ATLANTIC MARINE BIRD COOPERATIVE

Ongoing Project Updates and New Project Summaries by Members of the Atlantic Marine Bird Cooperative - 2024

February 2025

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At-Sea Surveys

Vessel-based Seabird Surveys in Eastern Canada

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The Canadian Wildlife Service (CWS) conducted systematic surveys of marine birds from ships under the Eastern Canada Seabirds at Sea (ECSAS) program, and in 2024 added an additional 22,530 km of data to the ECSAS database that was established in 2006. Survey effort extended from the eastern Canadian Arctic to the Gulf of Maine and east across the North Atlantic. The data are used to define threats to birds at sea, define areas for marine protection, and for the purposes of emergency response and damage assessments. The data can be found summarized in an Atlas of Seabirds at Sea in Eastern Canada at the Government of Canada's Open Data Portal (https://data-donnees.az.ec.gc.ca), and we recently published a summary of at-sea monitoring efforts by CWS in eastern and Arctic Canada in a special issue of Arctic Science (Gjerdrum *et al*. 2024).

Gjerdrum, C., D.A. Fifield, F. Bolduc, S.N.P. Wong, M. Beaumont, and M. Mallory. 2024. A history of monitoring marine birds at sea in eastern and Arctic Canada. Arctic Science 10(4):834-849. doi.org/10.1139/as-2024-0037

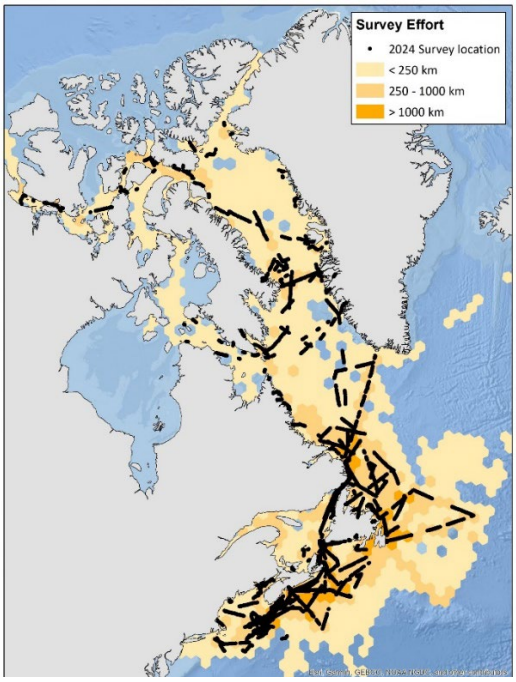

Figure: Pelagic seabird survey effort in eastern Canada since 2006, highlighting survey effort from 2024.

Gulf of Mexico Marine Assessment Program for Protected Species (GOMMAPPS): Seabird Surveys in the Northern Gulf of Mexico, 2017-2020

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Research was conducted in the northern GOM from the coastline out to ~50 nm (for aerial surveys) and from the continental shelf out to the EEZ between roughly 81° and 98° W and 24° and 31° N. We trained seabird observers aboard USFWS Kodiak amphibious aircraft and NOAA Vessels of Opportunity to document distribution and abundance of seabirds across seasons and across the three BOEM planning areas. From the aerial survey platform, we also collected data on wintering waterfowl, marine mammals, and sea turtles, and from the vessel survey platform, we also collected data on non-marine birds, marine mammals, and flying fish. Aerial seabird observers detected and recorded a total of 52 species of birds with representatives from five taxonomic groups: 23 seabird species, 15 waterfowl species, 10 wading bird species, 3 raptor species, and 1 shorebird species. Vessel seabird observers recorded 1,345 detections of 6,980 birds classified as non-marine avifauna representing 77 species. Vessel seabird observers recorded 9,347 detections of 44,029 seabirds representing 44 species; 47 species of seabirds were identified across survey platforms, years, and seasons. Seabird observations accounted for 87.4% of all avifauna detections, 86.3% of all individual birds, and 39.3% of all birds identified to species. Species composition differed among years and between seasons irrespective of survey platform. Predictive models of species distribution and abundance and the relative influence of a suite of environmental covariates varied considerably depending on the survey platform and model used, season, and species or guild. The inclusion of individual environmental covariates within a predictive modeling framework should be evaluated at the species-level within a specific season; ensuring there is spatio-temporal overlap of environmental covariates with seabird observations. Observations of the proposed listed Black-capped Petrel (*Pterodroma hasitata*) collected during this study represents a major advancement in our knowledge of at-sea distribution for this species.

