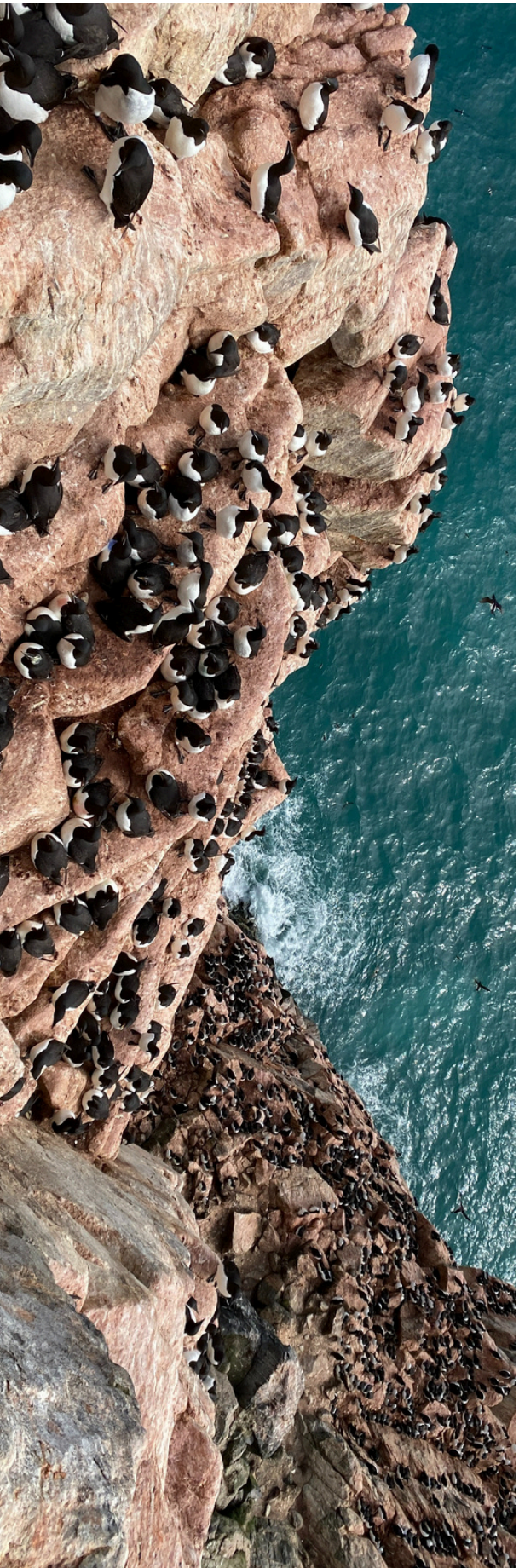
ENVIRONMENT AND CLIMATE CHANGE CANADA

ARCTIC SEABIRDS & ECOSYSTEMS

2024 FIELD SEASON AND RESEARCH REPORT



PROJECT OVERVIEW

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

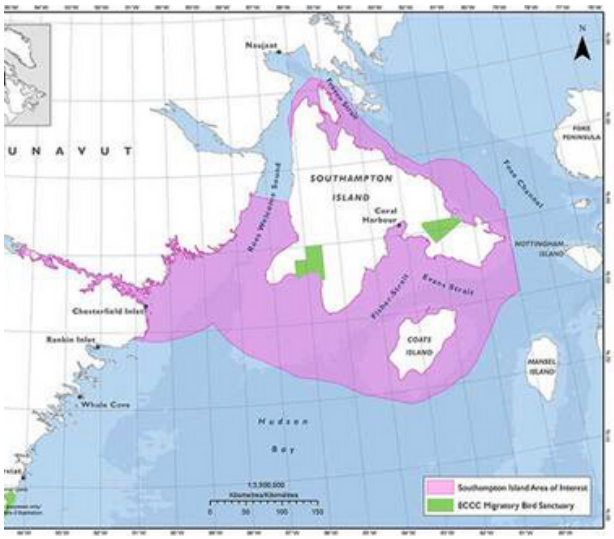
Research efforts in 2024 continued at Coats Island where Environment and Climate Change Canada has been researching thick-billed murres since 1981. We also completed work at Cape Graham Moore and re-initiated work at Digges Island. These long term data sets, paired with new tracking technologies and physiological approaches, enables us to establish an ecological baseline in both the low and high Arctic to assess potential impacts of planned shipping activity as well as projected changes in climate on seabird populations.

CONTRIBUTING TO MARINE PROTECTED AREAS

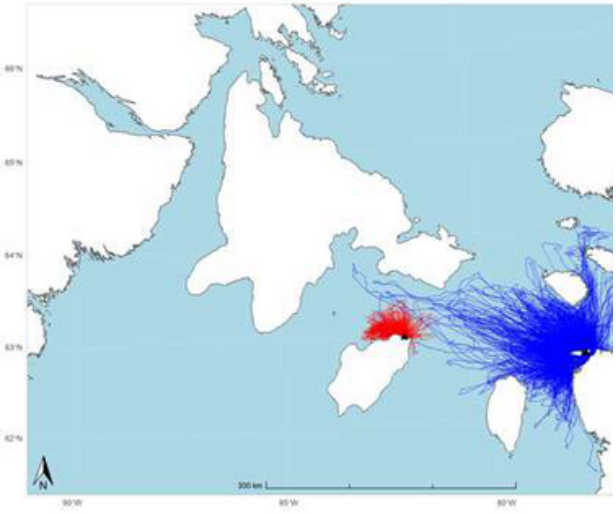
The formal protection of the marine environment is a national priority. In the Arctic, Government Departments and local communities are working together to identify areas worthy of protection. The spatial use of the ocean by wildlife is one element that is considered when designing marine protected areas.

As one example, our team is contributing seabird spatial tracking information which is being used in the design and assessment of 'The Southampton Island Area of Interest'. This area encompasses the nearshore waters around Southampton and Coats Island in the Kivalliq Region of Nunavut and is under consideration for the Department of Fisheries and Oceans Marine Protected Area Program. This site comprises 93,000 km2 within the Hudson Bay Complex Marine Bioregion, and is approximately 1.6% of Canada's ocean territory.

