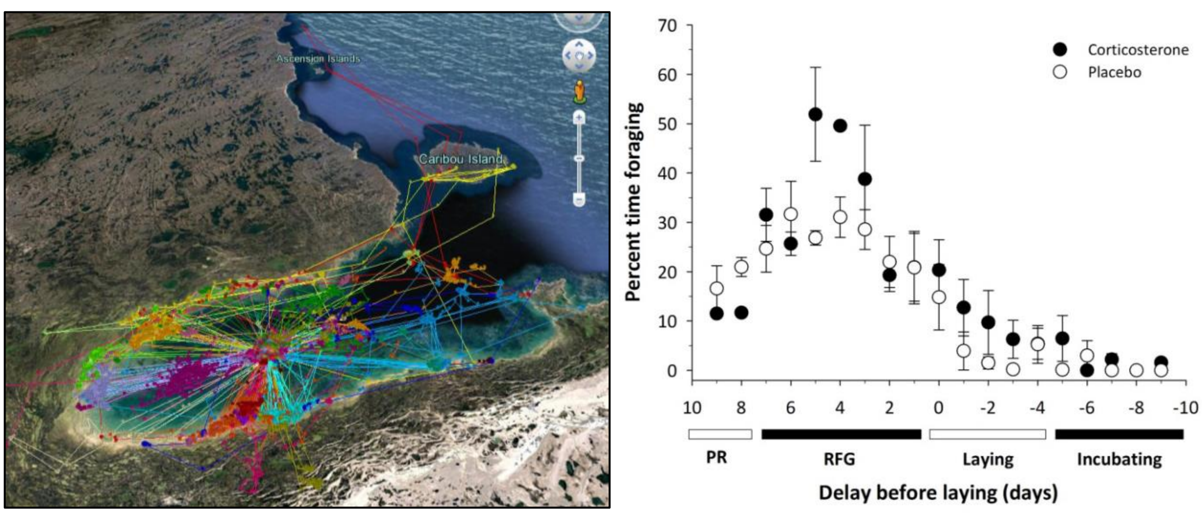
3. Understanding the physiological mechanisms linking climate variability, reproduction, and survival of arctic breeding migratory birds.

4. Investigating direct effects of changing sea-ice regimes on eider reproduction and population dynamics.

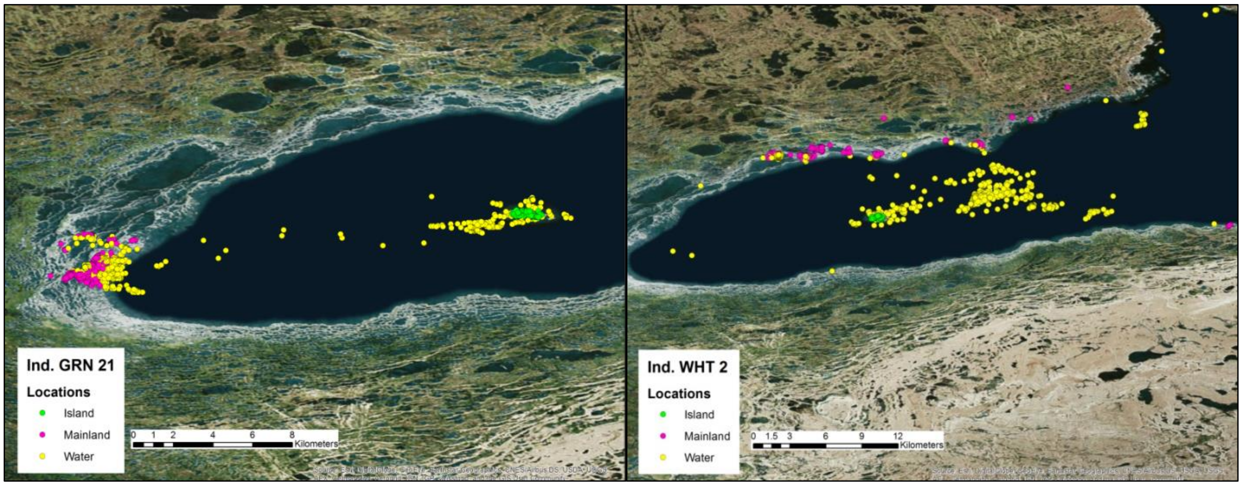
The Physiology that Links Foraging to Reproduction

