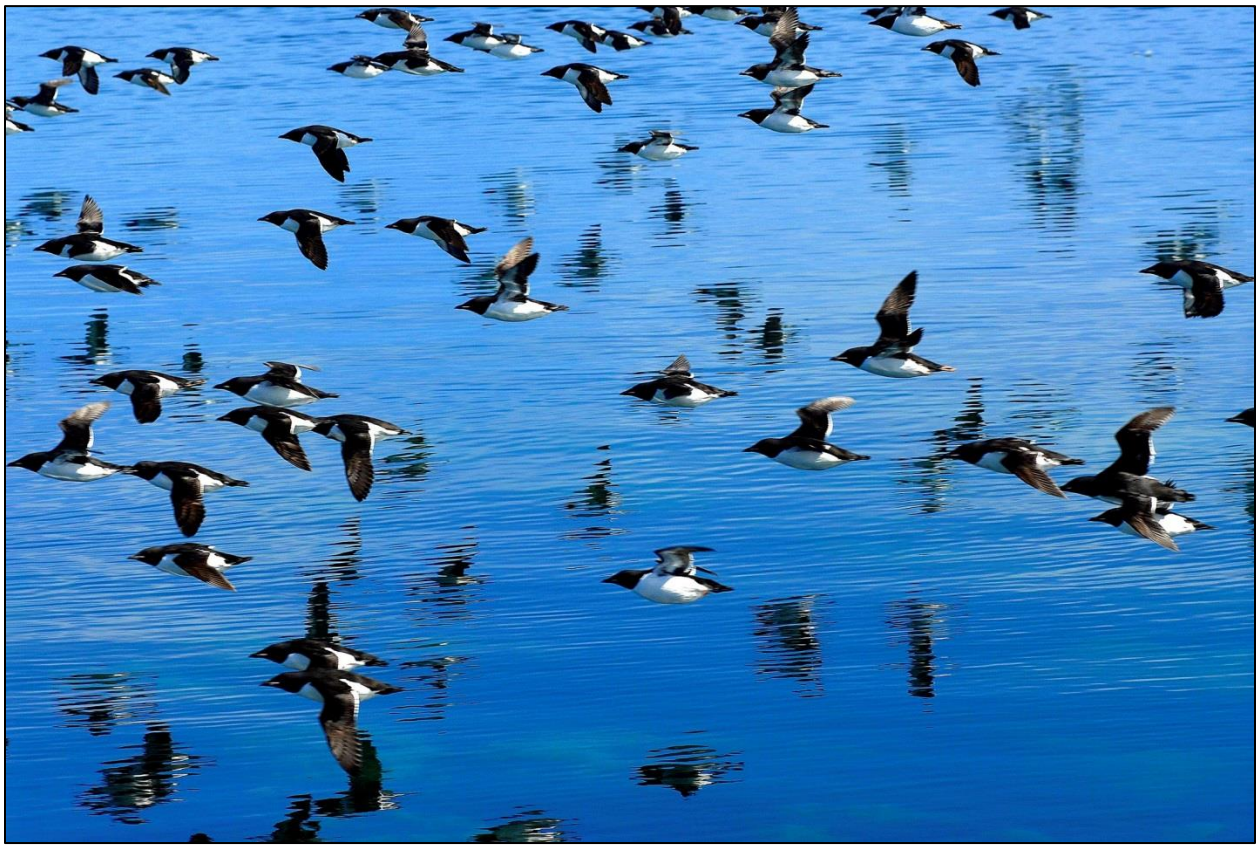
Marine Habitat Use by Thick-billed Murres