Southampton Island is the largest island in Hudson Bay, near the confluence of Hudson Bay and Foxe Basin waters; making it an area of high marine productivity. The area is important for key marine species including beluga whales, and bowhead whales. It also contains walrus haul-out sites, polar bear dens, and marine habitats of seabirds. This proposed protected area will encompass two Environment and Climate Change Canada (ECCC) Migratory Bird Sanctuaries: The Harry Gibbons (Ikkattuaq) Migratory Bird Sanctuary, and the East Bay (Qaqsauqtuuq) Migratory Bird Sanctuary.



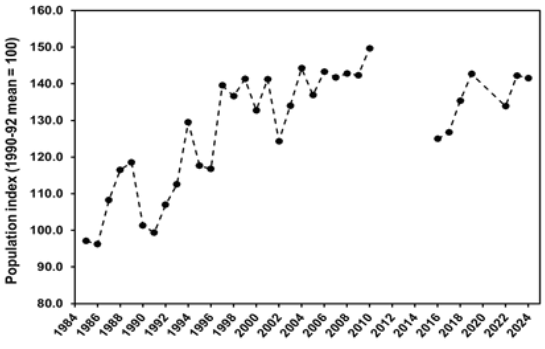
Proposed marine protected area.



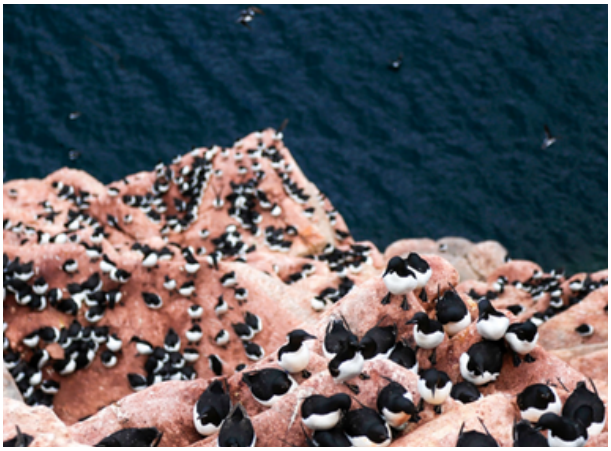
Thick-billed murre foraging tracks

LONG-TERM POPULATION MONITORING

Thick-billed murres (*Uria lomvia*), known as akpa in Inuktitut, are the most abundant seabird in the Canadian Arctic, and one of the most abundant by mass in the global Arctic. Their meat is an important source of protein in winter in Newfoundland, Labrador and Nunatsiavut, and their eggs are an important source of late-spring protein for some communities. Moreover, murres are an ice-associated, Arctic species that act as important indicators for the entire Arctic ecosystem. This is particularly useful given that we are able to easily monitor population and reproductive trends in murres at nesting colonies. This research is difficult to achieve for many other Arctic animals, such as marine mammals and fish.



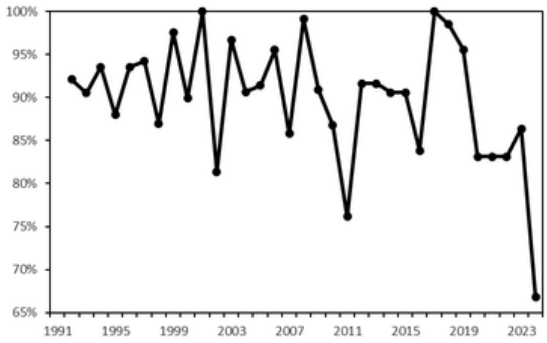
Change in population size index of Coats Island murres across years.



At the Coats Island murre colony, we have been recording long-term changes in the timing of breeding, nestling diet and growth, and population size since the 1980's. This long term data set allows us to piece together what may cause changes in population sizes. This is the only such ongoing study for any seabird in the Canadian Arctic, and the only one of its duration for thick-billed murres in the entire Arctic. Therefore, if we begin to see population declines in Canada, we are in a strong position to identify the causes, and to inform hunting quotas, shipping lanes, and other management protocols.

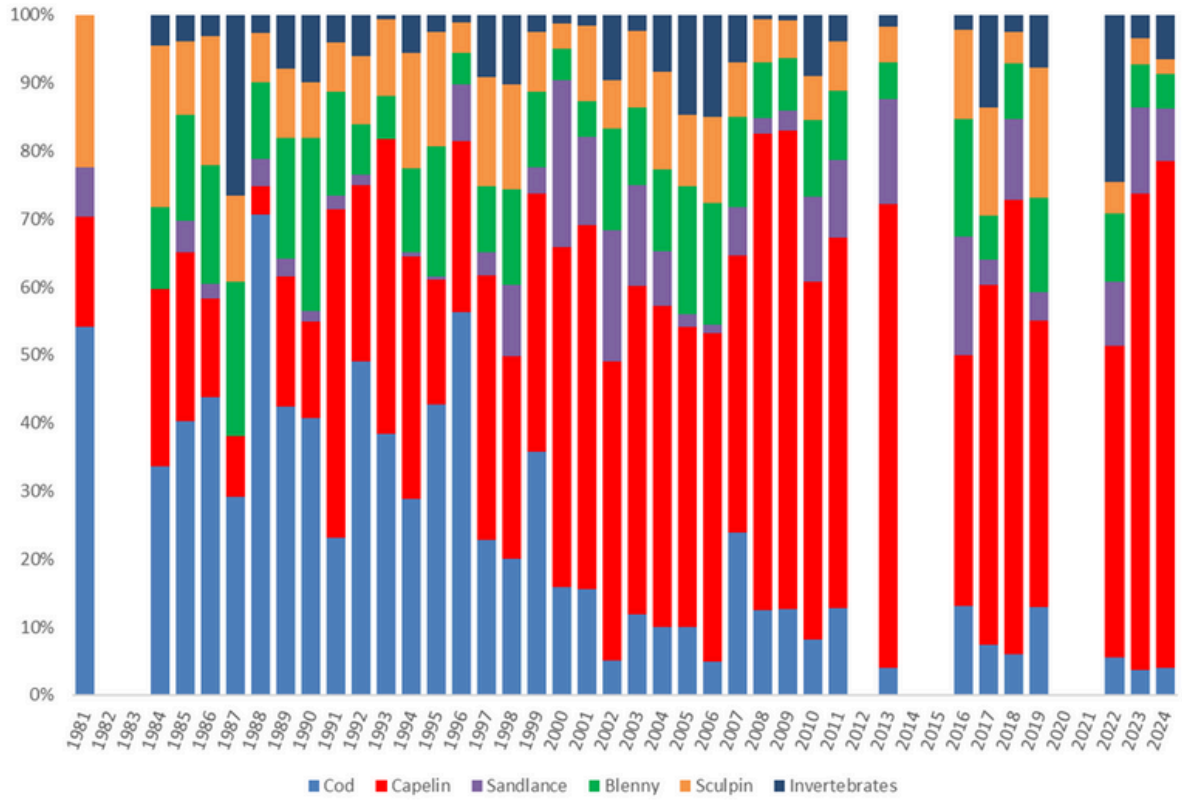
In Norway and Greenland, murre populations are declining, and we currently do not know why. Counts of murres at Coats Island have been relatively stable for 30 years, after increasing in the 80s and early 90s due to reduced hunting pressure on the wintering grounds. As such, harvest is