- Dr. Holly Hennin (Post-Doctoral Fellow, University of Windsor) and Dr. Oliver Love (Professor, University of Windsor)

Finding out what controls the decision to breed in birds remains one of the key questions of ecology. The question has remained elusive for so long because it requires a certain type of biological system and a specialized and highly collaborative team. Female eiders are an ideal model in which to ask these questions because they must forage at very high rates on their breeding grounds to gain almost a kilogram of body fat so that they can both afford to lay eggs and make it through a fasting incubation that lasts almost a month. Combining this unique system at East Bay Island with our team's work using ground-breaking tools over the past decade has finally made answering these questions a reality. We can measure and even temporarily alter female physiology right after birds arrive from migration, track their foraging behaviour at East Bay with small GPS units that track their movements, and then finally find females within our colony when they start laying. Combining all this data together is revealing that eider hens with higher levels of key energetic hormones invest more time and effort in foraging behaviours, have higher fattening rates, and end up laying the earliest in the colony, which leads to both larger clutches and higher duckling survival.



Combining GPS tracking of movement (left) and physiology (right) revealed that eider hens with higher levels of a key energetic hormone (corticosterone) spend more time foraging during the rapid follicle growth (RFG) period when they are developing eggs.



Our GPS tracking studies are revealing that female common eiders may use different foraging strategies to solve the same breeding problems at East Bay. For example, female GRN 21 (left) fed consistently at a specific freshwater river mouth at the far west of the bay, whereas female WHT 2 (right) fed across a diversity of freshwater and marine areas all around the bay.

Our work is also revealing that individual eider hens may use very different foraging strategies to solve the same complex problem of how to efficiently get enough food in order to fatten quickly, lay earliest and maximize their chances for a successful breeding event. Ongoing work by M.Sc. student Kyle Parkinson is using stable isotopes in the blood of these same eider hens to reveal what specific food items they are targeting in these areas so that we can assess how energy use and energy gain ultimately influences the breeding decisions that lead to the highest success.

All of this complex work is timely and critical within the context of climate change as it helps us understand whether it is just certain eiders, or the entire colony, that has the physiological flexibility to continuously adjust their foraging behaviour in response to annually-changing sea ice conditions. Answering this question is an important step that will allow us to eventually explore the possible consequences of changing sea ice conditions on eider population viability in the Arctic.

The Eider's Perspective: Behavioural and Physiological Responses of an Arctic Seabird to Novel Predation Risk from Polar Bears

- Erica Geldart (M.Sc. Student, University of Windsor)

The East Bay Island common eider colony has experienced an increase in polar bear nest predation, perhaps as a consequence of the bear's reduced access to seals on ice due to sea-ice loss. In order to determine the capacity of common eiders to respond to an increased risk of predation by bears, we are monitoring the behavior of incubating common eider hens using ground and aerial drone videography (2016-2017) as well as artificial egg heart rate monitors. This study will continue in the summer of 2019 at East Bay Island. By simultaneously monitoring real-time behaviour and heart rate responses of breeding common eiders, we will be able to link stress-induced behaviour and physiology in order to investigate the sensitivity of common eider responses to bears. These data will lead to better predictions of how sea-ice loss may indirectly affect eider ducks through an intensifying predator-prey interaction.

Top: A trail camera filming an incubating hen and a foraging polar bear.
Bottom: A hen flushing in response to an approaching polar bear.

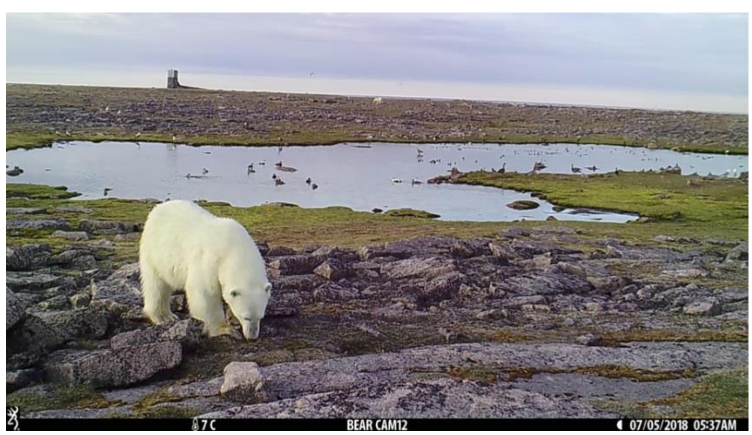
The Bear's Perspective: Polar Bear Terrestrial Foraging Ecology in a Common Eider Colony

