Marine Habitat Use by Thick-billed Murres

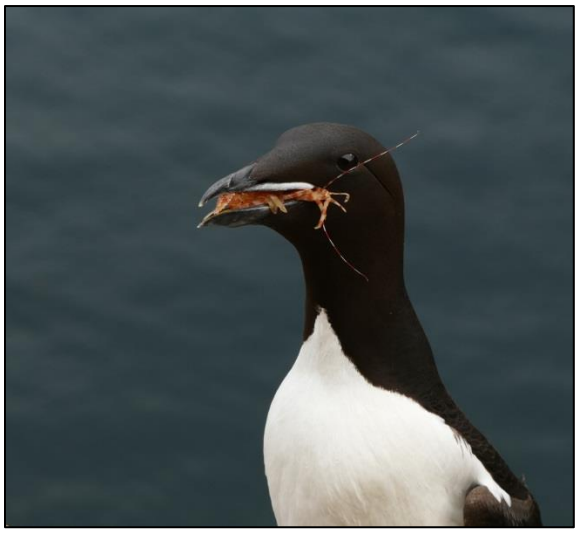
2016 Field Season Report

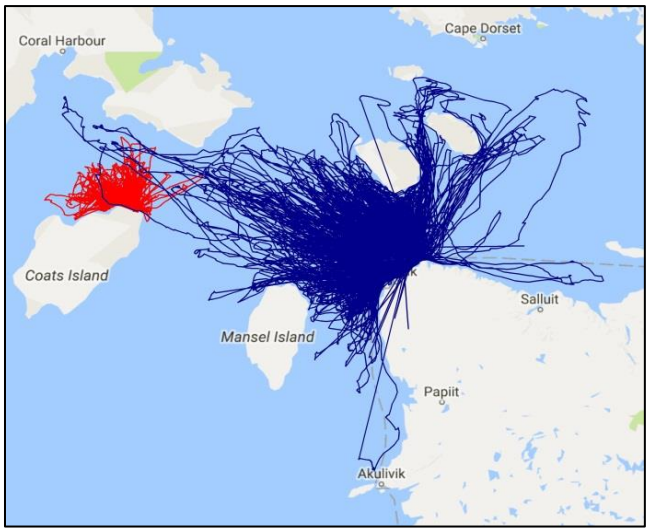
Project Overview

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 thick-billed murres, in an effort to identify key marine habitats. At the Digges Island colony in Hudson Strait, we are investigating whether birds breeding at various locations within the colony itself use different marine habitat areas, and whether this changes between breeding stages (incubating eggs vs feeding chicks). We are also examining how foraging behaviour influences the physiology and energy budgets of thick-billed murres. At the Cape Graham Moore colony on Bylot Island in the high arctic, we are collecting data on foraging movement and physiology, which we will compare to our previous work at Digges Island to understand the differences between colonies. Our work will establish a baseline of marine habitat use which may be used for murre assessing the potential future impact of planned shipping lanes and marine protected areas in the region. These projects will also help to provide the information necessary to develop efficient monitoring protocols for Canada's northern thick-billed murre colonies.

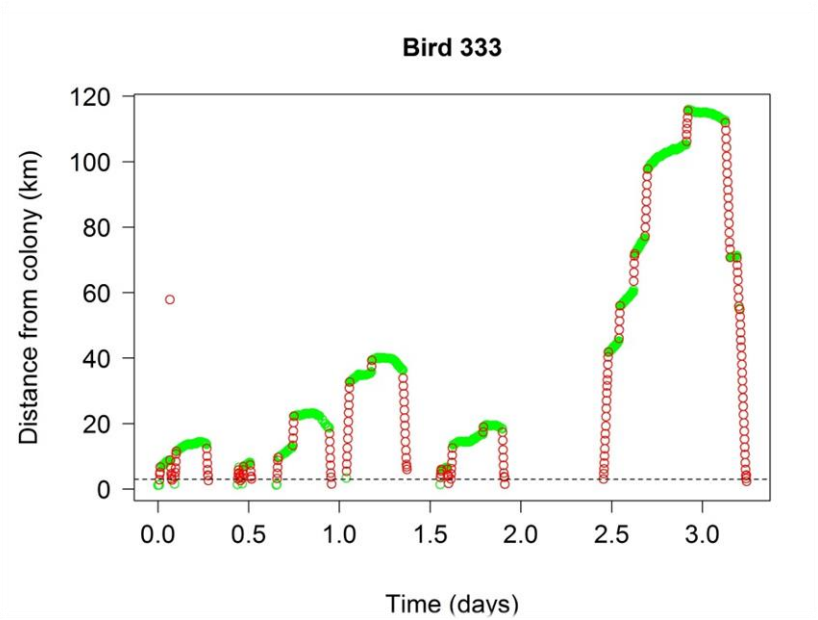
Mapping Energy Hotspots at Digges Island

