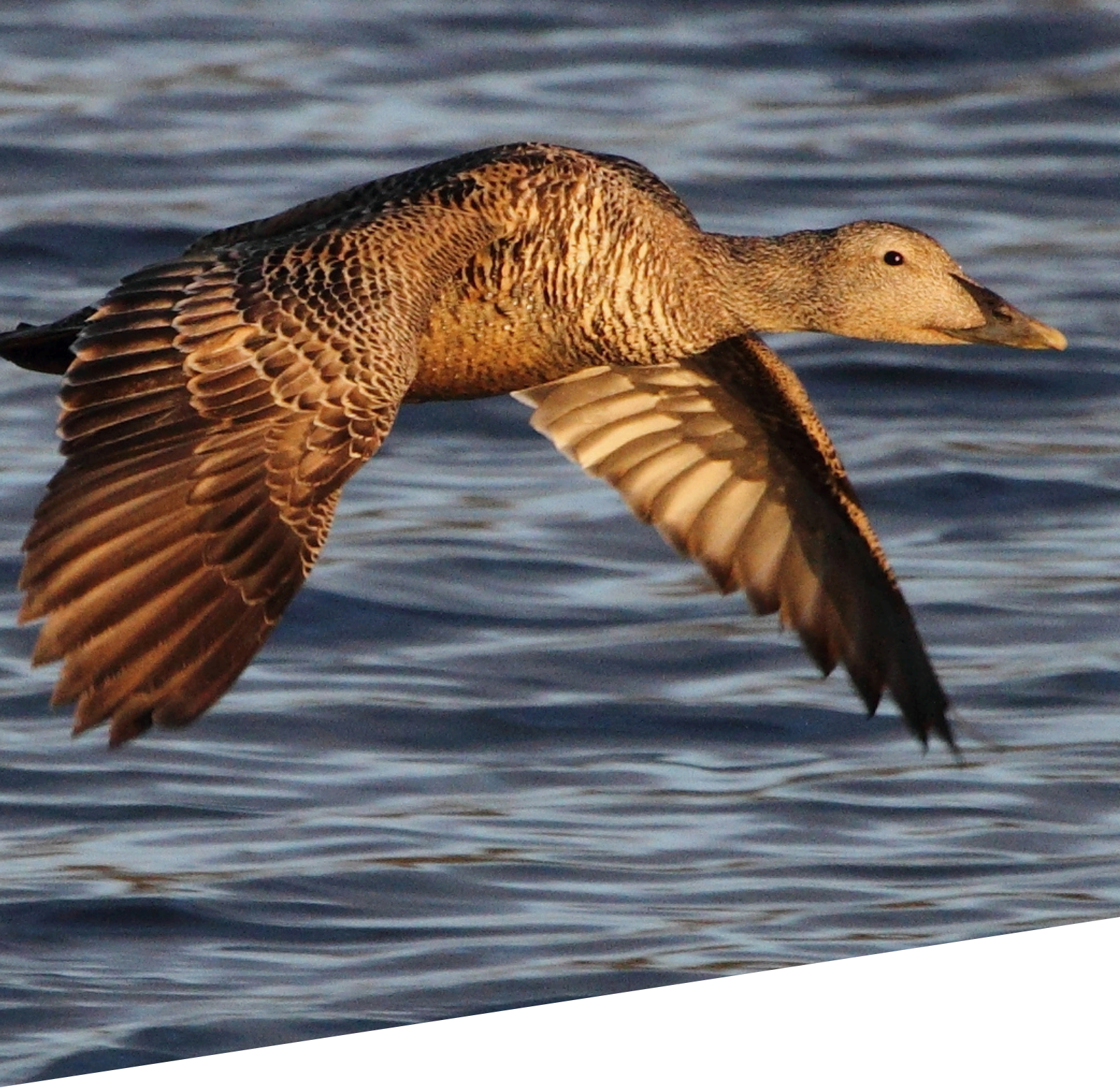


ENVIRONMENT AND CLIMATE CHANGE CANADA

ARCTIC SEADUCKS & ECOSYSTEMS

2024 FIELD SEASON AND RESEARCH REPORT

PROJECT OVERVIEW

Our studies at East Bay/Mitivik Island were initiated in 1996 in response to concerns that northern common eider ducks were being overharvested on their wintering grounds in west Greenland. Since then, many new issues have emerged and our long-term dataset has allowed us to expand our research to respond to concerns raised by Northern communities and contribute to environmental assessment initiatives. Many of the emerging issues that we are currently researching include the influence of climate change and resource development on Arctic marine birds. Our findings relating bird movements and their habitat use contribute to the ongoing planning of marine protected areas in Northern Hudson Bay.

Our research objectives include:

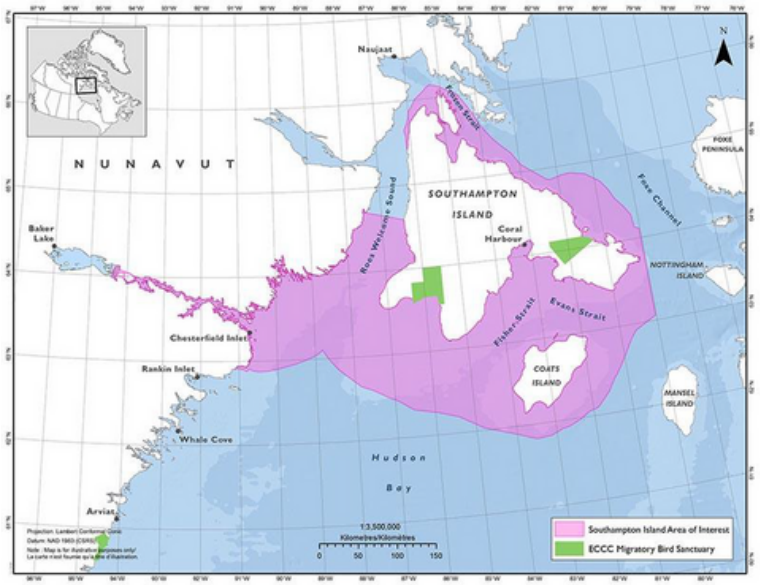
1. Investigating direct effects of variable annual weather conditions and changing sea-ice conditions on eider reproduction and population dynamics.
2. Investigating and forecasting relationships between polar bears and eiders as diminishing sea ice influences bear predation of eider nests.
3. Identifying key seabird marine habitats in an effort to identify potential issues related to northern industrial development, particularly year-round shipping.
4. Understanding the physiological mechanisms linking climate variability, reproduction, and survival of arctic breeding migratory birds.
5. Tracking birds using GPS technologies to quantify their use of coastal and off-shore marine habitats. These findings are contributing to the design of marine protected areas currently proposed in Northern Hudson Bay.

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.

Our team is contributing seabird spatial tracking information which will be useful in the design 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 93000 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 foraging habitats of seabirds. This new 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.

STRATEGICALLY SHIFTING PROGRAM FOCUS

After nearly three decades of research conducted at East Bay (Mitivik) Island, our research program has accomplished a lot and more than originally planned. In addition to our published findings and influence on conservation policy, we have trained multiple cohorts of Inuit and Arctic scientists to examine long term ecological trends in changing Arctic ecosystems.

One of the most striking ecological changes to East Bay Island has been the increasing presence of polar bears at the colony who are arriving earlier during eider incubation and foraging on eggs. Although this has provided new research opportunities to study the interactions of bears and birds (see above), the consistent predation and often complete destruction of the colony has resulted in nearly no duckling recruitment to the breeding population for nearly ten consecutive years, resulting in a continuous decline in colony size (Fig 1).

We responded to the risks posed by increasing number of polar bears on the island by intentionally shortening the research season, safely extracting field staff from the island by helicopter in late June/early July each year (beginning in 2014). The shorter field season reduced the encounters between polar bears and field workers as intended but made it challenging to collect key long-term data from the colony such as laying dates, nesting distribution, timing of nest failure, and eider adult survival which has been the foundation of our research program for so many years.