Project Accomplishments:

Davis, K. L., E. D. Silverman, A. L. Sussman, R. R. Wilson, and E. F. Zipkin EF. 2022. Errors in aerial survey count data: identifying pitfalls and solutions. Ecology and Evolution 12(3): https://doi.org/10.1002/ece3.8733

Jodice, P. G. R., P. E. Michael, J. S. Gleason, J. C. Haney, and Y. G. Satgé YG. 2021a. Expanding the marine range of the endangered black-capped petrel *Pterodroma hasitata*: occurrence in the northern Gulf of Mexico and conservation implications. BioRxiv: https://doi.org/10.1101/2021.01.19.427288
Jodice, P. G. R., P. E. Michael, J. S. Gleason, J. C. Haney, and Y. G. Satgé. 2021b. Revising the marine range of the endangered black-capped petrel *Pterodroma hasitata*: occurrence in the northern Gulf of Mexico and exposure to conservation threats. Endangered Species Research 46:49-65. https://doi.org/10.3354/esr01143
Michael, P. E., K. M. Hixson, J. C. Haney, Y. G. Satgé, J. S. Gleason, and P. G. R. Jodice. 2022. Seabird vulnerability to oil: exposure potential, sensitivity, and uncertainty in the northern Gulf of Mexico. Frontiers in Marine Science: 880750 https://doi.org/10.3389/fmars.2022.880750
Michael, P. E., K. M. Hixson, J. S. Gleason, J. C. Haney, Y. G. Satgé, P. G. R. Jodice. 2023. Migration, breeding location, and seascape shape seabird assemblages in the northern Gulf of Mexico. PLoS ONE 18(6): e0287316
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0287316

Data Releases

Sussman AL, and Eyler MC. 2018. EPA 40km hexagons for conterminous United States. U.S. Geological Survey data release. Washington (DC): U.S. Department of the Interior, U.S. Geological Survey. https://doi.10.5066/P9C56AY1
Aerial survey, NCEI Accession 0247205:
https://www.ncei.noaa.gov/archive/accession/0247205
DOI Minted: https://doi.org/10.25921/vyg0-tv44
Citation: Wilson, R. R., J. S. Gleason, J. E. Lyons, E. D. Silverman, A. L. Sussman, E. F. Zipkin, and K. L. Davis. 2022. Seabird visual surveys using line-transect methods collected from USFWS aircraft in the Gulf of Mexico for the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) project from 2018-01-31 to 2020-02-12 (NCEI Accession 0247205). U.S. Department of the Interior, Bureau of Ocean Energy Management. NOAA National Centers for Environmental Information. Unpublished Dataset. https://doi.org/10.25921/vyg0-tv44 [Date Accessed]

Vessel survey, NCEI Accession 0247206:
https://www.ncei.noaa.gov/archive/accession/0247206
DOI Minted: https://doi.org/10.25921/afrq-h385
Citation: Gleason, J. S., R. R. Wilson, P. G. R. Jodice, Y. G. Satgé, P. E. Michael, K. M. Hixson, A. L. Sussman, and J. C. Haney. 2022. Seabird visual surveys using line-transect methods collected from NOAA vessels in the northern Gulf of Mexico for the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) project from 2017-07-21 to 2019-09-25 (NCEI Accession 0247206). U.S. Department of the Interior, Bureau of Ocean Energy Management. NOAA National Centers for Environmental Information. Unpublished Dataset. https://doi.org/10.25921/afrq-h385 [Date Accessed]

Applications to Knowledge Gaps in Seabird Management Using Data from Gulf of Mexico Vessel Surveys, 2010-2025

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The Gulf of Mexico is a critical marine region providing breeding, staging, migration, and wintering habitats for more than 400 bird species. Information still remains sparse about the composition, distribution, and abundance of birds in most offshore waters of the Gulf, however, particularly given the large footprint of oil and gas infrastructure in the Central and Western Planning Areas, as well as newly anticipated offshore wind energy and aquaculture projects expected in the northern Gulf. Since 2010, three large vessel surveys have sought to bridge knowledge gaps for marine bird species to improve applications to avian management and conservation needs: Natural Resource Damage Assessment (NRDA) Bird Study 6 (2010-2011), Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS; 2017-2019), and Vessel Surveys for Abundance and Distribution (VSAD; 2023-2024). Along with additional repositioning cruises conducted in the Gulf, a large data set has been accumulated, consisting of observations gathered during 700 on-effort survey days and along more than 74,000 km of distance on-effort. Data are available from all seasons and each of the three BOEM planning areas (***Figure 1***).

