East Bay Island Migratory Bird Research

2016 Field Season Report (NIRB file 06AN026)

Project Overview

2016 marks the 20th consecutive year of field research at East Bay Island. Our studies at East Bay were initiated in 1996 in response to concerns that northern common eiders 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 environmental assessment initiatives. Many of the emerging issues that we are currently researching relate to climate change and resource development, and how these issues may influence arctic marine birds. They include:

1. Investigating relationships between polar bear predation on eider nests and diminishing sea ice.

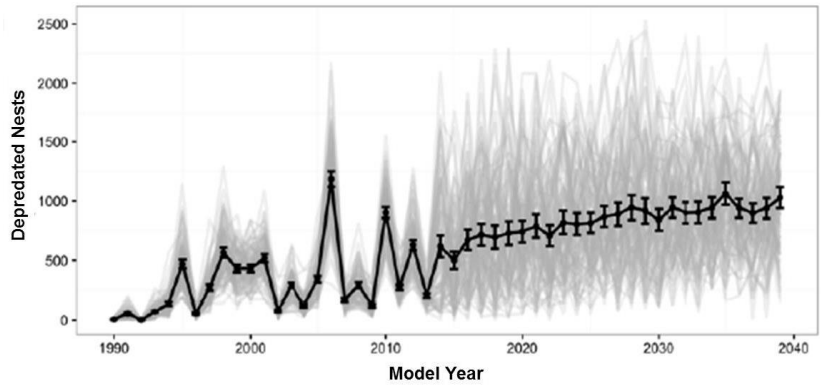
2. Identifying key seabird marine habitats in an effort to mitigate potential issues related to northern industrial development, particularly year-round shipping.

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.

Climate Induced Changes in the Predator-Prey Relationships of Common Eiders and Polar Bears

Polar bear predation of common eider nests at East Bay is increasing, apparently because of earlier seasonal sea-ice break-up. This has resulted in complete reproductive failure for eiders at East Bay in 3 of the past 5 years. However, it is unclear the degree to which foraging on eggs can provide energetic benefits to polar bears. To predict the consequences of increasing nest predation for both polar bears and eiders, we developed an agent-based model that uses ecological principles to model behavior of individuals. Our model reproduced observed increases in polar bear presence on the colony, and predicts increases in nest predation as advances in ice-breakup continue (Fig 1). Furthermore, the model indicated that increasing nest predation will not compensate for predicted declines in polar bear body condition caused by increases in the length of the ice-free period.