These developments also came at a time when the costs of Arctic research continued to rise, placing significant financial pressure on our program and our collaborators. Collectively, these issues have generated a challenging situation in which the resources and safety risks associated with maintaining

the program are no longer commensurate with the priorities of ECCC. So, after 28 years, we have made the decision that the 2024 field season will be the final field season of the East Bay Island field station.

This new direction has prompted us to recall the old adage, "With change comes opportunity". The shift away from East Bay Island has generated new opportunities to redirect our research focus to other areas of the Eastern Arctic that can better address issues of eider duck conservation and management.

In July of 2024, we initiated a new multi-faceted project in collaboration with the community of Kinngait, the Nunavut Wildlife Management Board, and the Sea Duck Joint Venture. As part of our long-term monitoring program led by ECCC, we are returning to Baffin Island to resume surveys of common eider nesting colonies in the Hudson Strait which were first initiated by Dr. Graham Cooch in the 1950s.

Our intent is to understand how the density and distribution of common eiders nesting on coastal islands has changed over nearly 70 years. These surveys will also help to inform a related social-science project led by Drs. T. Semeniuk (U of Windsor), V. Nyguen (Carleton U), and D. Henri (ECCC) and funded by NSERC, which is currently examining how changes in colony distribution and size may be generating challenges and new costs associated with harvesting common eider ducks by the community of Kinngait. In addition to community-driven questions, we will assess the potential impact of ongoing lumpfish fisheries by-catch on eider ducks wintering in west Greenland in collaboration with scientists from Denmark and the Greenland Institute of Nature.

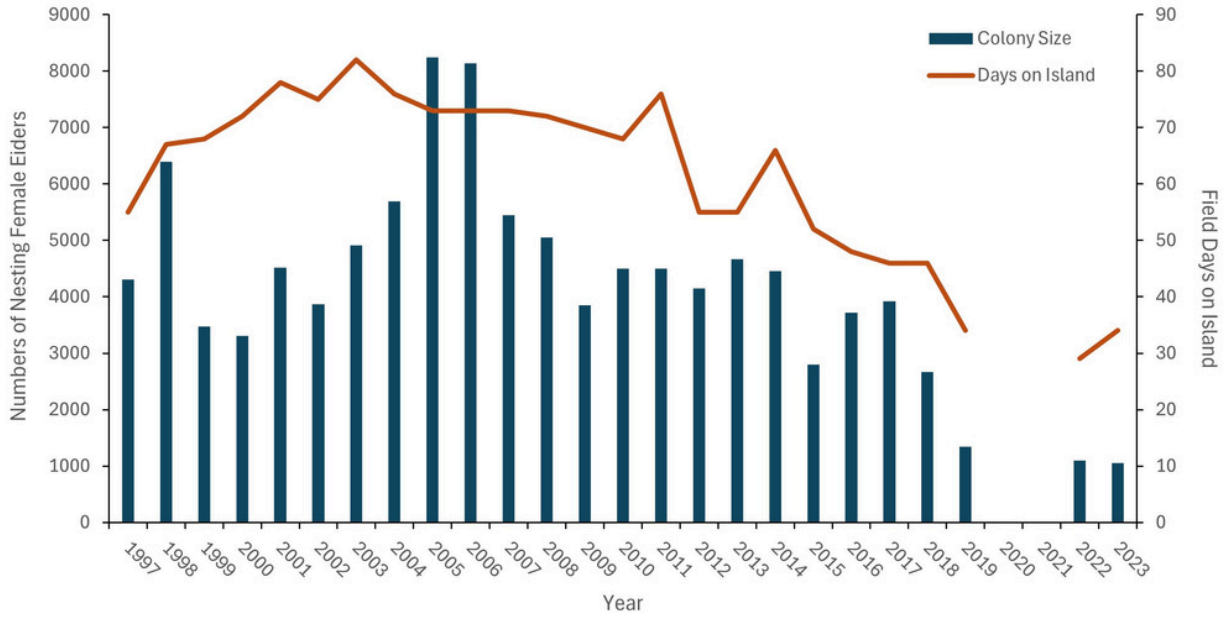


Fig. 1 - Number of nesting female common eiders across time (blue bars) and field season duration (in days; orange line) across years at East Bay Island, NU.