Several new project applications of this large data set to management and conservation requirements for Gulf bird species began in late calendar year 2024 and early calendar year 2025. Starting with a merger of the GOMMAPPS, VSAD, and NRDA 6 information into a combined data set, early work has emphasized the testing and validation of both the metadata and primary observations for use in several applications to seabird management. For all applications, existing or newly-developed *R*-coded scripts will be among the product deliverables. In the first project, flight height profiles (in meters above sea level) are to be constructed for up to 59 marine bird species characteristic of the Gulf. Flight height profiles are based on binned coding available from the NOAA input program *SeeBird*: code 1 = 0-2 meters; code 2 = 2-10 meters; code 3 = 10-25 meters; code 4 = 25-50 meters; code 5 = 50-100 meters; code 6 = 100-200 meters; code 7 = >200 meters. Second, starting with the same 59 bird species, another project will figure the percentage of all individuals from each species that are attracted to offshore anthropogenic structures in the Gulf of Mexico. This will include a breakdown by structural type for this attraction whenever possible (e.g., fishing vessels, channel markers, navigation buoys, oil and gas platforms). In a third project, and to derive spatially-explicit information about marine bird densities for sites, locations, or areas where birds are exposed to oil spills and other marine

environmental perturbations, the strength of the combined data set is being explored for the minimum resolutions that are available for deriving spatially-explicit density estimates, either directly or via predictive habitat models. The long-term goal is to build a querying system that enables customized generation of spatially-explicit information by location, e.g., within defined latitude and longitude boundaries. In a fourth project, we are using a combined Gulf data set to evaluate optimal locations on the Louisiana-Texas (LATEX) continental shelf for conducting new, spatially-targeted winter surveys of marine birds, especially with respect to distance offshore and in the context of several recently-proposed BOEM wind energy and lease areas.

Figure 1. Large vessel coverage for three marine bird survey programs conducted in the Gulf of Mexico, 2010-2024. Solid dark lines delineate Western, Central, and Eastern Planning Areas designated by BOEM.

Recent Project Accomplishments:

Michael P.E., J.S. Gleason, J.C. Haney, K.M. Hixson, Y.G. Satgé, and P.G.R. Jodice. 2024. Black Terns (*Chlidonias niger*) beyond the breeding grounds: occurrence, relative density, and habitat associations in the northern Gulf of Mexico. *Wilson Journal of Ornithology* 136: 220–236. https://doi.org/10.1676/23-00069

Michael, P.E., J.C. Haney, J.S. Gleason, K.M. Hixson, Y. Satgé, and P.G.R. Jodice. 2024. Flying fish habitat and co-occurrence with seabirds in the northern Gulf of Mexico. *Fisheries Oceanography*. In press. https://doi.org/10.1111/fog.12712 (see ***Figure 2***)

Haney, J.C., P.E. Michael, J.S. Gleason, R.R. Wilson, Y.V. Satgé, K.M. Hixson, and P.G.R. Jodice. In press. Relative abundance, seasonal occurrence, and distribution of marine birds in the northern Gulf of Mexico. *Marine Ornithology*.

Sutherland, K.E., N.J. Metheny, and J.C. Haney. In press. First U.S. Atlantic record of Nazca Booby *Sula granti*, with implications for vagrancy by Pacific seabirds into the Gulf of Mexico. *Marine Ornithology*.

Figure 2. A Brown Booby *Sula leucogaster* nabs a flying fish put into flight near the bow of NOAA R/V *Gordon Gunter*. Relationships between Gulf seabirds and flying fish are subject of a forth-coming paper titled "Flying fish habitat and co-occurrence with seabirds in the northern Gulf of Mexico" to appear soon in *Fisheries Oceanography.* Photo by Kate Sutherland.

Acoustic Motus Offshore Monitoring at the Dominion Commercial Offshore Wind Project, Virginia

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Collaborator: Dominion Energy

Dominion Energy will be constructing the Coastal Virginia Offshore Wind (CVOW) Commercial Project located on the Outer Continental Shelf of Offshore Virginia. As part of this project, Dominion will be conducting an extensive post-construction bird and bat monitoring program using acoustics and Motus receivers. Acoustic detectors and Motus receivers will be installed on substations and turbines around the project's perimeter and interior. Acoustic data will provide an index of bird and bat activity around the turbines, while the Motus receivers will provide large-scale movement data on Motus-tagged animals moving through and around the wind facility.

Metocean Buoy Survey of Marine Wildlife in the New York Offshore Planning Area

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Collaborator: Greg Forcey, Normandeau Associates, Inc.

One floating LiDAR (light detection and ranging) buoy remains deployed in the New York Bight in the summer of 2022 and is collecting wind resource data for a period of two years. The buoy is deployed in the vicinity of OCS-A 0537. On behalf of NYSERDA, Normandeau Associates worked with Ocean Tech to add wildlife sensors to the deployed buoy and are analyzing and making wildlife data collected from the buoys available through the ReMOTe (https://remote.normandeau.com) data management system. These data include passive acoustic microphone data of detected vocalizations by birds and bats, hydrophone data of detected vocalizations by marine mammals, and MOTUS and VEMCO receiver data of detected NanoTagged birds and fishes.

Aerial Digital Surveys Off the Coast of Delaware

Contact: Julia Robinson Willmott, Normandeau Associates, Inc., jwillmott@normandeau.com
Collaborator: APEM Inc.