- Patrick Jagielski (M.Sc. Student, University of Windsor)

Due to the decreasing spatial and temporal extent of sea ice in the Foxe Basin, the number of polar bears arriving at East Bay Island early in the season (*i.e.* in late spring and early summer) has steadily increased over the past 15 years. This early arrival time allows the bears to opportunistically forage on common eider eggs. In July 2016 and 2017, we collected videography footage of foraging bears using aerial drones; and in the summer of 2018, also deployed 49 motion-sensitive cameras on the ground. Using these data in combination, we are examining variation in individual polar bear foraging behaviours (different foraging modes), and quantifying the energetic consequences (cost of searching, caloric gain from eggs) associated with terrestrial foraging. Preliminary observations suggest polar bears locate nests by cuing on eider hens flushing from their nests to a greater degree than predicted. This behaviour likely decreases searching efforts of bears and, thus, increases profitability. This study will lead to a better description of polar bear terrestrial foraging behaviours on birds and will help determine to what degree terrestrial foraging for eggs on East Bay Island contributes to energetic gain for polar bears.

A trail camera filming a foraging female polar bear with two cubs.

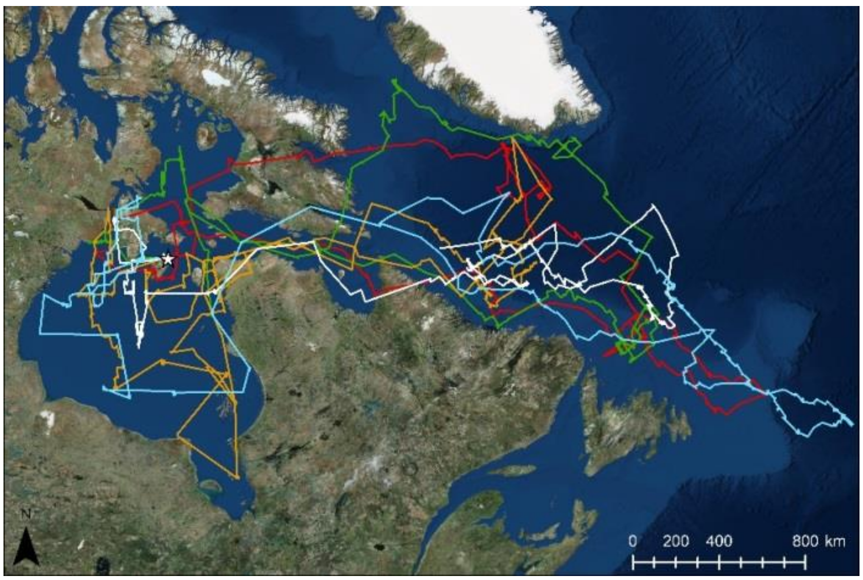
Foraging adult polar bear in the same location at a different time.



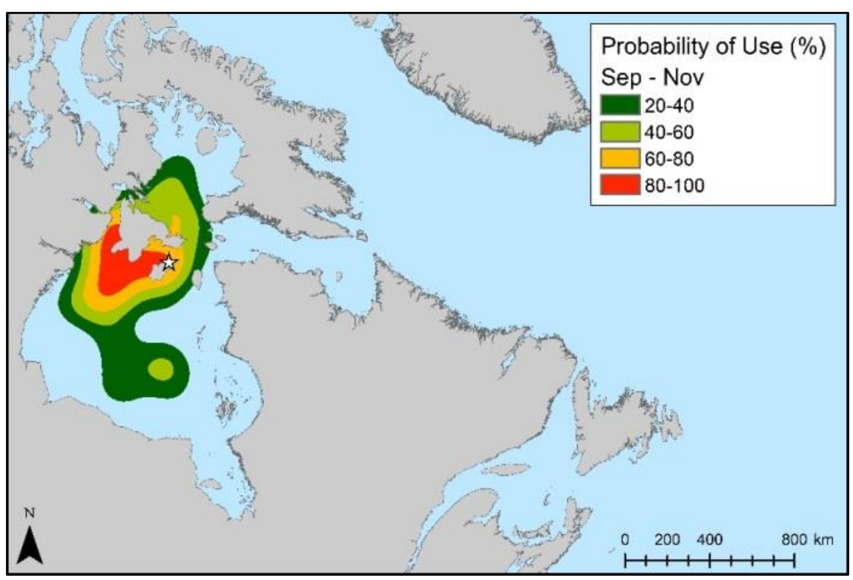
Distribution, Habitat Use and Foraging Behaviour of Thick-billed Murres