SEA DUCK JOINT VENTURE

Sea ducks are a large group of waterfowl that, when compared to other waterfowl species, little is known about. Some sea duck populations are declining in North America or have lower numbers than they did historically, and they depend on sensitive coastal, arctic, and boreal habitats throughout the continent.

The Sea Duck Joint Venture (SDJV) is an American and Canadian conservation partnership of wildlife organizations committed to maintaining sustainable populations of North American sea ducks throughout their ranges. The Joint Venture contributes research funding directly to support sea duck research, monitoring projects, and outreach programs intended to improve understanding required for effective population and habitat conservation throughout North America, including the Arctic. Projects are cooperatively funded by Congressional appropriations and partner contributions.

The SDJV, in collaboration with Ducks Unlimited, Inc., has recently developed a graduate student fellowship program to support research on North American sea ducks. The goal of the program is to increase the number of skilled early career professionals interested in sea duck research, management, and conservation. **Shayla Kroeze** (Queens University), and **Emily MacDonald** (University of Windsor) have received Student Fellowship Awards to support their graduate research of eider ducks.

To learn more, please visit the SDJV website: **seaduckjv.org**

Socioeconomics of Mitiq (Eider Duck) Harvest to Support Food Security and Well-being

Katharina (Kt) M. Miller - Ph.D. Student, Carleton University with Dr. Dominique Henri and Dr. Vivian Nguyen

In northern Indigenous communities subsistence harvest is critical to food security and well-being. For instance, eider ducks, are harvested widely by coastal Inuit communities for meat, eggs and feather down. Climate-induced early sea-ice breakup can benefit eider reproduction, increasing nesting opportunities and therefore increasing potential food availability to Indigenous communities. At the same time, earlier sea-ice melt is increasing the risk of eider nest predation by polar bears that now spend more time on shore, thereby reducing the number of eggs to harvest and imposing serious risk to harvesters.

To anticipate the consequences of climate change, harvesting, and polar bear predation on eider abundance and distribution it is critical to develop an understanding of Inuit Qaujimajatuqangit (IQ – Inuit knowledge) of duck hunting, egg picking, and down collecting in order to analyze both their economic and cultural value.

Common eider nest

This summer Kt joined our field team conducting coastal eider duck surveys between the communities of Kinngait and Kimmirut to begin her doctoral studies. She worked to codesign her research with the Inuit crew and gather initial data on the cost of harvest ensuring IQ is embedded in her research. Overall, Kt aims to bring together knowledge from Inuit ways of knowing, ecology, and economics to support food security and Inuit research priorities.

How Genetics might have influenced the response of Common Eiders to Avian Cholera

Shayla (Shay) Kroeze - Ph.D. Student, Queen's University Drs. Vicki Friesen and Grant Gilchrist

Arctic species are beginning to face novel diseases, in part due to warmer climates increasing the exposure of wildlife to disease vectors (e.g., mosquitoes). However, the genetics of disease resistance in wild populations is surprisingly lacking, particularly in Arctic species. From 2005-2012, the common eider colony on East Bay Island experienced several outbreaks of avian cholera, resulting in high mortality rates and decreased reproductive success. Since 2011, the mortality rate of female eiders has been less than 1%, likely due to herd immunity. However, it is unknown why in years of high cholera mortality, some eiders dies while others survived.