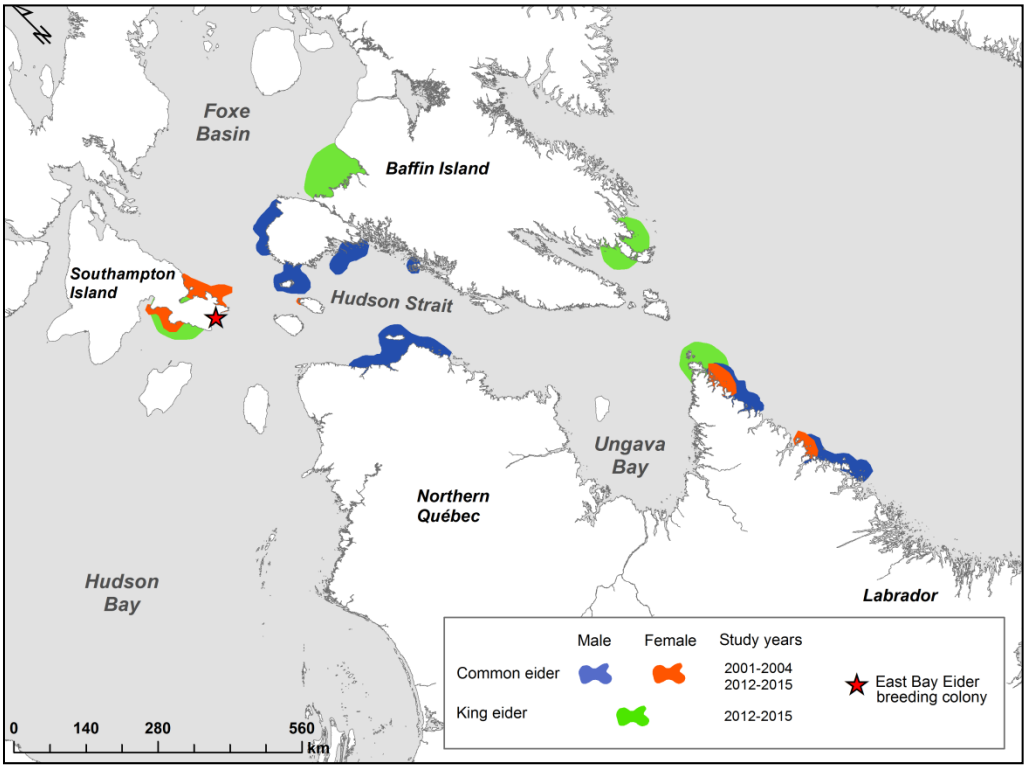


Model predictions of nest predation in relation to year (Dey et al. 2016).

In an effort to improve our agent based model, we used an aerial drone this summer to film foraging behavior of polar bears at East Bay Island. The footage collected will allow us to more accurately parameterize foraging metrics such as time taken to find and consume nests. Polar bears often scare nesting eider hens off of their nests, which then allows gulls to consume the eggs. The drone footage will allow us to examine the combined effect of gulls and bears on eider nest failure.

Ecological Importance of Sea Ice in Determining Habitat Use of Eider Ducks in a Rapidly Changing Arctic

Using satellite tracking data, we are investigating the influence of sea ice on the migratory patterns and habitat use of common and king eiders in Hudson Strait, Nunavut. Recent decades have seen an increase in the ice-free period in Hudson Strait, concurrent with the growth of shipping activity necessary to support resource development in the Canadian Arctic. This project is an ongoing partnership between Environment and Climate Change Canada, Inuit communities, Canadian universities and Baffinland Iron Mines with the objective of providing the information necessary to limit the potential overlap between sensitive marine habitats and maritime shipping traffic.



Areas with high levels of habitat use by eiders tagged at East Bay Island.

We are using satellite telemetry data of common and king eiders tagged at East Bay, together with Synthetic Aperture Radar (SAR) imagery of coastal sea ice conditions to: 1) identify which areas are important for eiders (e.g. Figure 2), 2) determine the period when the areas are used, and how consistently they are used across years, and 3) investigate how ice conditions account for the seasonal variability in the use of those habitats. Ultimately, we aim to improve knowledge on how sea ice conditions influence movement behavior and habitat use of migratory Arctic bird species.

The Physiological Limits of Behavioural Adaptation to Climate Change

New GPS tracking technology is now allowing our team to obtain detailed movement and diving behaviour of individual common eiders during the pre-breeding period. Our team captured female common eiders upon arrival at the breeding colony and fitted them with temporary GPS units in order to monitor foraging behaviour between arrival and laying. This pre-breeding period is critical for female eiders as this is when they accumulate the necessary energy stores required to reproduce successfully. Corticosterone is an energetic hormone that influences foraging behaviour. Our previous work suggests that female common eiders with experimentally elevated levels of corticosterone bred earlier, and had higher reproductive success compared to birds with natural corticosterone levels. However, it is unclear *why* elevated corticosterone led to earlier breeding and higher reproductive success. To investigate whether elevated levels of corticosterone result in higher foraging rates, this year we combined GPS tracking technology with corticosterone manipulations; something that is rarely if ever attempted among wild bird populations.

Deploying nets used to capture eiders at East Bay Island; Constructing a GPS receiver station.

Timing of ice break-up affects foraging during the pre-breeding period, influencing the timing of breeding. Our previous work at East Bay indicates that timing of breeding is critical for reproductive success. By understanding the physiological mechanisms that drive foraging behaviour, we can better understand the degree to which eiders are able to modify their foraging behaviour in response to variable sea ice conditions. This in turn will allow us to model the consequences of changing ice conditions on eider foraging behaviour, reproductive success, and ultimately population viability.

2016 Student and Post Doc Contributions

Dr. Cody Dey (Post-Doctoral Fellow, University of Windsor) is using computer simulation models to quantify and predict the consequences of climate induced changes to polar bear and common eider predator-prey relationships.

Dr. Sjoerd Duijns (Post-Doctoral Fellow, Carleton University) is using coastal boat-based surveys to assess factors influencing the coastal distribution of marine birds during the breeding season.

Dr. Holly Hennin (Post-Doctoral Fellow, University of Windsor) is examining how individual quality and environmental variability influence reproductive investment in common eiders.