unlikely to be the cause of these declines. As a long-lived species survival is an important component of population trends. Typically, survival is near 90%, with only a few years having survival well below 90%. This past summer, survival was catastrophically low with only 2/3 of the birds returning. It will take another year before we can finalize those numbers, as some individuals may have skipped breeding rather than died.



Thick-billed murre survival (%) across years at Coats Island since 1990-91. Each year represents the following breeding season.

In addition to assessing population trends, we have seen changes in diet that indicate larger changes in the ecosystem. We have observed a shift in the main prey species brought to chicks at Coats Island, with capelin replacing Arctic cod. We suspect this is due to reduced summer ice cover that began in the mid 90's. However, this has not affected nestling growth, suggesting that adult murres are able to compensate for the shifts in prey species.



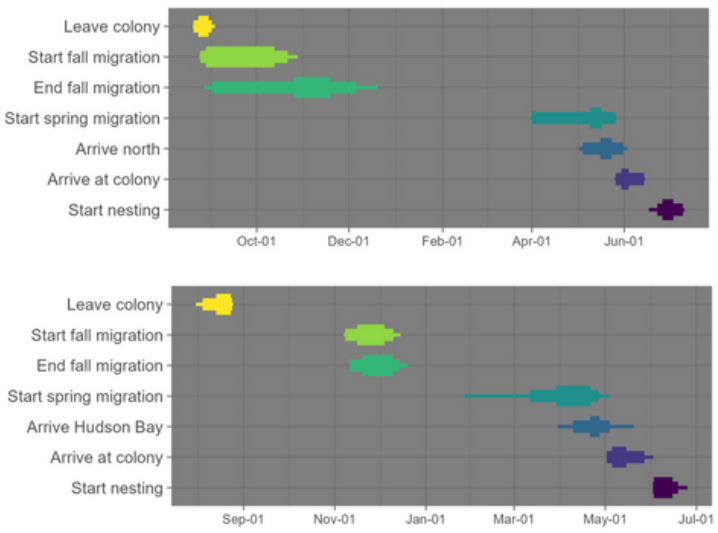
Thick-billed murre prey species delivered to chicks across years at Coats Island.

YEAR-ROUND MOVEMENTS OF THICK-BILLED MURRES

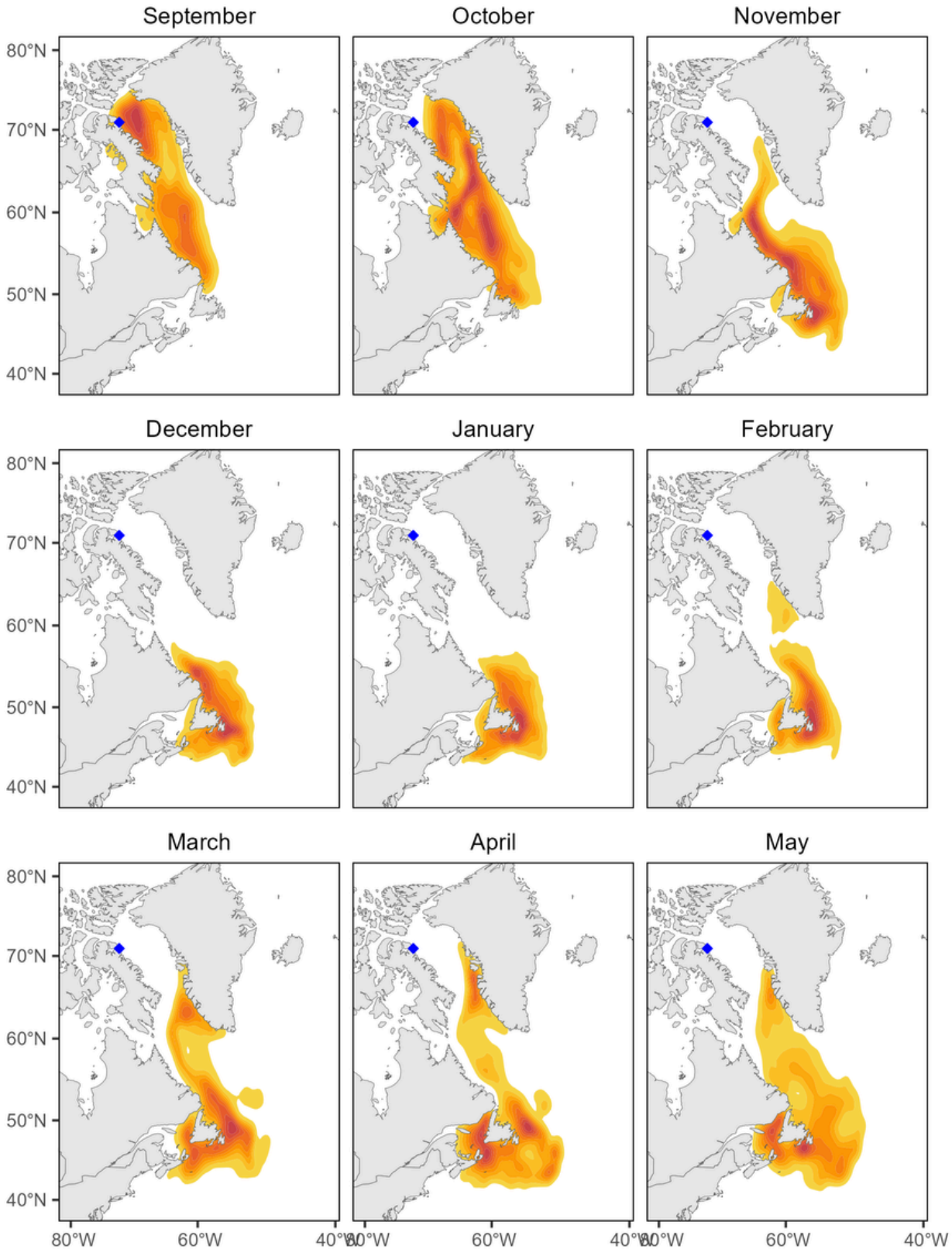
In collaboration with SeaTrack, the Arctic Council, and CWS-Quebec, we have deployed GLS loggers at both Cape Graham Moore and Coats Island. Using these loggers we are able to track murres at sea to identify key habitats used throughout the entire year, determine possible overlap with shipping activities in the region, and identify ecological differences between nesting colonies.