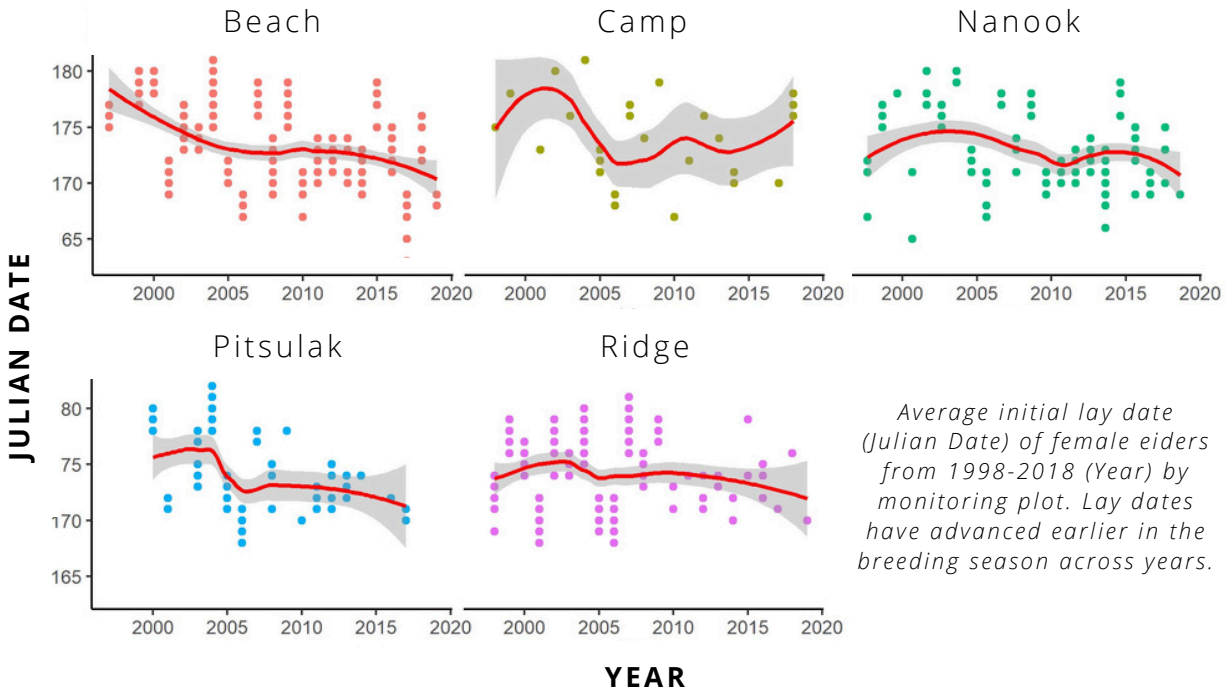
Shay will examine the role of genetics in contributing resistance to cholera among eiders. She will analyze whole genome sequences from our archive of eider blood samples that both survived the cholera epidemic and did not, as well as from eiders that were found to have a strong immune response to cholera based on antibody levels. This will be accompanied by a long-term dataset on immune-related variables in these eiders such as age, body size, etc. She will test for correlations between variation in genes and cholera resistance controlling for immune related variables, specifically focused on genes previously found to be involved in immunity in other bird species. Additionally, Shay will explore how these genes changed in frequency before, during, and after the outbreaks, as well as in colonies that have never been exposed to cholera. Results from her research will provide rare information on the population genetics of disease resistance in wild populations, and the vulnerability of Arctic bird species to emerging infectious diseases.

Influence of Environmental Variability on Nest Site Selection by Common Eiders

Duncan Wright - M.Sc. Student, University of Windsor with Dr. Christina Semeniuk

Choosing the right habitat is critical to an organism's survival and reproduction as it can affect access to quality food resources, secure mates, avoid predation, and optimize of physiological processes. When selecting habitats, individuals often distribute themselves non-randomly to balance these tradeoffs. Nesting selection patterns follow the same trends, but with an emphasis on individual survival and reproductive success. Among birds, we assume that the earliest nesting birds choose the highest quality sites, and achieve the highest reproductive success.

Although responses to climatic and environmental stressors have been demonstrated during nesting in Common Eiders (*Somateria mollissima*), little is known about nest site preferences on a broad spatial scale. Further, despite the predicted effect of temperature on lay dates in Common Eiders, it is currently unknown if nesting behaviour has been adjusted for rapidly changing climatic conditions. Using long-term monitoring data from East Bay/Mitivik Island (1999-2018) Duncan will assess the role of seasonal environmental cues (temperature, precipitation, wind speed, wind direction), and nest site characteristics (distance to water, base substrate, wind cover, and viewshed) on nest site selection (nest site location, nesting date) on a spatial-temporal scale. This 20 year dataset will provide insight into high quality sites and nest site selection in a Habitat Selection Theory framework.