Dr. Pierre Legagneux (Post-Doctoral Fellow, UQAR) is working with the long term common eider reproductive dataset from East Bay Island to investigate relationships between climate variation, individual variation in oxidative stress/immune function and reproductive success.

Dr. Emily McKinnon (Post-Doctoral Fellow, University of Windsor) is examining migratory carry-over effects and ecosystem linkages in the East Bay Snow bunting population.

Lorelei Guery (Ph.D. 2011-2016; UQAR) is investigating the influence of climatic fluctuations on common eider life history and population dynamics.

Frankie Jean- Gagnon (Ph.D. 2015-2019; Carleton University) is quantifying the factors influencing year-round coastal habitat use of eider ducks in the Canadian Arctic using satellite telemetry.

Dr. Jennifer Provencher (Ph.D. 2011-2016; Carleton University) reviewed and explained the pathways and effects of mercury on Arctic marine birds.

Justin Roy (Ph.D. 2015-2019; UQAR) is using genetic markers in common eiders to assess population differences in winter carry-over effects on investment decisions.

Rolanda Steenweg (Ph.D. 2013-2017; Dalhousie University) is studying how different climatic conditions on the wintering grounds influence reproductive timing and success of common eiders breeding at East Bay Island.

Christine Anderson (M.Sc. 2014-2016; Acadia University) quantified the migration movement ecology and key habitats of Herring Gulls in Eastern North America breeding at East Bay.

2016 Student Contributions Continued…

Nik Clyde (M.Sc. 2014-2016; Carleton University) quantified how nutrient input from eider ducks influences plant communities and species diversity and in turn eider nesting distribution on islands in Hudson Strait.

Mylene Dufour (M.Sc. 2015-2017; UQAR) is working to map Eider Duck benthic prey distribution in order to further understand seasonal habitat use of arctic breeding eiders.

Peter Marier (M.Sc. 2014-2016; University of Windsor) is examining links between climatic variation, insect emergence and timing of breeding in Snow buntings at East Bay.

Sean Power (M.Sc. 2015-2017; University of Windsor) is examining links between baseline stress physiology and fattening rates in Snow buntings breeding in the Arctic.

Kyle Parkinson (M.Sc. 2017-2019, University of Windsor) is examining the impacts of climatic variability on foraging decisions and success of common eiders.

2016 Inuit Participation

Jupie Angootealuk has worked with us at East Bay since 2013. He has proven to be a highly effective research assistant and occupied critical research roles on both the eider and bear research teams this year.

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

Clifford Natakok worked as an integral component of our 4 person bear research team at East Bay this year. His duties involved videography, data collection, and monitoring for bears.

Michael Shimout was at East Bay for two weeks in late June working in research assistant apprentice role, with guidance from Josiah and Jupie.

Recent Popular Press

Hennin, H.L., Bêty, J., Legagneaux, P., Gilchrist, H.G., Williams, T.D., and Love, O.P. 2016. Fattening quickly while saving energy benefits earlier breeding. Press release for American Naturalist. Aug. 1, 2016.

Windsor Star (print and online news article). Arctic meltdown has polar bears slimming down on all-egg diet. October 7, 2016.

AM 800 Windsor (radio interview of Cody Dey). October 7, 2016.

University of Windsor Daily News (online news article). Egg diet no replacement for seals as polar bears battle climate change, study finds. October 6, 2016.

Discovery News (online news article). Polar bears won't survive on birds and berries. September 19, 2016.

2016 East Bay Island Publications

Dey, C. J., Richardson, E., McGeachy, D., Iverson, S. A., Gilchrist, H. G. and Semeniuk, C. (2016) Increasing nest predation will be insufficient to maintain polar bear body condition in the face of sea-ice loss. Global Change Biology. In Press. doi:10.1111/gcb.13499.

Guery, L., S. Descamps, R. Pradel, S. A. Hanssen, K. E. Erikstad, G. W. Gabrielsen, H. G. Gilchrist, and J. Bety. Winter migration or residency: hidden survival heterogeneity of three common eider populations in response to climate fluctuations. Journal of Animal Ecology, Resubmitted (Sept 2016).

Hennin, H.L., Bêty, J., Legagneaux, P., Gilchrist, H.G., Williams, T.D., and Love, O.P. (2016) Energetic physiology mediates individual optimization of breeding phenology in a migratory Arctic seabird. American Naturalist, 4: 434-445.

Hennin, H.L., Wells-Berlin, A.M., and Love, O.P. (2016) Baseline glucocorticoids are drivers of body mass gain in a diving seabird. Ecology and Evolution, 6:1702-1711.