2017 Field Season Report



Project Overview

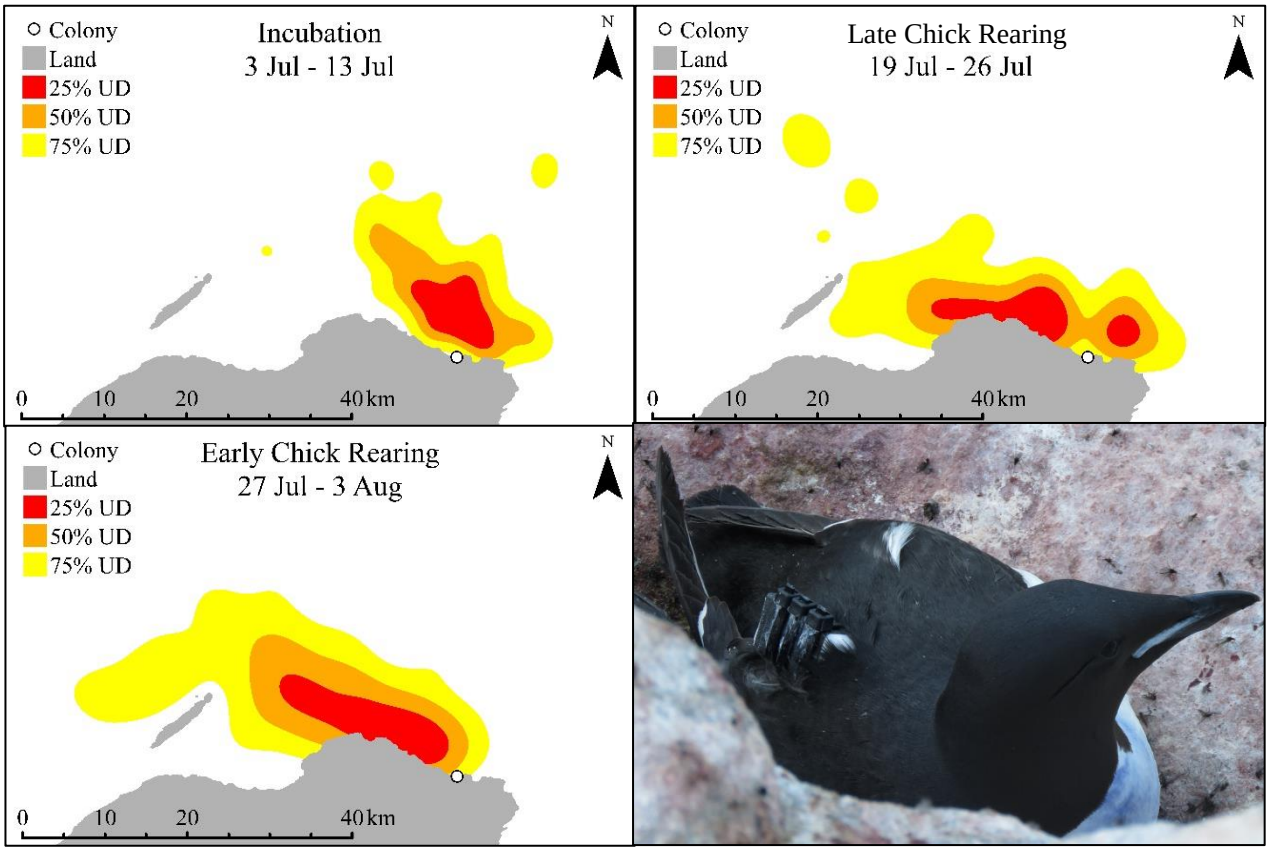
Recent increases in resource development activities are projected to increase shipping traffic in Canada's eastern Arctic marine regions. However, there is not enough information to properly assess potential ecological impacts of year-round shipping lanes on marine wildlife. Our goal is to work in partnership with industry to determine the distribution and abundance patterns of seabirds, in an effort to identify key marine habitats.

This year's sampling efforts were concentrated at Coats Island where Environment and Climate Change Canada has been recording the timing of breeding, reproductive success and diet of individual thick-billed murres on study plots since 1981. This long term data set, together with new tracking technology and physiological approaches, is enabling us to establish an ecological baseline from which to assess potential future impacts of planned shipping activity and climate change on marine wildlife in the region.