Average initial lay date (Julian Date) of female eiders from 1998-2018 (Year) by monitoring plot. Lay dates have advanced earlier in the breeding season across years.

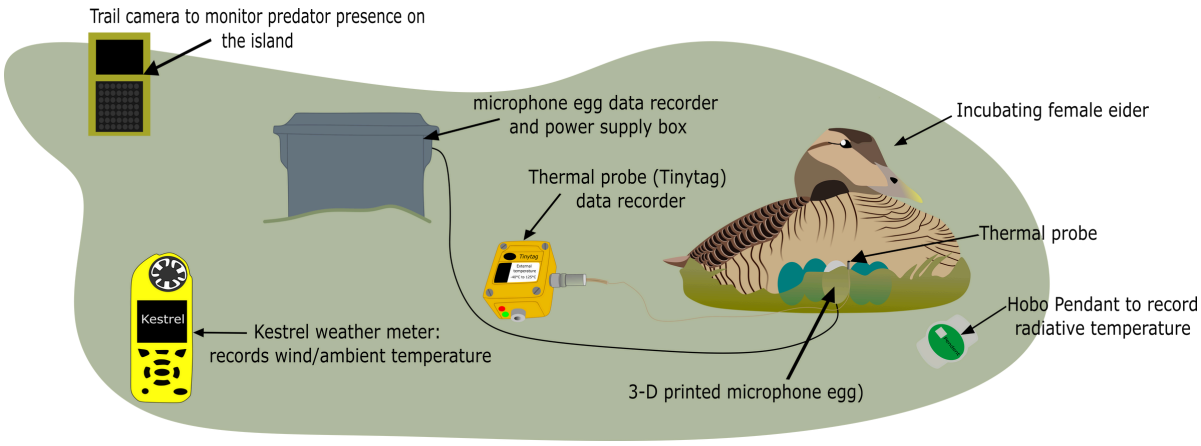
Impacts of Thermal Stress on the Nesting Behaviour and Physiology of Eiders

Emily MacDonald - M.Sc. Student, University of Windsor with Drs. Christina Semeniuk and Oliver Love

Arctic temperatures are rising at an alarming rate, yet its direct impact on Arctic species remains understudied. To address this, Emily is examining the physiological and behavioural response of incubating female eiders to thermal stress at the East Bay/Qaqsauqtuuq Migratory Bird Sanctuary, Nunavut. Female eiders here may be especially at risk to over-heating during incubation because their nests are exposed to the sun, and they fast for the duration of their incubation (i.e., 24-26 days without energy input to combat increased costs of thermoregulation).

This summer, Emily monitored the heart rate (proxy for metabolic rate and physiological indicator of heat stress) and incubation consistency/nest movements (behavioural response to heat stress) of nesting female eiders to ambient temperatures. To do this, she installed a heart rate recording microphones and thermal probes in 36 female eider nests while simultaneously recording ambient and radiative temperature, and wind speeds around the nests and breeding colony. Emily's dataset builds on similar data from 2018 (20 females), 2019 (12 females), and 2022 (14 females).

Assessing heat stress on the energetic and behavioural costs of breeding female Common Eiders will provide insight into their vulnerability to a rapidly warming Arctic. Further, predicting temperatures at which eiders experience thermal stress can inform projected climate impacts and management strategies of this culturally important seabird.



Example set up of heart rate and temperature recorders in a Common Eider nest with surrounding environmental temperature recording devices

PUBLICATIONS

Barnas A, C Simone, E Geldart, OP Love, P Jagielski, HG Gilchrist, E Richardson, C Dey, CAD Semeniuk. 2024. An interspecific foraging association with polar bears increases foraging opportunities for avian predators in a declining Arctic seabird colony. **Ecology and Evolution** 14:e11012. DOI: 10.1002/ece3.11012.