Henri, D., Jean-Gagnon, F., and Gilchrist, G. (2016) Using Inuit traditional ecological knowledge for detecting and monitoring avian cholera among common eiders in the Eastern Canadian Arctic. Ecology and Society (ID# ES-2016-8400), In Press.

Iverson, S. A., Forbes, M. R., Simard, M., Soos, C., and Gilchrist, H. G. (2016) Avian Cholera emergence in Arctic-nesting northern common eiders: using community-based, participatory surveillance to delineate disease outbreak patterns and predict transmission risk. Ecology and Society, In Press.

Iverson, S. A., Gilchrist, H. G., Soos, C., Buttler, I., Harms, N. J. and Forbes, M. R. (2016) Injecting epidemiology into population viability analysis: avian cholera transmission dynamics at an arctic seabird colony. Journal of Animal Ecology. doi:10.1111/1365-2656.12585.

Jean-Gagnon, F., Legagneux, P., Gilchrist, G., Bélanger, S., Love, O. and J. Bêty. (2016) The impact of sea ice conditions on breeding decisions is modulated by individual state in an arctic partial capital breeder. Oikos (ID# OIK-04011) – Submitted.

Legagneux, P., Hennin, H. L., Gilchrist, H. G., Williams, T. D., Love, O. P., & Bêty, J. (2016). Unpredictable Perturbation Reduces Breeding Propensity Regardless Of Pre-Laying Reproductive Readiness In A Partial Capital Breeder. Journal of Avian Biology.

Macdonald, C. A., McKinnon, E. A., Gilchrist, H. G., & Love, O. P. (2016). Cold tolerance, and not earlier arrival on breeding grounds, explains why males winter further north in an Arctic-breeding songbird. Journal of Avian Biology, 47: 7-15.

McKinnon, E. A., C. A. Macdonald, H. G. Gilchrsit, and O. P. Love. (2016) Spring and fall migration phenology of an Arctic-breeding passerine. Journal of Ornithology 157: 681-694.

Provencher, J. F., M. R. Forbes, M. L. Mallory, S. Wilson, and H. G. Gilchrist. (2016) Anti-parasite treatment, but not mercury burdens, influence nesting propensity for late arriving individuals and those in poor condition. Science of the Total Environment, In Press.

Provencher, J. F., M. R. Forbes, H. Hennin, O. Love, B. M. Braune, M. L. Mallory, and H. G. Gilchrist. (2016) Implications of mercury and lead concentrations on breeding physiology and phenology in an Arctic breeding sea duck. Environmental Pollution, In Press.

Provencher, J. F., M. L. Mallory, G. Mitchell, H. G. Gilchrist, and M. R. Forbes. (2016) Direct and indirect causes of sex differences in mercury concentrations and parasitic infections in a marine bird. Science of the Total Environment 551-552: 506-512.

Research Partners and Financial Support

Our research at East Bay Island was a combined effort of many people and organizations. Dr. Grant Gilchrist (Environment and Climate Change Canada (ECCC)) leads the project together with Dr. Oliver Love (University of Windsor), Dr. Christina Semeniuk (University of Windsor), Dr. Joël Bêty (Université du Québec à Rimouski) and Dr. Evan Richardson (ECCC). The project coordinator in 2016 was Mike Janssen (ECCC).

The research at East Bay Island is logistically complicated and labour intensive, requiring a relatively large, dedicated crew of students and biologists. Our field crew in 2016 included Pierre Legagneux, Holly Hennin, Jenna Cragg, Ariane Batic, Frankie Jean-Gagnon, Nik Clyde, Rolanda Steenweg, Christine Anderson, Bob Hansen, Justin Roy, and Oliver Love. Local expertise was provided by Josiah Nakoolak, Jupie Angootealuk, Clifford Natakok, and Michael Shimout of Coral Harbour.

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 Canada Wildlife Research Division, Environment Canada Ecotoxicology and Wildlife Health Division, Baffinland Iron Mines Corporation, the Canadian Wildlife Service, the PEW Charitable Trusts, Mitacs, Oceans North, Polar Knowledge Canada, ArcticNet, Nunavut General Monitoring Plan, Université du Québec à Rimouski, University of Windsor, Carleton University, Acadia University, Polar Continental Shelf Program (PCSP), Northern Scientific Training Program, Northern Contaminants Program, NSERC, and the Canada Research Chairs program.

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