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

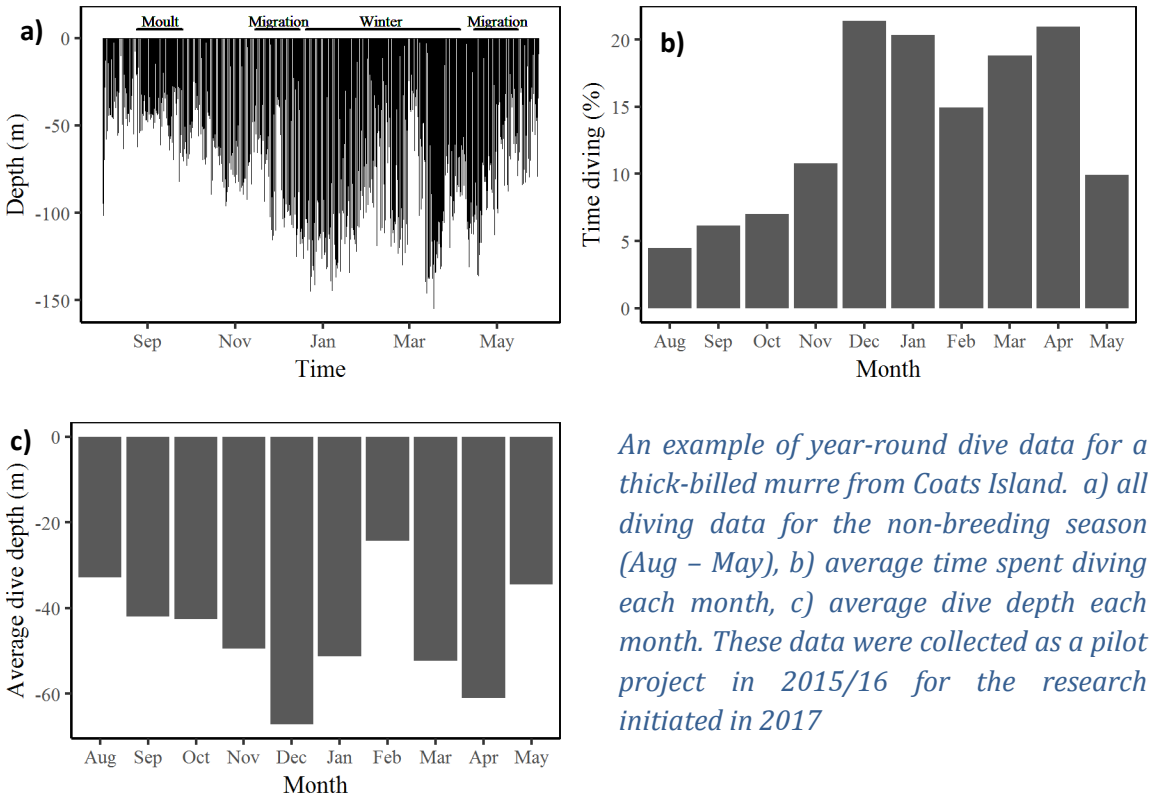
- Allison Patterson (Ph.D. student, McGill University)

To examine variation in foraging behaviour and distribution of thick-billed murres, we collected GPS data from more than 70 breeding murres at Coats Island during incubation and chick rearing. This information will be analyzed in combination with GPS data collected by us in previous years from three colonies in the Canadian Arctic. We found that during incubation, the core foraging area, represented by the 50% utilization distribution, covered 144 km^2 and was distributed immediately north of the colony. In early chick rearing, the size of the core foraging area increased to 198 km^2 and foraging was distributed more to the west of the colony and closer to the coast of Coats Island. The size of the core foraging area increased again during late chick rearing, to 255 km^2, and moved farther northwest, between the colony and Bencas Island. Mapping where birds forage around the colony and how this distribution changes within and between breeding seasons is essential to protect critical habitat around murre colonies.



Maps showing the foraging ranges (utilization distributions, UD) of thick-billed murres from the Coats Island colony during three stages of the breeding season in 2017. Bottom right: GPS attached on the back of a thick-billed murre

Moreover, we deployed 47 geolocators with temperature-depth-light recorders on adult murres at Coats Island to look at year-round distributions, habitat use, and foraging behaviour. These small data loggers are attached to the leg bands of murres and record light levels, pressure, and temperature for up to 1 year. Light-level data will be used to determine where murres go during the non-breeding season (Aug – May). The depth and temperature data will be used to estimate daily activity rates and diving behaviour throughout winter.