- Allison Patterson (Ph.D. candidate, McGill University)

In 2018, we retrieved 35 geolocators from thick-billed murres at Coats Island which were deployed on breeding murres in 2017. Each device was 3.6 cm long, weighed less than 6 g and was attached to a plastic metal band on the bird's leg. These geolocators recorded light levels, depth, temperature, and wet/dry state every 10 seconds for 12 months. Light levels can be used to estimate the location of tagged birds year-round. Tracking from multiple individuals can be combined to identify important areas for murres at different times of year.

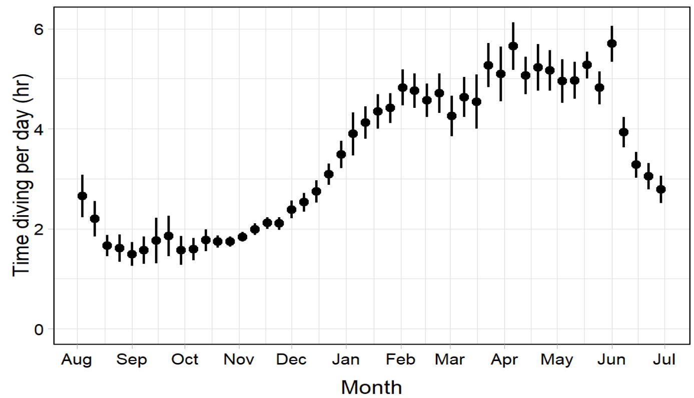


The year-round movements of five thick-billed murres from Coats Island, tracked using geolocators. Each colour represents the movements of an individual bird. The white star shows the murre colony at Coats Island, NU, where murres were tagged.



Expected probability of use by thick-billed murres from Coats Island during the post-breeding period (Sep-Nov), based on the five tracks shown in above figure. Red and orange show the areas most intensely used by murres between breeding and migration. The white star shows the murre colony at Coats Island, NU, where murres were tagged.

Additionally, measurements of depth, temperature, and wet/dry state can be used to quantify foraging murre behaviour throughout the year. This behavioural information will be combined with location estimates to identify critical non-breeding habitat for thick-billed murres and determine times of year and locations when murres are most vulnerable to environmental change and human activity. An additional 46 geolocators were put out on murres at Coats Island in 2018 to expand this year-round tracking project over multiple years.



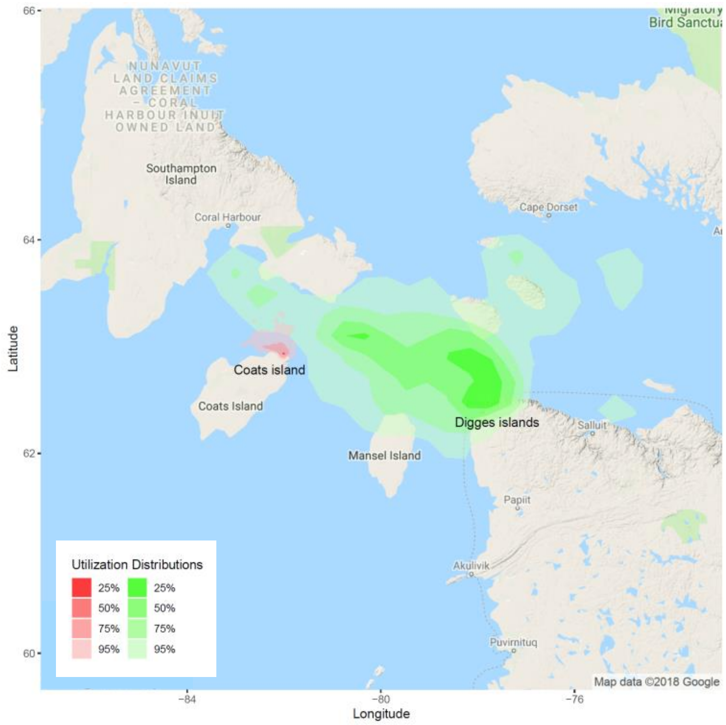
Average time spent diving per day for 31 thick-billed tracked from Aug 2017 to June 2018.