US Wind is planning an offshore wind project in lease area OCS-A0490 off the coast of Delaware. They have implemented two years of aerial digital surveys to study the impacts of traffic separation and vessel traffic on birds and other species. Information on the project can be found at https://remote.normandeau.com/uswind_home.php

2 Years of Buoy-based Acoustic Studies for Birds and Bats in Delaware

Contact: Julia Robinson Willmott, Normandeau Associates, Inc., jwillmott@normandeau.com
Collaborator: Ocean Tech, Inc.

US Wind is planning an offshore wind project in lease area OCS-A0490 off the coast of Delaware. Deployed within the lease area, they have implemented two years of buoy-based bird, bat, and marine mammal acoustic studies and deployed floating MOTUS receivers. Information on the project can be found on https://remote.normandeau.com/uswind_home.php

Colony Management and Monitoring

Urban Seabird Colonies: Are They a Source or Sink?

Contact: Ruth Boettcher, Virginia Department of Wildlife Resources, ruth.boettcher@dwr.virginia.gov
Collaborators: Bridie Farmer & Ben Gluhosky, Virginia Department of Wildlife Resources; Mario Balitbit, The Nature Conservancy; Chelsea Weithman & Kelsi Hunt, Virginia Tech

South Island (SI) is part of the I-64 Hampton Roads Bridge-Tunnel (HRBT) complex in Hampton, Virginia. From 2009-2019, SI supported Virginia's largest seabird colony. The HRBT Expansion Project commenced in fall of 2019 and required the colony be permanently removed from SI. In February 2020, the Virginia Department of Wildlife Resources was charged with providing temporary nesting habitat for the displaced seabirds until the construction of a new nesting island is completed. Ft. Wool (FTW), an artificial island adjacent to SI, was transformed into a 1.5-acre breeding site. An additional acre of habitat was created on industrial barges in the FTW embayment. We successfully used audio lures and decoys to attract Royal Terns (ROYT) and four other seabird species to FTW and the barges. From 2018-2023, we applied plastic field-readable bands (PFR) on 9,367 ROYT (9,141 young, 226 adults). In 2023, we surveyed other ROYT colonies in Virginia for PFR-banded birds to determine if urban colonies are sources or sinks. We observed 270 individuals that were banded as chicks on SI and FTW in two remote colonies of which 77% (n = 208) were banded as chicks on SI in 2018 and 2019 and 23% (n = 62) were banded as chicks on FTW between 2020 and 2023. In 2024, we increased our resighting efforts and recorded a combined total of 623 marked individuals at both colonies of which 392 (70%) were banded as chicks on SI and FTW between 2018 and 2020. ROYTs typically begin breeding at four or five years of age and while we unable to confirm breeding for most marked individuals at these colonies, the fact that 67% (n = 600) of the 893 resighted individuals were at least four years of age suggests that heavily disturbed urban colonies do produce future breeders.

Waterbird Research on Poplar Island, Maryland

Contact: Diann Prosser, USGS Eastern Ecological Science Center, dprosser@usgs.gov
Collaborators: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Maryland Environmental Service, Maryland Dept of Natural Resources

Our team continues to conduct a variety of research with colonially nesting waterbird species on Poplar Island (Talbot County, Maryland), a beneficial dredge use project in the Chesapeake Bay. Our first umbrella of work includes efforts to understand reproductive success and breeding ecology at this site. We are working to develop multi-state models aimed at improving nest success estimates for common terns (Sterna hirundo) relative to more traditionally used proportional hazard models with provisional results indicating substantial improvement in model precision. Similarly, we have ongoing mark-recapture studies exploring fledge success and local movements of common terns within the Chesapeake Bay region, including the recent identification of a previously unreported staging area which supported up to 37% of our fledged chicks from a given year (in press). This effort will be further informed by the proposed deployment of GPS transmitters on a small number of common terns and black-necked stilts

(Himantopus mexicanus) in 2025, aimed at gathering data on habitat use on Poplar Island, as well as broader foraging ecology, regional habitat use, and possible interfaces for disease introduction. The second major umbrella of our work focuses on exploring how management activities impact success of focal species. Following major predation over the past two seasons, we will be working with USFWS to explore approaches to reduce impacts from black-crowned night herons (Nycticorax nycticorax) and other avian predators, along with a pilot effort to assess suspected predation of tern nests by white-tailed deer. We will continue exploring efficacy of management activities as opportunities and challenges arise.