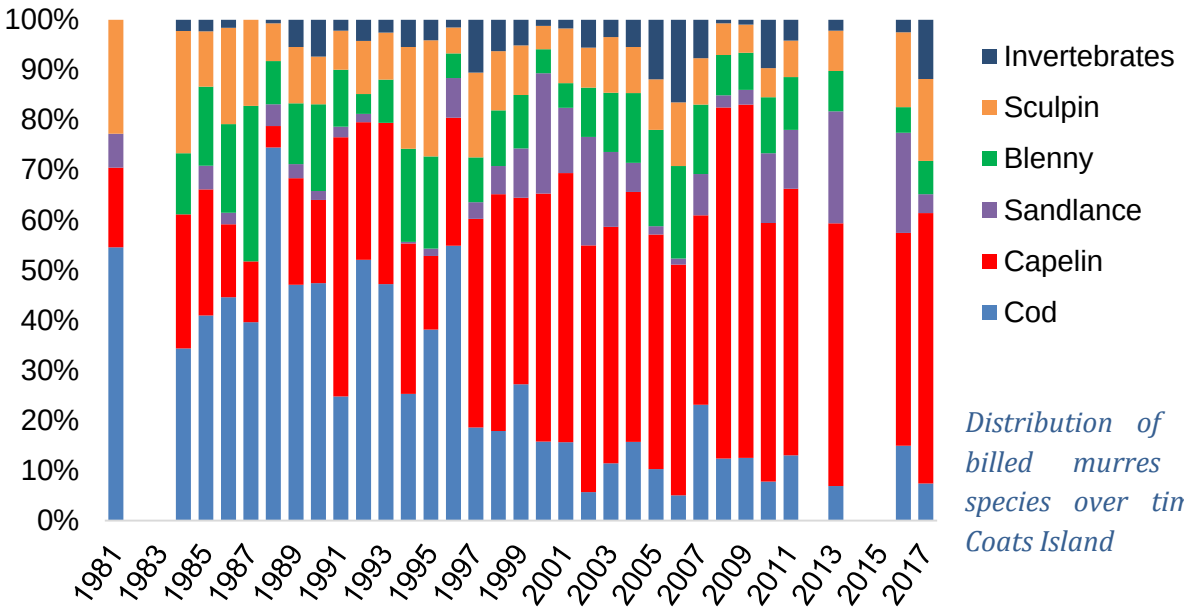
An example of year-round dive data for a thick-billed murre from Coats Island. a) all diving data for the non-breeding season (Aug – May), b) average time spent diving each month, c) average dive depth each month. These data were collected as a pilot project in 2015/16 for the research initiated in 2017

Data loggers deployed in July 2017 will be retrieved in June 2018, when murres return to breed. These data will also be used to examine how behaviour during the non-breeding season influences breeding success the next year. This will improve our understanding of how winter habitat use influences murre population dynamics and will also help to identify key wintering areas used by murres.

Long Term Monitoring at Coats Island

Since 1981, we have been collecting data on the timing of breeding, nestling diet and growth, and population size. Although the population had been growing since the start of annual censuses, since 2010 the counts have been lower than the long term average suggesting a decline that is also being observed at the Digges Island colony. We therefore suspect that similar but as yet unknown factors may be influencing both of these thick-billed murre colonies in Hudson Strait.

Documenting the type of prey that adults select to feed their chicks provides an indication of fish species that may be available to seabirds. We have seen a shift in the main prey species brought to chicks at Coats Island, with Capelin replacing Arctic Cod as the primary prey species. We suspect this is due to a shift towards reduced summer ice cover that occurred in the mid 90's.



Distribution of thick-billed murres prey species over time at Coats Island

We found that reductions in summer sea ice were associated with fewer Arctic cod in chick diet. Yet this does not seem to affect the nestling growth, suggesting that adults are able to adjust their provisioning behaviour according to what is available in the ecosystem.

So far, reductions in summer sea ice have mostly been detected in the low-Arctic. However, if the phenomenon keeps progressing northward, the patterns observed at Coats Island could also occur in the colonies found in mid and high-Arctic. With the shift of available resources these novel conditions could potentially lead to more interspecific competition. For example, Razorbills typically out-compete murres and they have been observed at the Coats Island colony in years when sand lance was more abundant than usual.