At Cape Graham Moore, birds left the colony in late August, either migrating away from the breeding range immediately, while others remained in the area of Lancaster Sound through September and October. Most birds had reached their wintering areas by the start of November; murres from this colony spent the winter south and west of Newfoundland on the southern Labrador Shelf (including the Grand Banks), on the Scotian Shelf, and in the Gulf of St Lawrence.

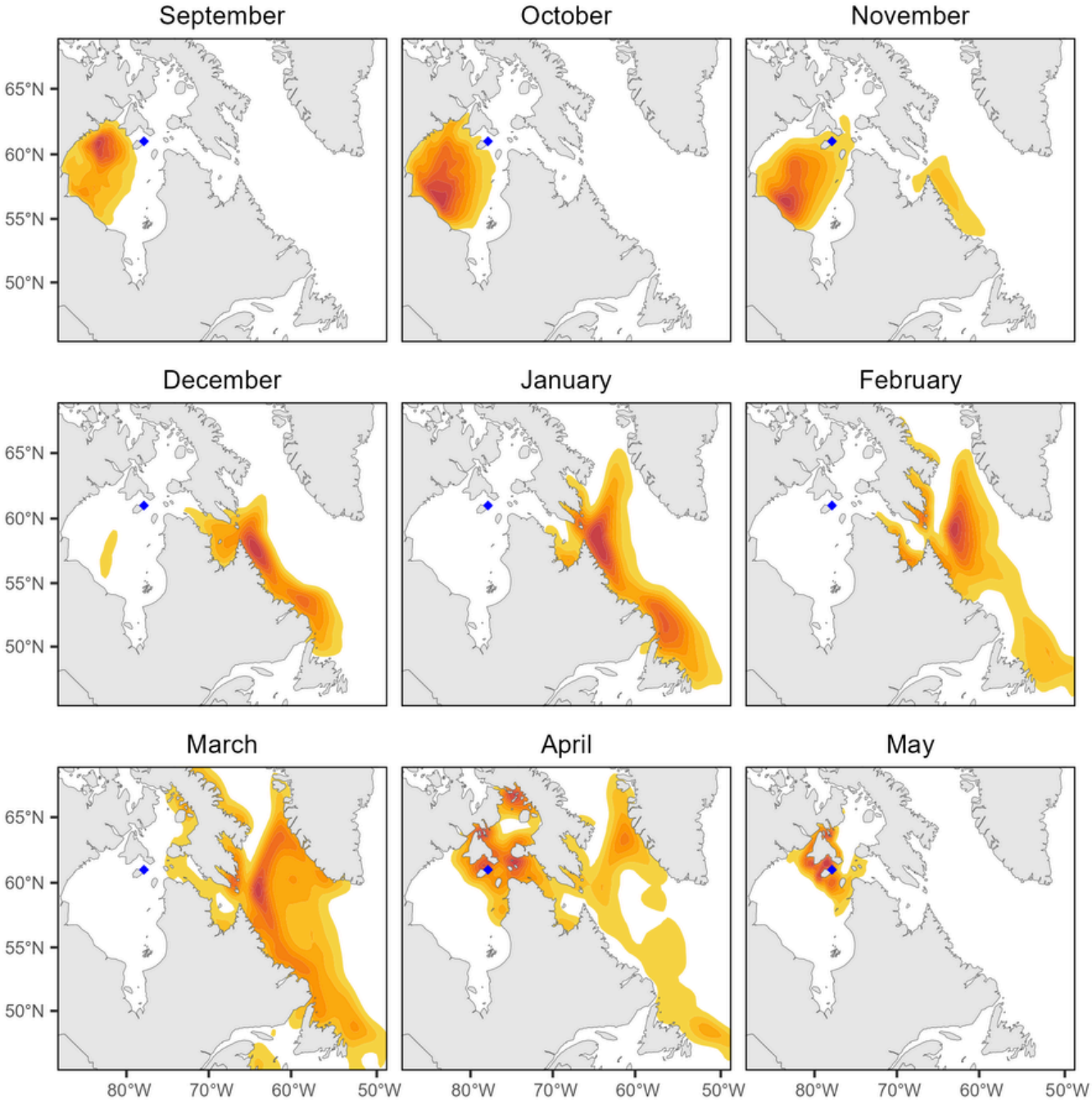
By contrast, birds at Coats Island left the colony in late August and remained in Hudson Bay through the feather moult in September to November. Fall migration began in November and December when birds migrated through Hudson Strait to reach the Northern Labrador Shelf. During winter, birds from Coats Island spread out within the Labrador Sea, the Eastern Scotian Shelf and the East Greenland Shelf.