Atlas of breeding sites for waterbirds in the northern Gulf of Mexico

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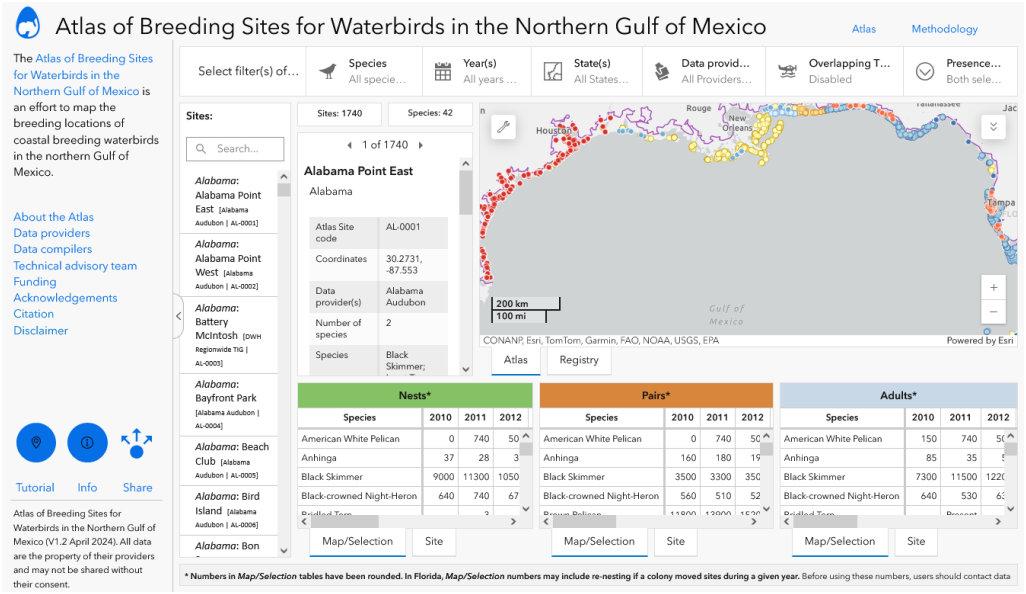
Collaborators: Kathy Hixson, Clemson University; Jeff Gleason, U.S. Fish and Wildlife Service; Patrick Jodice, U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, pjodice@clemson.edu.

With the planned expansion of renewable energy development in federal (and state) waters in the northern Gulf of Mexico, a coast-wide spatial inventory of breeding sites is needed to support habitat management, monitoring and research, as well as marine spatial planning, oil spill response plans, and post-Deepwater Horizon oil spill restoration. We are finalizing a new online tool aimed at facilitating the management of waterbirds along the Gulf coast: the Atlas of Breeding Sites for Waterbirds in the Northern Gulf of Mexico. The atlas integrates existing data from 2010 to 2022, including 38 datasets from 9 data providers, representing more than 44,000 surveys of 42 breeding species at 1,740 sites in all five coastal states. We build the Atlas in the ArcGIS Online environment. All data manipulations were done in R; R scripts are available at this link: https://doi.org/10.5066/P14SQSCU. We are currently working on transferring the product to FWS. Once available to the public, this resource will provide critical contemporary information to understand the distribution and status of breeding waterbirds in the northern Gulf of Mexico.



Landing page for the upcoming Atlas of Breeding Sites for Waterbirds in the Northern Gulf of Mexico (Y. Satgé).

Colonial Seabird Monitoring and Conservation in Atlantic Canada

Contact: Sabina Wilhelm, Canadian Wildlife Service, Environment and Climate Change Canada, sabina.wilhelm@ec.gc.ca
Collaborators: Chris Ward, Gill Holmes, Rob Ronconi, Jen Rock, Canadian Wildlife Service, Environment and Climate Change Canada; Sydney Collins, Bill Montevecchi, Kyle d'Entremont, Madeline Sceviour, Eleanor Gnam, Memorial University of Newfoundland; Caleb Spiegel, U.S. Fish and Wildlife Service.

Colonial seabird monitoring in 2024 was focused in eastern Newfoundland where we updated population trends and assessed productivity of seabirds breeding in the Witless Bay Ecological Reserve in Newfoundland and the three Northern Gannets colonies.

The most notable changes in the Witless Bay Ecological Reserve centered around Great Island, which previously hosted the largest Black-legged Kittiwake colony, the second largest Common Murre colony, and the second largest Herring Gull colony in the Reserve. Surveys in 2024 revealed annual population declines ranging between -7% and -12% for these species and are attributed to ongoing disturbance associated with large numbers of Bald Eagles and the presence of an active nest detected in 2024. Negative impacts associated with eagles in the Reserve were initially documented in 2010 with the most recent surveys suggesting no signs of this pressure subsiding on cliff- and ground-nesting seabirds. Conversely, crevice nesting Razorbills and burrow-nesting Atlantic Puffins did not appear to be affected by eagles (despite the latter being an important food source for their chicks based on carcasses observed in the eagle's nest) with the Razorbill population having increased annually by +3% since 2002 and the puffin population showing no change since 1994. In contrast, the murre population on Gull Island, despite also being occasionally disturbed by eagles, grew annually by +21% between 2001 and 2024, because of birds immigrating from Great and nearby Green Island, where high eagle disturbance is also regularly observed, and which previously hosted the largest murre colony in the Reserve. Kittiwakes and Herring Gulls also showed annual declines on Gull Island over the past 25 years but at less precipitous annual rates (-1% and -3% respectively) compared to those observed on Great Island, while Razorbill and puffin annual growth rates on Gull Island mirrored those on Great Island at +3% and +0.9% respectively. Interestingly, the presence of eagles on kittiwakes did not appear to affect their productivity as these were similar between Great and Gull Islands in 2024, estimated at 0.5 and 0.6 fledged chicks/nest respectively, but lower compared to Cape St. Mary's estimated at 0.9 fledged chicks/nest.