Using Sulfur Isotopes to Determine Risk of Mercury in Seabirds

- Esteban Góngora (M.Sc. student, McGill University)

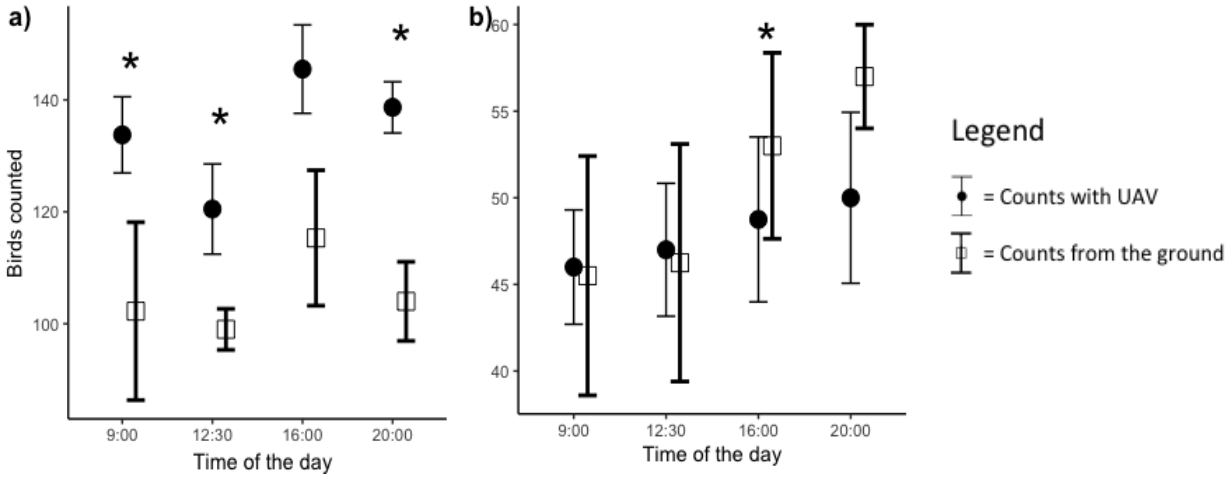
Transformation of mercury into toxic forms and its accumulation are processes affecting both the environment and humans in the Arctic. Seabirds are often used to monitor levels of mercury in the ocean because they integrate exposure over large areas and bring that signal back to a central location (their colony) where they can be easily sampled by scientists. To interpret variation of mercury in seabirds, it is important to understand how mercury concentrations are magnified through the food web. Stable isotope ratios have been widely used to explain mercury accumulation in organisms. Certain types of bacteria, known as sulfate-reducing bacteria, can convert ionic mercury into methylmercury, the most toxic form of mercury. Methylmercury is the by-product of a process called sulfate reduction, which we can measure using the sulfur isotope ratio.

We measured mercury and isotope ratios for 56 individuals of 15 species of fish and invertebrates that are common prey for thick-billed murres. We observed that mercury is strongly related to the sulfur isotope ratio when data were grouped by species. Our results demonstrate the usefulness of sulfur isotope ratios to account for variation in mercury among marine animals and to study the possible underlying effects that methylmercury production may have on mercury pathways in Arctic ecosystems. It seems that the smallest organisms, bacteria, can affect the health of some top predators, such as seabirds, in unexpected ways.

The Use of UAVs to Census Seabirds

- Émile Brisson-Curadeau (M.Sc. student, McGill University)

Unmanned aerial vehicles (UAVs) provide an opportunity to rapidly census wildlife in remote areas while removing some of the hazards. However, wildlife may respond negatively to the vehicles potentially skewing counts. We surveyed thick-billed murres using a UAV and compared census techniques to ground photography. An average of 8.5% of murres flew off in response to the UAV, but >99% of those birds were non-breeders. We were able to count more birds in a plot with the drone compared with ground photography when few non-breeders were present.



Thick-billed murres counted from the ground and with the UAV. a) a very dense plot with few non-breeders (~0%), b) plot with low density and considerable portion of non-breeders (~20%). Stars indicate if a group is significantly different than its associated group for the same time of the day

We could not detect any impact of the UAV on breeding success of murres. Furthermore, we found little evidence for habituation by murres to the UAV. UAVs provide a less hazardous and potentially more accurate method for surveying cliff nesting birds. This study allowed us to provide some simple recommendations for their use, such as a minimal take off distance of 30 m away from the plot to avoid scaring off the birds being individually counted.

Recent Peer Reviewed Publications

Braune, B. M., R. J. Letcher, A. J. Gaston, H. G. Gilchrist, and M. L. Mallory. 2016. Trends and patterns of polybrominated diphenyl ethers in thick-billed murre eggs from the Canadian Arctic. Organohalogen Compounds. Accepted.