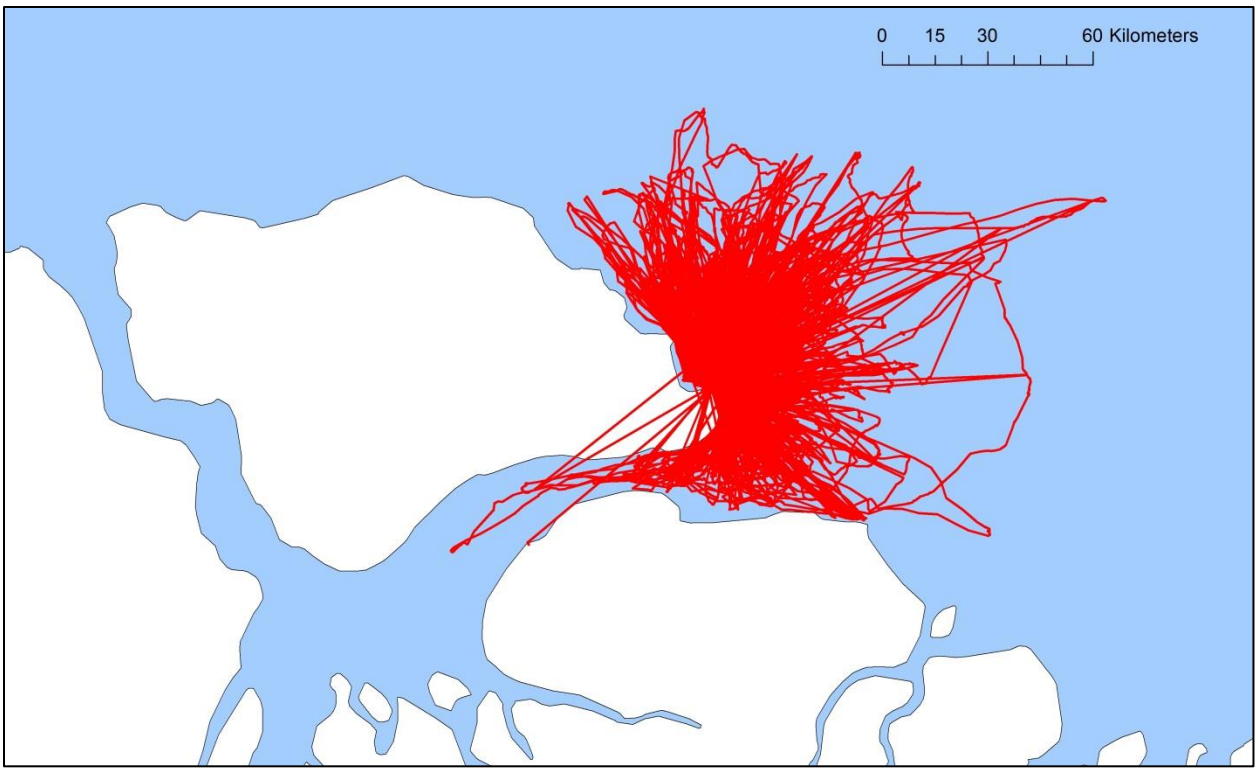
Much of our recent work has focused on using GPS tracking data to map the flights thick-billed murres make on foraging trips during incubation and chick-rearing. Building on this work, we are now using accelerometers and time-depth recorders to quantify the diving effort and energy expenditure of thick-billed murres while foraging. This allows us to study which foraging behaviours are the most energetically profitable and how individual birds decide which movement strategies to use. We will then be able to combine information on energy intake and expenditure with GPS tracks to map the hotspots of high energy intake for thick-billed murres in the marine environment. Previous studies have predicted that we should see a 'halo' of low energy intake around the colony, as large colonies will likely deplete nearby prey resources, forcing them to search further away from the colony for their preferred prey.