The Newfoundland Northern Gannet breeding population experienced precipitous declines due to the highly pathogenic avian influenza outbreak in 2022, reduced by -43% in 2023 compared to surveys conducted in 2018. Surveys in 2024 revealed that the Baccalieu and Cape St. Mary's colonies remained unchanged from the 2023 survey while Funk Island is showing promising signs of recovery likely related to an existing pool of immature birds ready to recruit at a younger age due to the high vacancy of nesting sites in the core breeding area. We obtained for the first time in 2024 breeding success data for gannets at Funk and Baccalieu Island from aerial photographs; previous information existed only for Cape St. Mary's visible from land. Funk Island had the highest breeding success at 0.74 fledged chicks/nest while Baccalieu Island had the lowest at 0.44 fledged chicks/nest. Cape St. Mary's breeding success in 2024 was 0.67 fledged chicks per nest, above the long-term average of 0.62 (1977-2023).

Seabird Tracking

Using GLS, TDR, and GPS to Track Alcids on the Newfoundland and Labrador Shelf

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Collaborators: Megan Dalton, Emily Runnells, Gibson Rieger, University of Manitoba, Department of Biological Sciences.

The Davoren Lab continued their decadal scale research on seabirds and their prey on the east coast of Newfoundland. Recent work has focused on alcids breeding on James Island. Between 10-15 GLS loggers have been deployed on Atlantic Puffins and Razorbills each year between 2019-2022, with 23 and 30 tags per species recovered to date, respectively. Tagged Razorbills traveled all the way from the Labrador Sea down to Cape Hatteras in some years, while a diversity of movement paths was evident among the puffins, including some that gathered in the Gulf of Maine. In 2021-2022, 30 combination GLS and TDR loggers were deployed on Razorbills, with 16 tags retrieved to date. These GLS and GLS-TDR datasets, combined with stable isotope analysis on multiple tissues (feather, eggshell membrane, blood), will be used by students to study carry over effects and isotopic niche overlap among species, along with time-activity budgets during key under-studied parts of the annual cycle (e.g., moult, pre-laying) and the effects of personality on foraging behavior and non-breeding distribution. During 2023 & 2024, GPS-TDR loggers were simultaneously attached to chick-rearing Atlantic Puffins (n = 22) and Razorbills (n = 35) for short-term (1-5 day) deployments. These tracking data will be combined with long-term monitoring of spawning capelin biomass to assess whether inter-annual variation in prey biomass differentially influences the foraging effort and breeding success of these two species. As Atlantic Puffins provision chicks with a high proportion of sand lance, these tracking data will also be used to inform ongoing ship-based research on sand lance density and distributional patterns in coastal Newfoundland.

Uncovering Migration Patterns to Guide Conservation of Sea Ducks

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Marine birds that undertake long-distance migrations experience breeding and non-breeding periods that are temporally and geographically disconnected yet inextricably linked. Events occurring during one stage of the annual cycle can profoundly influence individuals and populations during subsequent periods. For example, low food availability on non-breeding grounds can impact the reproductive success of individuals during the breeding season. Critical

to conservation of migratory birds is understanding how populations are connected and how the conditions they experience throughout the year may influence their survival and reproduction. However, studying seasonal interactions remains a challenge for species that are difficult to track throughout their life cycles, such as migratory sea ducks.

We are studying two species of sea ducks, Long-tailed Ducks (*Clangula hyemalis*) and Surf Scoters (*Melanitta perspicillata*), which seasonally migrate between their breeding areas in northern Canada and non-breeding areas in the Great Lakes and Atlantic and Pacific Oceans. Despite their conservation concern and vulnerability to overharvest, minimal tracking data exists to inform management of these marine birds. To bridge these knowledge gaps, we are using stable isotopes to delineate the degree of population mixing throughout the annual cycle by first-year Long-tailed Ducks and Surf Scoters. Specifically, we are using a dual stable isotope approach (δ^2H, $\delta^{34}S$) to estimate breeding locations from feathers collected during the non-breeding season. The results of this study can inform educated management decisions regarding the stability and resilience of these sea duck populations. Such information will be key to designing appropriate monitoring programs, understanding the potential impact of anthropogenic activities, and assessing whether certain subpopulations are more affected by hunting than others