Brisson-Curadeau E., Burke C., Fifield D., Pace P., Bird D., Sherley R., Elliott K.H. 2017. Can drones census wildlife? Recommendations based on observations of four cliff-nesting species of seabirds. Scientific Reports. In Review.

Elliott KH, Gaston AJ. 2015. Diel vertical migration of prey and light availability constrain foraging in an Arctic seabird. Marine Biology, 162:1739-1748.

Elliott, K. H., Linnebjerg, J. F., Burke, C., Gaston, A. J., Mosbech, A., Frederiksen, M., and Merkel, F. 2017. Variation in Growth Drives the Duration of Parental Care: A Test of Ydenberg's Model. The American Naturalist 189:526-538.

Hargan, K. E., N. Michelutti, K. Coleman, C. Grooms, J. M. Blais, L. E. Kimpe, H. G. Gilchrist, M. L. Mallory, and J. P. Smol. 2016. Cliff-nesting seabirds influence productivity and sediment chemistry of lakes situated above their colony. Science of the Total Environment. Accepted.

Lazarus T, Sueur C, Ropert-Coudert Y, Elliott KH. 2016. Bimodal flight patterns in a central-place forager. Marine Ecology Progress Series. In Revision.

Sorenson, G.H., Dey, C.J., Madliger, C.L., and Love, O.P. 2016. Effectiveness of baseline corticosterone as a monitoring tool for fitness: a meta-analysis in seabirds. Oecologia. In Press.

2017 Student Contributions

Dr. Sarah Wong (Post-Doctoral Fellow, Acadia University) is using at-sea surveys to identify seasonal areas of high seabird density in relation to current and future shipping activity in the waters of Hudson Strait and east Baffin Island.

Dr. Sjoerd Duijns (Post-Doctoral Fellow, Carleton University) examined the consistency in foraging behaviour of thick-billed murres at sea, both within and between individual birds.

Allison Patterson (Ph.D. 2016-2020, McGill University) is studying the year-round distribution and foraging behaviour of thick-billed murres in relation to weather and sea ice conditions.

Cynthia Franci (Ph.D. 2015-2020, McGill University) is researching how the multiple stressors of climate change and contaminants interact to impact thick-billed murre populations.

Thomas Lazarus (Ph.D. 2015-2019, McGill University) is studying the at-sea distribution of thick-billed murres to map their energy intake hotspots at sea.

Ashley Hanas (M.Sc. 2016-2018, McGill University) is studying how stress hormones affect the anti-predator freeze response of thick-billed murre chicks.

Émile Brisson-Curadeau (M.Sc. 2016-2018, McGill University) is using "bio-logger" devices to examine thick-billed murre diet in relation to detailed foraging activity budgets.

Esteban Góngora (M.Sc. 2016-2018, McGill University) is measuring fecal bacteria and prey DNA to see if individual specialization in diet is associated with a particular microbiome.

Graham Sorenson (M.Sc. 2014-2016, University of Windsor) examined the impact of ice conditions on foraging behaviour and energetic physiology in thick-billed murres.

Research Partners and Financial Support

Our research at Coats Island was a combined effort of many people and organizations. Dr. Kyle Elliot (McGill University) leads the project together with Dr. Grant Gilchrist (Environment and Climate Change Canada, ECCC). Kim Fernie (ECCC) co-led a project on the effects of contaminants on the resilience to climate change in seabirds.

Remote research is logistically complicated and labour intensive. Our work would not be possible without our extensive crew of climbers, students, biologists and local guides. This year's Coats Island crew included Allison Patterson, Émile Brisson-Curadeau, Esteban Góngora, François St-Aubin Migneault, Jean-Hugues Martin, Sarah Poole, Scott Flemming and Kyle Elliot. Logistical support and local expertise was provided by Josiah Nakoolak from Coral Harbour. Pictures were provided by E. Brisson-Curadeau, E. Góngora, S. Flemming and J. Werner.

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, Baffinland Iron Mines Corporation, the PEW Charitable Trusts, Mitacs, Polar Knowledge Canada, ArcticNet, Oceans North, University of Windsor, McGill University, NSERC, Bird Studies Canada, Wildlife Habitat Canada and the Northern Contaminants Program.

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