Foraging Range of Thick-Billed Murres at Digges Island

- Thomas Lazarus (Ph.D. candidate, McGill University)

In 1963, Professor Philip Ashmole proposed that large seabird colonies could deplete forage fish in their vicinity, creating a "halo" of drastically reduced food availability near the colony. As a result, seabirds would be expected to increase their foraging range to access sustainable food sources over time, suggesting that foraging range depends not only on prey distribution but also on time of year and colony size. In other words, if Ashmole's halo hypothesis is correct, ecological impact assessments could be biased by the timing and duration of a study and/or by the size of the colony considered.

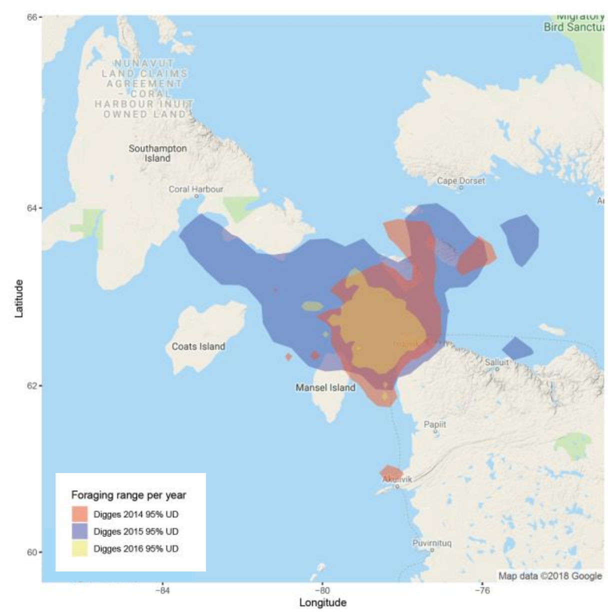
To test Ashmole's halo hypothesis, intense sampling effort on thick-billed murres was completed at both Coats Island and Digges Island seabird colonies. The thick-billed murre colony at Digges Island is about 10 times larger than the colony at Coats Island, allowing us to make comparisons between colonies of different sizes. From 2014 to 2016, we deployed over 250 GPS loggers on individual murres.



Estimated foraging range of Digges (green) and Coats (red) islands in 2015.