Timing of key stages of the annual cycle for thick-billed murres from Cape Graham Moore (top) and Coats Island (bottom) tracked between 2022-2023. Thinnest lines show range of dates for all birds, medium thickness lines the dates show 90% of birds, and thickest lines show the dates for 50% of birds.



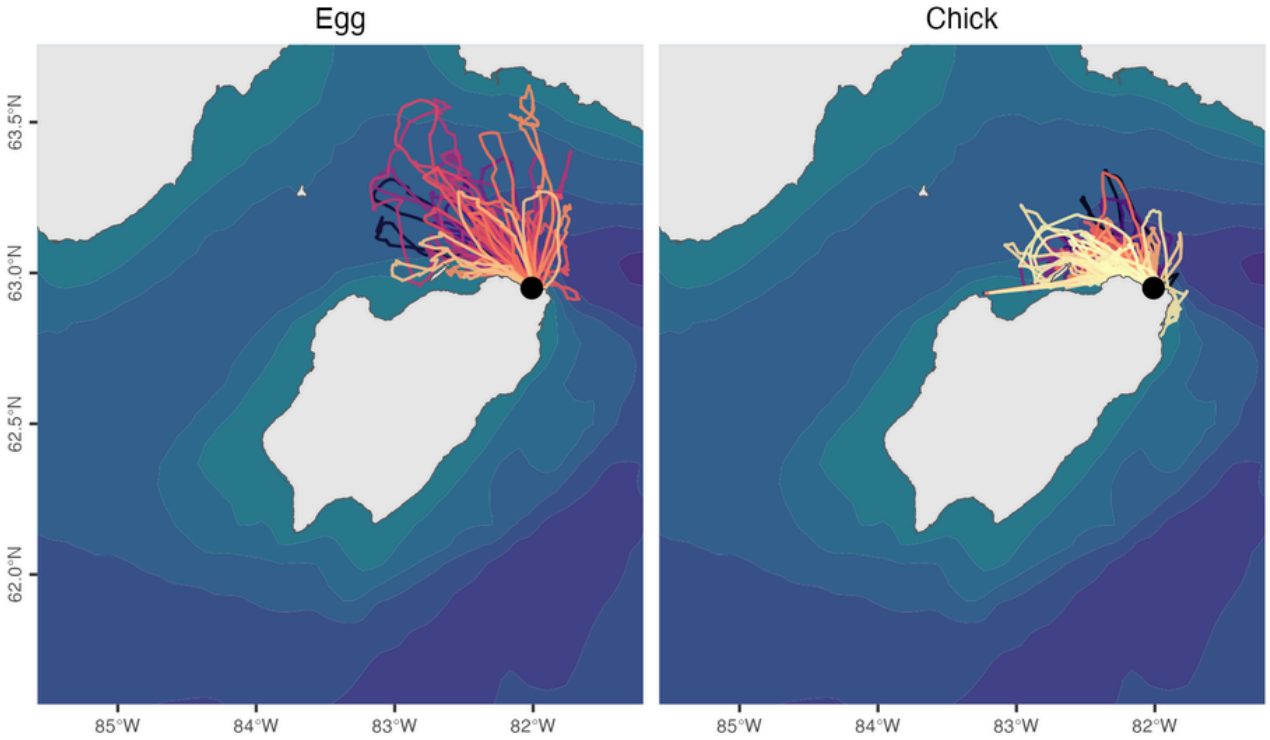
*Non-breeding distribution of thick-billed murres (14 individuals) from **Cape Graham Moore** (winter 2022-2023). Lighter colours indicate areas of highest use for each month. Blue diamond indicates the colony.*



*Non-breeding distribution of thick-billed murres (20 individuals) from **Coats Island** (winter of 2022-2023). Lighter colours indicate areas of highest use. Blue diamond indicates colony location.*

MOVEMENTS WHILE BREEDING

GPS tracking devices have been deployed at Coats Island as part of our long term monitoring program and as part of several student projects. This tracking is important to characterize differences in habitat use throughout the breeding season, to inform the development of a marine protected area in the region, and to assess how thick-billed murre habitat use and shipping route overlap may change in relation to breeding stage.



Deployments of GPS-accelerometers (AxyTrek™, Technosmart, 18 g, 1.9% of body mass and AxyTrek™, Technosmart, 9g, < 1% of body mass) at Coats Island during the summer 2024. We deployed 20 GPS during the incubation (left) and 32 during chick-rearing (right).

SURVEYS OF THICK-BILLED MURRE ARCTIC COLONIES

The Newfoundland and Labrador Thick-billed Murre (*Uria lomvia*) and Common Murre (*Uria aalge*) annual harvest is the only licensed harvest of seabirds in Canada. Though harvest of murres has declined considerably since the 1960-70s, colony declines across the North Atlantic have prompted domestic and international concerns over the sustainability of the harvest in Canada. The impact of current harvest is difficult to assess since there is considerable uncertainty in recent population sizes, trends, and demographic rates, particularly in the eastern Canadian Arctic where some colonies have not been surveyed in 40 years.

To inform harvest management, updated information on the Canadian population is required. Therefore, the objective of this project is to support harvest management decisions for the Atlantic population of Thick-billed Murre by conducting surveys at the nine largest murre colonies in the eastern Canadian Arctic – Digges Sound, Akpatok, Coburg Island, Akpait, Prince Leopold Island, Cape Hay, Cape Graham Moore, Coats Island, and Hanztsch Island (Fig. 1).