An example of thick-billed murre foraging trips. Red open circles represent flying, green closed circles represent diving. We can estimate how much energy is used during each of these behaviours. Is it more energy efficient for birds to take a few longer trips, or many short trips?





Foraging movements of thick-billed murres tracked at Cape Graham Moore in 2014 and 2016.

Collecting Ecological Baseline Data at Cape Graham Moore

2016 was our third season collecting data at Cape Graham Moore. We deployed 57 GPS units to track the repeated foraging movements of thick-billed murres in Eclipse Sound and Baffin Bay. It is becoming increasingly apparent that this data will be useful as an ecological baseline against which environmental changes in the region can be assessed. For example, both the proposed Lancaster Sound National Marine Conservation Area and proposed shipping routes from the Baffinland Mary River Mine will require reference data. By tracking thick-billed murres at Cape Graham Moore, we are already working to identify key habitat sites in the region, which will help us to monitor shifts in habitat use if they occur. By collecting physiological data at the same time, we will also be able to evaluate how environmental changes affect fattening rates and stress levels in seabirds, and in turn how physiology will affect demographic rates of these wild bird populations.

Linking Foraging Behaviour and Physiology to Study the Impact of Ice Conditions on Thick-Billed Murres

When measuring wildlife population trends there is typically a lag between the environmental changes that affect demographic rates (birth-rates, death-rates) and detectable population declines. To predict potential population declines sooner, an alternative solution is to monitor changes in individual behaviours and physiological traits that will affect populations. At Digges Island, we collected data on foraging behaviour, body condition, energetic hormones and metabolites to study how these traits were affected by ice conditions. We attached GPS units and collected small blood samples from 97 individuals in 2014 and 120 individuals in 2015.

We found that in the low ice year, birds took shorter foraging trips and travelled smaller distances in each trip in comparison to the high ice year. However, they also made more frequent foraging trips in the low ice year, meaning that the average daily distance travelled was similar in both high and low ice years. This is a new finding.

When we compared levels of the energetic hormones and metabolites between years, our results suggest that the thick-billed murres are able to find similar quality food resources in years with differing ice conditions, but they must work harder and expend more energy finding food in low ice years. These findings agree with previous studies which found that in low ice years, the diet of murre chicks contain less of their preferred prey species, fish which are associated with ice.

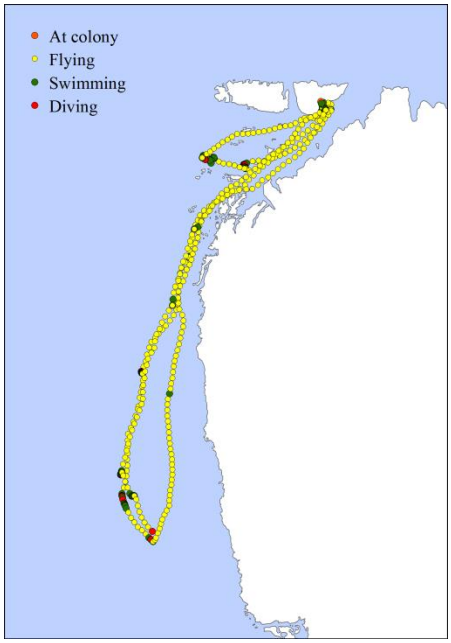
Climate change and warming oceans are predicted to have negative effects on Arctic-breeding seabirds. Our study uncovers some of the mechanisms by which environmental changes can cause energetic stress in thick-billed murres.