Geldart EA, OP Love, AF Barnas, CM Harris, HG Gilchrist, CAD Semeniuk. 2023. A colonial-nesting seabird shows limited heart rate responses to natural variation in threats of polar bears. **Royal Society Open Science** 10 (10):221108.

Geldart EA, OP Love, HG Gilchrist, AF Barnas, CM Harris, CAD Semeniuk. 2023. Heightened heart rate but similar flight responses to evolved versus recent predators in an Arctic seabird. **Avian Conservation and Ecology** 18(1): 22.

Richard S, HG Gilchrist, HL Hennin, VM Nguyen. 2023. Collaboration between local Indigenous and visiting non-indigenous researchers: Practical challenges and insights from a long-term environmental monitoring program in the Canadian Arctic. **Ecological Solutions and Evidence** 4 (3).

Simone C, EA Geldart, CAD Semeniuk, OP Love, HG Gilchrist, AF Barnas. 2023. Conspecific nest attendance behaviour of Common Eider (*Somateria mollissima*) in response to Polar Bear (*Ursus maritimus*) foraging activity: error or intent? **Canadian Field Naturalist** 136 (3).

Richard S, HG Gilchrist, HL Hennin, VM Nguyen. 2023. Collaboration between local Indigenous and visiting non-indigenous researchers: Practical challenges and insights from a long-term environmental monitoring program in the Canadian Arctic. **Ecological Solutions and Evidence** 4 (3).

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STUDENTS AND POST DOCS

Katharina (Kt) Miller

(Ph.D. 2024-2029, Carleton University) is exploring the link between socioeconomics of eider harvest, food security, intergenerational knowledge transfer, and well-being with the community of Kinngait, Nunavut (Carleton University International Doctoral Excellence Award, Maatje Nix Memorial Scholarship).

Shayla Kroeze

(Ph.D. 2023–2027, Queen's University) is examining the role of genetics in contributing resistance to avian cholera infection in Common Eiders (Natural Sciences and Engineering Research Council of Canada's Canadian Graduate Scholarship - Doctoral, SeaDuck Joint Venture Fellowship).

Emily MacDonald

(M.Sc. 2022-2024, University of Windsor) is examining the physiological and behavioural responses of Arctic-breeding Common Eiders to heat stress (University of Windsor Entrance Scholarship, Ontario Graduate Scholarship, SeaDuck Joint Venture Fellowship, Weston Family Awards in Northern Research).

Alysha Riquier

(M.Sc. 2022-2024, University of Windsor) is examining how variation in weather affects arthropod availability and Snow Bunting breeding phenology to ultimately determine whether buntings have the capacity to keep pace with climate change in a rapidly changing Arctic.

Rebecca Jardine

(M.Sc, 2022-2024, University of Windsor) is investigating the behavioural, physiological and fitness responses of an Arctic songbird to increasing temperatures on their breeding grounds (SCO-SOC Discovery Award).

Duncan Wright

(M.Sc. 2022-2024, University of Windsor) is exploring common eider nesting patterns using GIS spatial modeling (ESRI ArcGIS scholarship).

Jacob Peterson-Galema

(M.Sc. 2024-2026, University of Windsor) is examining the impacts of polar bears on common eider nesting behaviour.