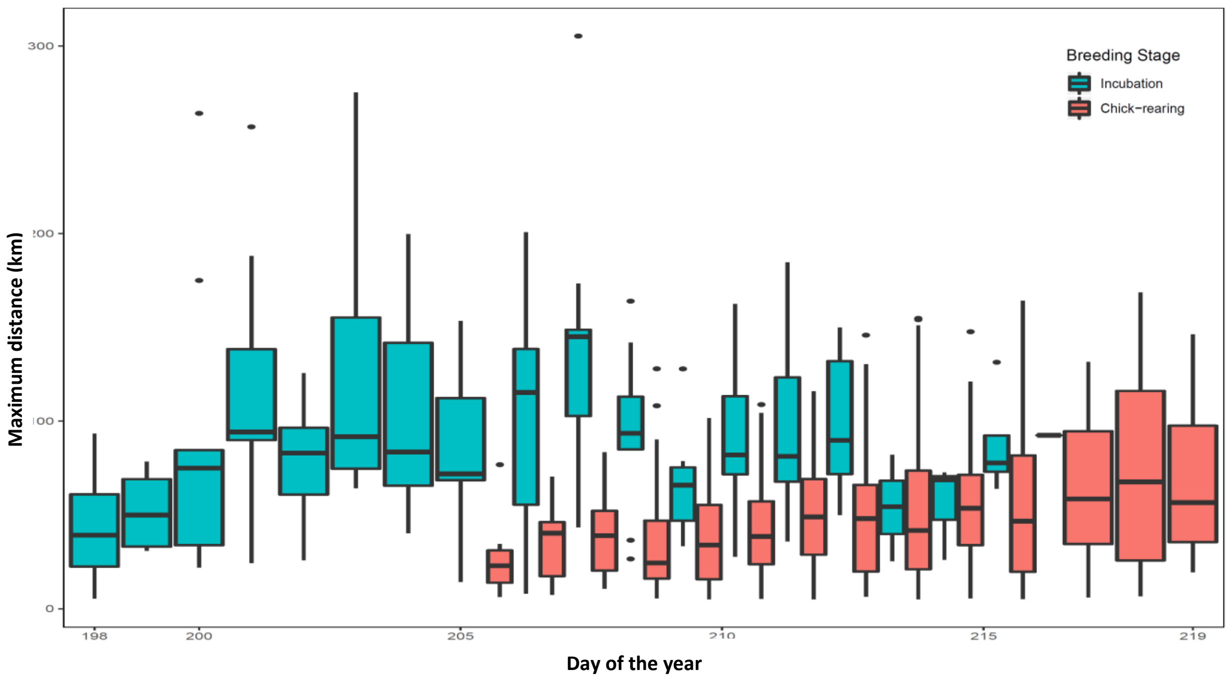
GPS data from 2015 support Ashmole's halo hypothesis: colony size seems to influence foraging range, creating a larger prey depletion halo. The Digges Island foraging range in 2015 was 35 times larger than that of Coats Island. One bird from Digges Island even foraged 300 km away from its colony, foraging within the Coats Island's foraging range. Since larger colonies forage further away from their colony, they also sample prey from a much larger area, suggesting that larger colonies should be selected for large-scale studies (*e.g.* studies on contaminants). In addition, the study area used for investigating local disturbances that could affect a seabird colony should be increased for larger colonies.

When considering data from other years, thick-billed murre foraging range appears to be highly variable. As such, ecological impact assessments should include data from several years to account for this high variability. So far, differences in ice conditions seem to be the best explanation of this variability. In the context of climate change, it appears that thick-billed murre foraging range could shrink with the decrease of sea ice coverage. This is concerning from a conservation point of view, as a small-scale localized disturbance (*i.e.* oil spill) could potentially impact one million birds if it occurs at a time when their foraging range is at its smallest.



Estimated foraging range of Digges from 2014 to 2016.

Data suggest that foraging range increases over the course of the breeding season, which supports the "progressive local depletion hypothesis" by Ashmole. The trend is consistent within incubation and chick-rearing, with the foraging range declining between the two breeding stages as adults have to return to the colony regularly to feed their chicks. As such, ecological impact assessments should also consider studying both incubation and chick-rearing.



Maximum distance from colony while foraging over time, separated by breeding stage.

Research Partners

The research at East Bay Island and Coats Island is logistically complicated and labour intensive, requiring a strong, dedicated crew. We are particularly grateful for the logistical support and local expertise provided by crew members Richard Nakoolak, Jupie Angootealuk and Josiah Nakoolak. We also greatly appreciate the continued support provided by the Aiviit Hunters and Trappers Organization and the Irniurviit Area Co-management Committee.

Research in Canada's north is expensive and funding for this work is necessarily provided by a network of partnerships that includes but is not limited to: Environment and Climate Change Canada Wildlife Research Division, Environment and Climate Change Canada Ecotoxicology and Wildlife Health Division, Baffinland Iron Mines Corporation, the Canadian Wildlife Service, The PEW Charitable Trusts, Mitacs, Polar Knowledge Canada, ArcticNet, Nunavut General Monitoring Plan (NGMP), Carleton University, University of Windsor, McGill University, Polar Continental Shelf Program (PCSP), Northern Scientific Training Program (NSTP), Northern Contaminants Program, Bird Studies Canada, Wildlife Habitat Canada Murre Fund, NSERC, and the Canada Research Chairs program.

Contact

If you have any questions, comments or concerns, please contact:

Grant Gilchrist
National Wildlife Research Centre
Environment and Climate Change Canada
Telephone: (613) 998 - 7364
Email: grant.gilchrist@canada.ca

Oliver Love
Biological Sciences
University of Windsor
Telephone: (519) 253 - 3000
E-mail: olove@uwindsor.ca

Kyle Elliott
Natural Resource Sciences Dept.
McGill University
Telephone: (514) 398 - 7907
Email: kyle.elliott@mcgill.ca