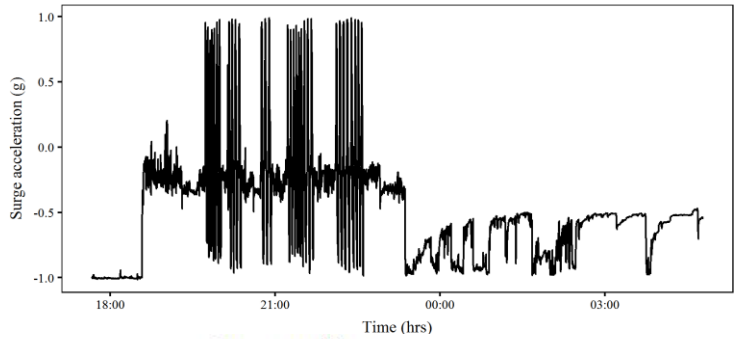
Testing New Technologies

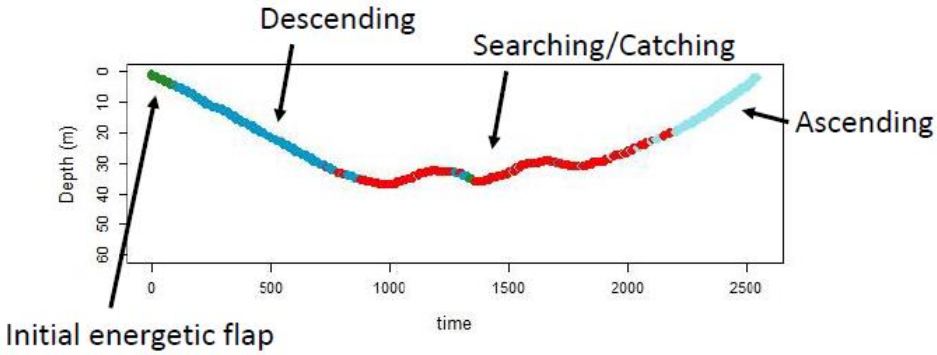
In 2015 and 2016, we have been testing methods for using two new technologies: back-mounted cameras and accelerometers. By pairing these methods with GPS tracks, we have been collecting much more detailed information on murre activity budgets, energy expenditure, and foraging behavior.

We attached small cameras to the backs of 3 thick-billed murres, revealing previously unknown feeding behaviours. We previously suspected that murres would stop flying and begin diving for food when they saw other murres feeding, but for the murres in our videos this did not appear to be true. The murres we recorded typically dove rapidly, not feeding on their way down and only feeding on their way up to the surface. Prey is likely easier to see while moving towards the light, and the murres themselves would be more difficult for prey to detect as they attack their prey from below. Our most surprising finding was that more than 80% of the prey caught were amphipods, a type of zooplankton. Amphipods are digested quickly, so it has been impossible to detect them in the stomach contents of murres at the colony.

An accelerometer is an electromagnetic device which detects acceleration forces in three dimensions to measure speed and direction. The same technology is used in cars to detect when airbags should be deployed in a crash. Accelerometers can be used to collect very high resolution data on individual activity. For example, video footage from a small number of birds can be used to pinpoint when a bird dives or when it catches a prey item. We can then match the timing of these events with the accelerometer data to identify the acceleration patterns associated with these behaviours, and extrapolate these patterns to larger numbers of birds equipped with accelerometers but not cameras.