INUIT PARTICIPATION

Josiah Nakoolak

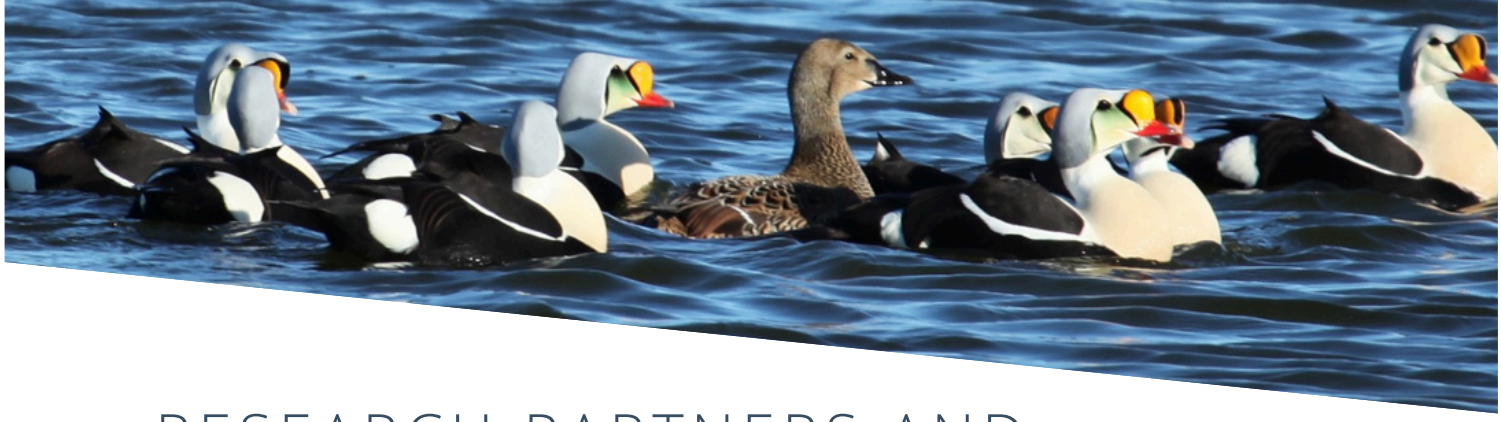
has worked with us as a guide and research assistant every year since 1997 and was awarded the Community Contribution to Research Award by the Northern Contaminants Program of the federal government. Josiah also operates as a mentor to our younger field workers.

Mark Eetuk

participated in the Inuit Field Training Program in 2018, was recruited to East Bay Island in 2019 to work as a research assistant, and has returned to join the team every year since.

Marvin Shimout

joined our East Bay Island team for the first time in 2024, and participated in the Inuit Field Training Program later in the summer field season.



RESEARCH PARTNERS AND FINANCIAL SUPPORT

Our research at East Bay Island is a combined effort of many people and organizations. Dr. Grant Gilchrist (Environment and Climate Change Canada; ECCC) co-leads the project together with Drs. Oliver Love (U of Windsor), Christina Semeniuk (U of Windsor), Evan Richardson (ECCC) and Holly Hennin (ECCC). Our research with the community of Kinngait is co-led by Dr. Grant Gilchrist, Dr. Dominique Henri (ECCC), Dr. Vivian Nguyen (Carleton U) and Dr. Christina Semeniuk. Support in Coral Harbour is provided through the Aiviit Hunters and Trappers Organization, and with special thanks to Noah Nakoolak. We thank Isabel Buttler and Rob Kelly for their ongoing contributions to data management.

The research at East Bay Island is logistically complicated and labour intensive, requiring a dedicated crew of students, biologists and Northerners. Our eider field crew in 2024 included Josiah Nakoolak, Mark Eetuk, Marvin Shimout, Grant Gilchrist, Shay Kroeze, Lindsay Daly, Kerry Roe, Justin Kreller, Jacob Peterson-Galema, Daniel Giesbrecht, Holly Hennin, Patrick Jagielski, Evan Richarson, and Clifford Natakok. Photos in this report provided by A Riquier, R Jardine, H Hennin, E Richardson, K Parkinson, and G Gilchrist.

Research in Canada's North is expensive and funding for this work is provided by a network of partnerships that includes but is not limited to: Environment and Climate Change Canada (ECCC) Wildlife Research Division, ECCC Canadian Wildlife Service, Baffinland Iron Mines Corporation, ArcticNet, Oceans North, Carleton University, University of Windsor, Polar Continental Shelf Program, Northern Scientific Training Program, Natural Sciences and Engineering Research Council of Canada, the Weston Family Foundation, the Canada Research Chairs program, Nunavut Wildlife Research Trust, and SeaDuck Joint Venture.

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