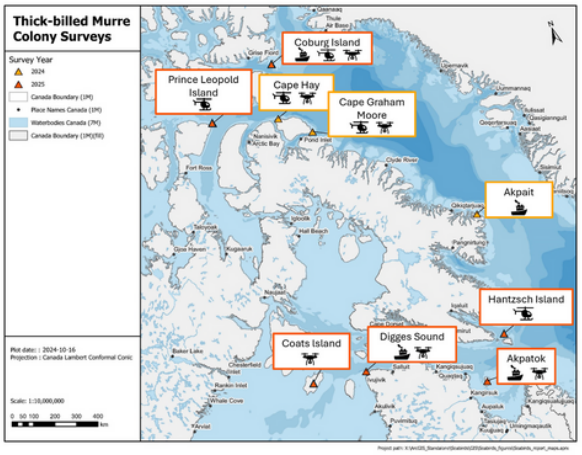
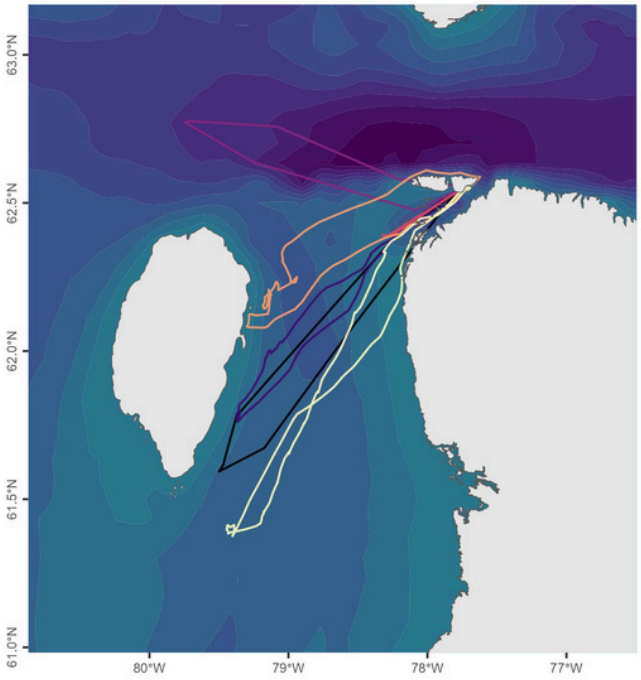


Figure 1. Survey updates and plans for thick-billed murre colonies in the Canadian Arctic for 2024 (yellow) and 2025 (orange).

Colony surveys are a collaborative effort between the Northern and Quebec regions of Canadian Wildlife Service, Environment and Climate Change Canada Science & Technology Branch, and academic partners (McGill University and Acadia University). In 2024, full colony surveys were conducted at Akpait, Cape Graham Moore and Cape Hay. Photos from the surveys will be counted to determine the number of birds nesting at these colonies. In 2025, full colony surveys will be conducted at Digges Sound, Akpatok, Coburg Island, Prince Leopold Island, Coats Island, and Hanztsch Island (Fig. 1).

RETURNING TO DIGGES ISLAND

Between July 7 and 11, we visited the Digges Sound murre colony, funded by the Oceans Protection Plan. The field trip to Digges Island involved both scientific and logistical activities, contributing valuable data for ongoing ecological research. Collaborating with Paulusie Tarriasuk and LNUK, as well as boat captains Charlie Paningajak and Henry Luuku and their crews, we tagged 11 thick-billed murres with GPS loggers and 15 more with geolocators as part of the SEATRACK project. These efforts took place at the S ledge, where climber Douglas Noblet and PhD student Anna Lippold led the tagging operations. In addition, we conducted drone and boat photographic surveys of both Digges Island and Cape Wolstenholme.



Foraging tracks of thick-billed murres at Digges Island in 2024

Our team also evaluated the condition of the research cabin on Digges Island, finding it functional but in need of maintenance. Overall, the trip combined wildlife monitoring and site maintenance, furthering our understanding of murre migration patterns and supporting infrastructure essential for ongoing studies in the region. We look forward to returning for consultations in Winter 2025 and to retrieve geolocators in Summer 2025, as well as expanding work on tracking murres and black guillemots.

Examining Trophic Interactions in Changing Arctic Marine Ecosystems

Dr. Allison Patterson - Post-doctoral Fellow, University of Windsor with Dr. Oliver Love

Climate change is known to be warming ocean temperatures in the Arctic faster than anywhere in the world. The distribution and abundance of critical forage fish species like Arctic cod are strongly tied to ocean temperatures and sea ice. Many marine predators (fish, marine mammals, and seabirds) rely on Arctic cod as prey. However, shipping, commercial fishing, and other industrial activity in the Arctic is expected to increase as sea-ice cover declines, which could exaggerate the effects of climate change on marine predators.

Allison is using the feeding activity of seabirds to monitor changes in fish populations at remote sites in the Canadian Arctic. Vast distances and challenging ocean conditions in the Canadian Arctic make it difficult to monitor fish populations using traditional sampling methods. However, Arctic seabirds breed in huge colonies and these birds are 'sampling' fish every day when they fly to sea to feed themselves and their chicks. She is using tiny activity loggers to measure how much effort birds are expending to catch fish, and DNA metabarcoding of fecal samples to identify prey species they consume. With this information, Allison will determine if there are changes in the fish species available around murre colonies and if the relative abundance of forage fish species is changing in response to changing environmental conditions. This information can be used when planning for sustainable harvest of fisheries in the face of climate change and commercial activity in Canada's North.

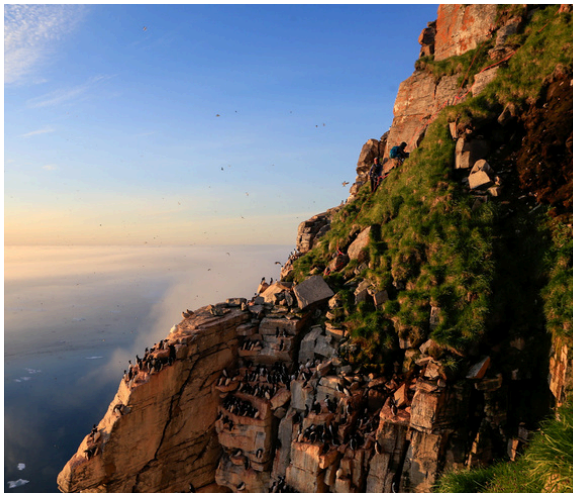
Thick-billed murres bringing fish to feed chicks at the colony. Clockwise from top-left: shrimp, fish doctor, capelin and sculpin, daubed shanny, and Arctic cod.