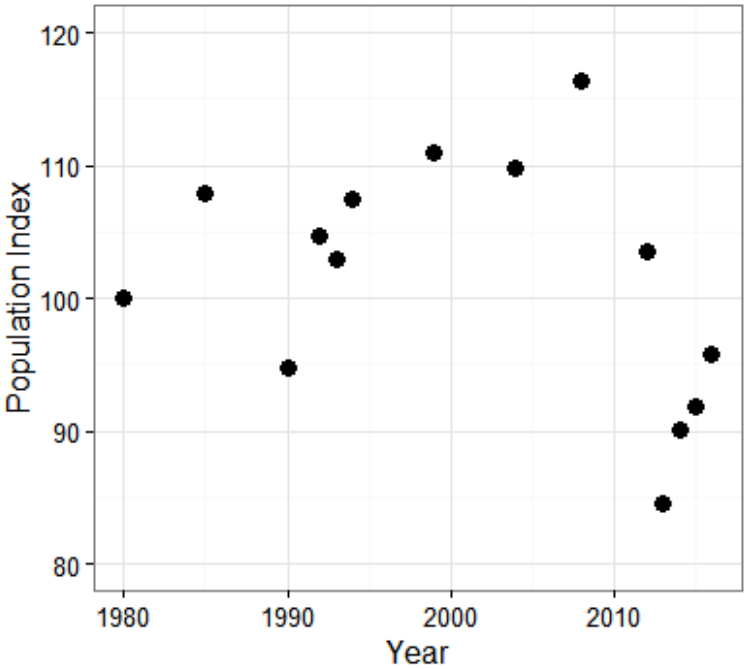




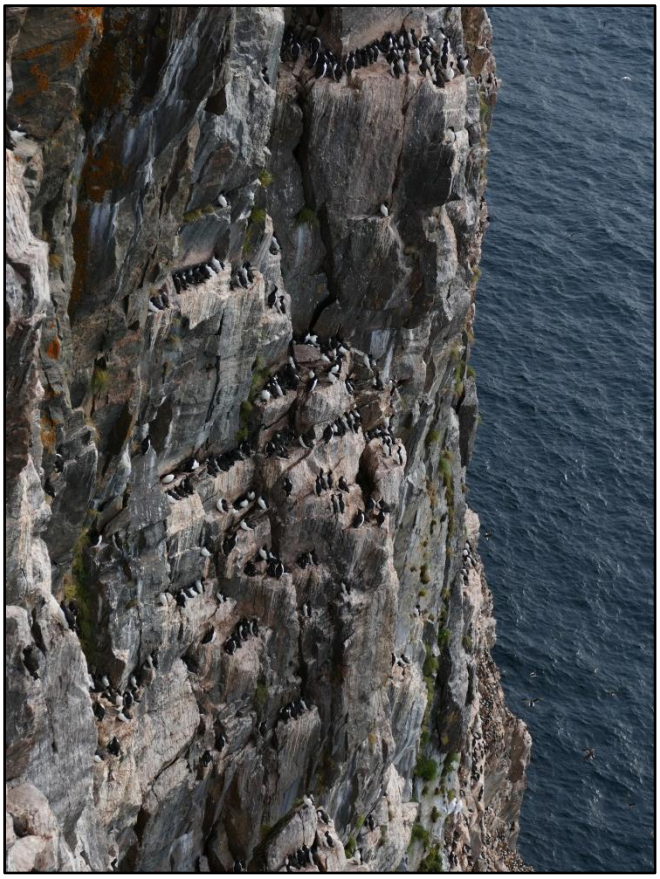
Long Term Population Monitoring

Environment and Climate Change Canada has led monitoring of thick-billed murre populations in Hudson Strait since the early 1950's. The colony at Digges Island has been regularly monitored since the early 1980's, initiated by Tony Gaston. In 2016, we continued this work by completing counts of the numbers of birds present at selected standardized study plots. Counts of thick-billed murres continued to be lower than the long term average and suggest a decline since 2010. This is a similar pattern to the nearby colony on Coats Island, suggesting that similar factors may be influencing the two colonies. There is now also evidence of decline in other low arctic colonies over the past 5 years.

In 2016, we also tested methods for using cameras based both on the ground and on unmanned aerial vehicles (UAVs) to conduct counts. We found that visual surveys detected more birds than using a ground based camera. The aerial view from UAVs made them very effective at surveying high density plots, but did not provide any improvements in low density plots. Developing methods for using UAVS for conducting counts will allow us to conduct a more complete census of unobservable areas of seabird colonies, making our population monitoring much more precise.



Relative change in thick-billed murre abundance at Digges Island since 1980.



2016 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.

Elliott KH, Linnebjerg JF, Mosbech A, Gaston AJ, Frederikson M, Burke C, Flemming M. 2016. Variation in growth drives the duration of parental care: an example and simple model for seabirds. American Naturalist. Accepted pending revisions.

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

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.

Recent Popular Press

Nature Sauvage (magazine article). 'Du guillemot au menu' by Émile Brisson-Curadeau.

CBC Radio North. Interview with Kyle Elliott on Arctic Seabird Ecology. 10 Feb. 2016

2016 Student Contributions

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

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.

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.

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.

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.

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.

Research Partners and Financial Support

Our research at Digges Island was a combined effort of many people and organizations. Dr. Grant Gilchrist (Environment and Climate Change Canada) leads the project together with Dr. Oliver Love (University of Windsor) and Dr. Kyle Elliot (McGill University). The project coordinator in 2016 was Mike Janssen (Environment and Climate Change Canada).

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. The Digges Island field crew included Graham Sorenson, Will Black, Thomas Lazarus, Bruen Black, Émile Brisson-Curadeau and Kyle Elliot. Logistical support, boat transportation and local expertise were provided by Phillipe Audlaluk of Ivujivik. The Cape Graham Moore field crew included Isabeau Pratte, Brian Malloure, Kerry Woo, and Grant Gilchrist. Parks Canada staff Terry Kalluk, Jamie Enook, Randy Quaraq, and Carey Elverum provided support and local expertise in Pond Inlet.

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 Canadian Wildlife Service, the PEW Charitable Trusts, Mitacs, Polar Knowledge Canada, ArcticNet, Oceans North, University of Windsor, McGill University, and NSERC.

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