Identifying Demographic Bottlenecks and Habitat Use to Support the Recovery and Management of American Common Eider (*Somateria mollissima dresseri*): A Range-wide, Full Life-cycle Telemetry Project

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Collaborators: Mark Mallory, Acadia University**;** Nic McLellan, Ducks Unlimited Canada Greg Robertson & Christine LaPage, Environment Canada; Jean -Francois Giroux, University of Quebec at Montreal; Al Hanson, Environnent Canada (retired); Oliver Love, University of Windsor; Kelsey Sullivan, Maine Dept. of Inland Fisheries and Wildlife; Lucas Savoy, Biodiversity Research Institute; Scott McWilliams, University of Rhode Island; Jay Osenkowski, Rhode Island Department of Environmental Management

The objectives for this study are: 1) document rates of non-breeding and pre-breeding body condition of American common eiders across their breeding range, and 2) establish a geo-spatial database used to examine multiple aspects of movement ecology, particularly their current habitat use. Through 2023, 182 transmitters were deployed in Maine, Nova Scotia, New Brunswick, Quebec, and Labrador (Fig 1). An evaluation of the data in 2023 suggested there were significant gaps in our coverage in the southern part of their wintering range and in their breeding range along the North Shore of the Gulf of St. Lawrence in Québec. Gutowsky et al. (2023) documented shifts in distribution of eiders with abundance in winter increasing south of Cape Cod and the Gulf of St. Lawrence. Abundance of eiders breeding along the Lower North Shore of Québec has been increasing rapidly since the early 21st Century (Rail 2022) and birds breeding in this area are a potential source for the increases observed in the Gulf of St. Lawrence. Therefore, we added an additional year of deployments to fill these gaps. Working with a large crew from URI, Rhode Island DEM and volunteers, we caught 36 eiders between 3 and 9 March 2024 and deployed 15 PTTs on adult females in Rhode Island. Deployments in Québec occurred in the waters surrounding the Mingan Archipelago National Park Reserve and on the ancestral lands of the Innu Nation. Consultations with the Innu community revealed

interest in the project, but concern that our activities might disturb local hunters because our proposed capture period overlapped with spring hunting activities by the community of Ekuanitshit. An Innu observer joined us for all field activities, and Parks Canada maintained daily updates on social media that advertised capture sites a day in advance so the community could notify us of potential conflicts. This system worked well and no conflicts were reported. Between 27 April and 5 May, we captured 71 eiders. This is a major over-wintering area for Northern Common Eiders (*S.m. borealis*) and 17 of the birds captured were *S. m. borealis* or *dresseri-borealis* hybrids. We deployed 26 PTTs on adult females of which three hens were *borealis* type birds. To date, we've deployed 227 PTTs that have logged ~200,000 locations between New York and Nunavut (Fig. 2).

Asha Grewal, a MSc. Student at Acadia University, used satellite telemetry data to estimate female breeding status; this is a complex procedure as the location errors associated with the telemetry data are often larger than the islands eider nest on, and there can be gaps in coverage due to the duty-cycle of transmissions, and signals may be interrupted when eiders nest in heavy cover. Ms. Grewal presented her results at the 2024 International Sea Duck Conference and will defend her thesis in winter 2025.

Future work includes analyses of migratory connectivity, year-round habitat use, and year-round annual movement and connectivity, and investigating industrial overlap/risk assessments. A separate analysis focusing on winter/non-breeding season movement and resource selection is also planned. More information on the project can be found on the Sea Duck Joint Venture website: https://seaduckjv.org/where-have-all-the-eiders-gone/.

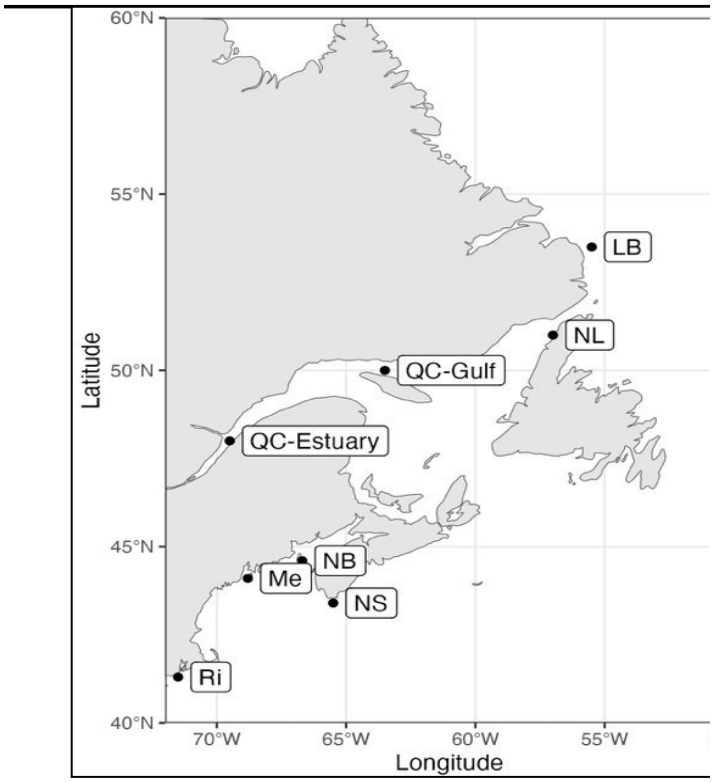

Figure 1. Deployment locations for satellite tags on Common Eiders, 2021 to 2024.