Interactive effects of climate change and plastic contaminants on Arctic seabirds

Dr. Anaïs Médieu – Post-doctoral Fellow, McGill University with Dr. Kyle Elliott and Dr. Kim Fernie

Climate change and environmental contamination, including plastic pollution, are among the major threats to Arctic wildlife. As Arctic temperatures warm, ice cover decreases, making ice-associated predators adjust their migratory routes and habitat use accordingly. Additionally, there have been increased exposure of Arctic top predators to plastic pollution which may change in relation to changing ice conditions. Therefore, ice-associated top predators may be differentially exposed to the cumulative effects of different plastics-associated chemical contaminants across a changing ice landscape.

Anaïs prepares thick-billed murre samples collected in the field for contaminants analyses.



Anaïs is investigating the interactive effects of climate change and plastic-related contaminants in thick-billed murres breeding at Coats Island. She will pair individual contaminant concentrations in blood samples with bio-logger deployments to model seabird migration patterns in response to climate-related changes in environmental conditions and sea ice cover. She will compare contaminant loads in birds using different migratory routes to understand sources of contaminant exposure along migratory routes. This spatio-temporal mapping of contaminant exposure will inform the interactive effects of climate change and contaminants exposure. Beyond the implications for wildlife health, Anaïs' work will provide information on food security to Northern communities, given the importance of murres as a harvested species.

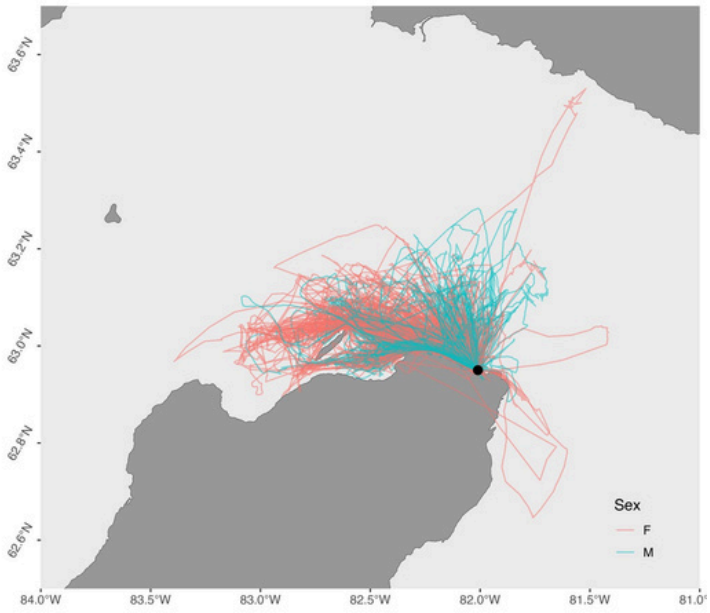
Breeding partners are opposites in foraging strategies

Marianne Gousy-Leblanc - Ph. D. Candidate, McGill University with Dr. Kyle Elliott and Dr. Vicki Friesen

While foraging success is important to reproductive success, for long-lived species with bi-parental care of offspring, complementary foraging strategies within a pair may be a strategy to enhance the probability of finding prey to provision offspring. Marianne tested whether breeding partners of thick-billed murres nesting at Coats Island used different foraging strategies, a species with long term-pair bonds and bi-parental care. Using GPS trackers and accelerometers, she measured foraging trips (distance and number of dives) of 40 pairs of thick-billed murres and randomized pairs across the colony to compare their similarity in foraging behaviour.

She found that individuals within a breeding pair were more dissimilar in their foraging trip distance and the number of dives during foraging trips compared to random pairs. Breeding pairs were also more similar in wing length than random pairs, either because individuals select similar sized (i.e., quality) partners, select sites that lead to similar sized (quality) partners, or to migration distance. Diversity in foraging strategies in this breeding colony may be maintained either through partner selection for differing strategies, or by divergence in strategies over the duration of their long-term pair bond.

A thick-billed murres bringing fish to feed its chick after a foraging trip.



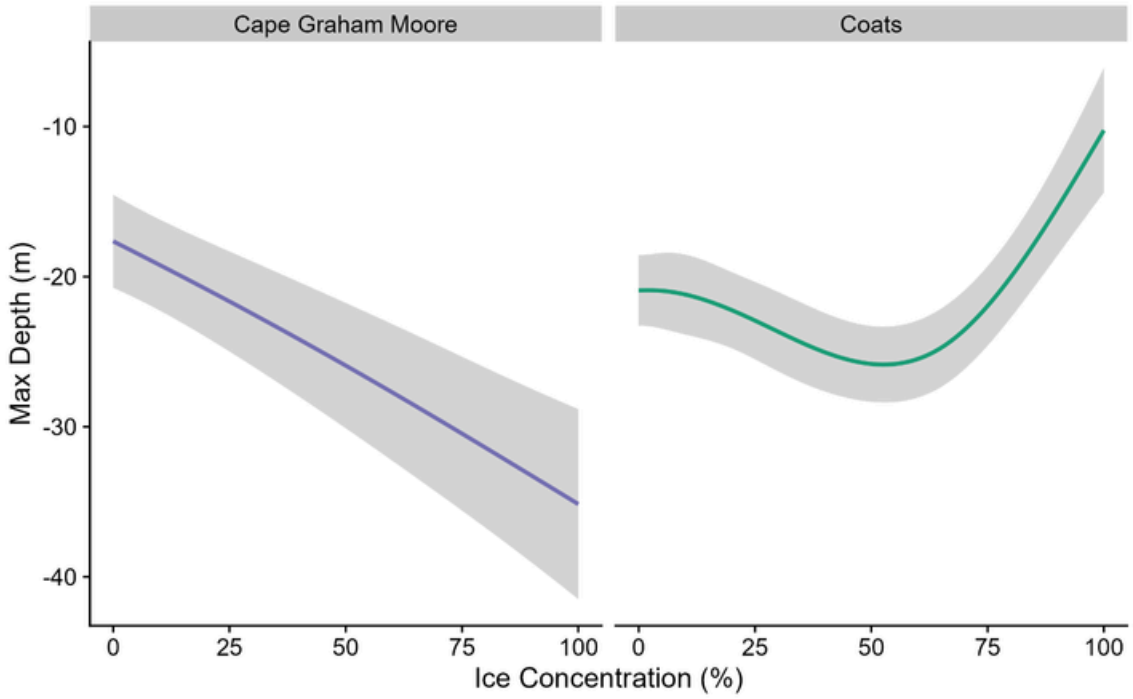
Foraging tracks of male and female thick-billed murres at Coats Island.

Influence of sea ice concentration on the foraging ecology of an Arctic seabird

Alyssa Eby - Ph. D. Candidate, McGill University with Dr. Kyle Elliott and Dr. Grant Gilchrist

Climate change is resulting in sea ice loss in Arctic regions, directly impacting ice-associated species, including marine mammals and seabirds. Thick-billed murres, an Arctic seabird, are likely to be impacted by changing ice conditions, as one of their prey items, Arctic cod is sea ice associated. Alyssa aims to compare sea ice use by thick-billed murres at a low Arctic colony (Coats Island, Nunavut) and a high Arctic colony (Cape Graham Moore, NU) using foraging movements measured from GPS data and sea ice data measured from satellite imagery during the breeding season (July-August) across multiple years (2014, 2016, 2018, 2019, 2022, and 2023).

At both colonies murres foraged near the colony (0-50 km) and foraged across all levels of sea ice concentration. However, the impact of sea ice concentration on the maximum dive depth of murres differed between high and low Arctic colonies. At Cape Graham Moore, maximum dive depth increased with sea ice concentration, with murres making deeper dives at higher sea ice concentrations. At Coats Island, the opposite relationship was observed with murres making shallower dives in areas with high sea ice concentrations. Alyssa's study highlights regional differences in sea ice use, which impact the responses of Arctic murre colonies to climate change.



Predicted relationship between maximum diving depth (m) and sea ice concentration within 1 km of foraging locations (%) at Cape Graham Moore, NU (high Arctic) and Coats Island, NU (low Arctic). Shading represents the 95% confidence interval.

Thermo- and insect tolerance in thick-billed murres

Jolie Nguyen - M. Sc., McMaster University with Dr. Emily Choy

As Arctic temperatures continue to warm as a result of climate change, cold-adapted species with a limited tolerance to heat will face increasing challenges. Thick-billed murres are an Arctic species which experiences heat stress at relatively low air temperatures, which may make it particularly at risk as the Arctic continues to warm. Using 3D-printed biophysical models of murres fitted with temperature loggers, Jolie assessed operative temperature (temperature the murres experience) of the murres at seven sites on the cliffs where they nest at Coats Island. Over the 24-day period in which they were deployed, the models measured operative temperatures as high as 45.5° C, even while ambient air temperatures only ever reached as high as 22° C, indicating that murres may be experience heat stress.

Two biophysical models of thick-billed murres deployed at Coats Island.

In addition to heat stress, thick-billed murres nesting at Coats Island are exposed to mosquito parasitism during the breeding season, which may further contribute to mortality in hot weather conditions. At the seven sites where her 3D models were deployed, Jolie also collected sweep samples to quantify mosquito abundance and assess exposure. Using this data, Jolie aims to determine how mosquito abundance at murre nesting sites changes in different weather conditions, and if hot temperatures influences parasitism on murres.

Foraging behavior and ecology of thick-billed murres

Alexandre Turmaine - M. Sc., McGill University with Dr. Kyle Elliott

Seabirds cover vast distances in search of forage fish, which are vital to marine ecosystems. In the Arctic, the thick-billed murre (Uria lomvia) is a well-studied diving seabird species that forage on capelin, Arctic cod, and other fish species integral to the region's marine food webs. With climate change having the strongest impact on Arctic ecosystems and fisheries placing significant pressure on fish stocks, understanding the impacts of these pressures on the abundance and distribution of forage fish species in the Arctic is crucial to seabird ecology and conservation.

While traditional fish stock surveys provide valuable data, they are costly, sample only a small part of the important areas, and can disrupt the ecosystems in the process. While traditional fish stock surveys provide valuable data, they are costly, sample only a small part of the important areas, and can disrupt the ecosystems in the process. As top marine predators, seabirds selectively sample the ocean's fish stocks every day while foraging, offering a unique and informative perspective on the distribution and availability of forage fish. Using GPS-accelerometers, Alex aims to determine where thick-billed murres forage (GPS) and the success rates of foraging trips to those locations (measured through higher wing beat frequency through accelerometer). With his research, Alex aims to map the foraging areas of thick-billed murres to identify key marine conservation areas.

GPS-accelerometers (AxyTrek™, Technosmart, 10 g, ~1% of body mass) deployed on a thick-billed murre incubating at Coats Island.

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STUDENTS AND POST DOCS

Dr. Allison Patterson

(Post-doctoral Fellow 2022-2024, University of Windsor) is studying how marine climate influences trophic interactions between seabirds and their prey (Weston Family Award in Northern Research - Postdoctoral Level).

Dr. Anaïs Médieu

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(Ph. D. 2021-2025, McGill University) is studying the importance of partnership and mate choice on reproductive success in thick-billed murres (Natural Sciences and Engineering Research Council of Canada).

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INUIT PARTICIPATION

Josiah Nakoolak

has worked with us as a guide and research assistant every year since 1997 and was awarded the Community Contribution to Research Award by the Northern Contaminants Program of the federal government. Josiah also operates as a mentor to our younger field workers.

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