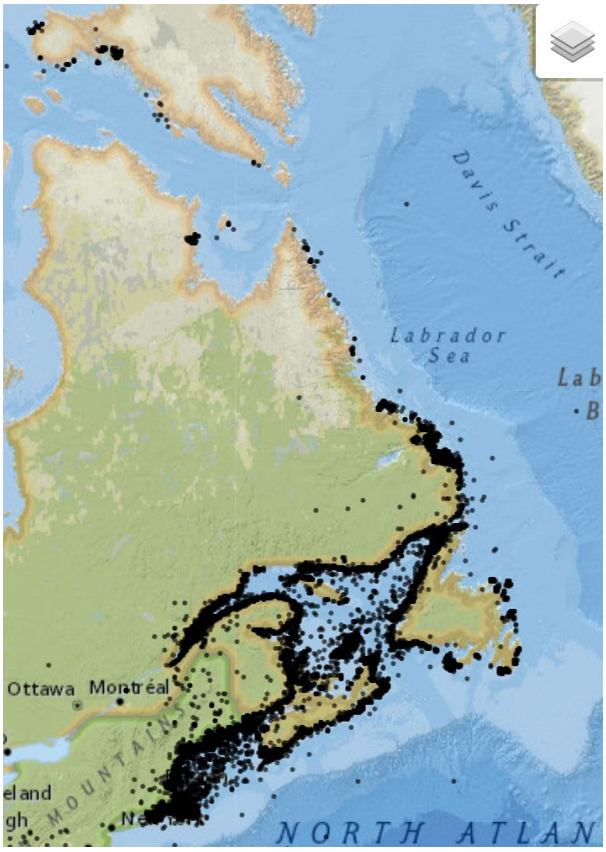

Figure 2. Tracking data from all Common Eiders tagged with PTTs from 1 May 2021 to 30 September 2024.

Seabird Tagging Within the Maine Coastal Islands National Wildlife Refuge Complex

Contact: Natasha Gownaris, Gettysburg College, ngownari@gettysburg.edu
Collaborators: Linda Welch & Jill Tengeres, U.S. Fish and Wildlife Service; Keenan Yakola Oregon State University

Given ongoing spatial planning for offshore wind in the Gulf of Maine, there is a pressing need to understand the foraging behavior of seabirds in this region. In 2024, the U.S. Fish and Wildlife Service (USFWS), Audubon Seabird Institute, and Gettysburg College collaborated to tag common and Arctic terns, Atlantic puffins, and Leach's storm-petrels across three USFWS-managed seabird breeding islands—Petit Manan Island, Ship Island, and Metinic Island—in the Gulf of Maine. Across these three islands, we tagged a total of 16 Arctic terns, 29 common terns, 4 Atlantic puffins, and 13 Leach's storm petrels.

We found that tern nests with tagged birds had higher hatching rates than those without tagged birds, but they had slightly lower fledging rates. Terns on Petit Manan Island generally traveled shorter distances to forage compared to 2023, with most trips having a maximum distance of within 25 km offshore for common terns (which also traveled inshore to forage) and 30 km offshore for Arctic terns. On Ship Island, common terns foraged inshore and generally within 40 km offshore of the colony. Foraging distances were considerably greater than in 2023, when most foraging trips were within 10 km of the colony. Common terns and Arctic terns breeding on Metinic Island shared offshore foraging areas, generally traveling within 30 km of the colony, but common terns also fed inshore of this island.

The four Atlantic puffins tagged on Petit Manan Island had a fledging rate of 75%, similar to that of nests without tagged birds. While their foraging areas varied, all puffins generally foraged within 30 km of the colony, with three of the four individuals making trips lasting 12 hours or more. Their foraging areas overlapped significantly with the offshore areas used by common and Arctic terns on Petit Manan Island. Leach's storm petrels tagged on Petit Manan Island traveled much farther, often exceeding 400 km to reach foraging areas at the continental shelf break.

Our findings highlight the considerable variability in foraging behavior across species, space, and time, stressing the need for multi-year, multi-colony collaborative tagging studies to inform spatial management in the Gulf of Maine. In addition to their management relevance, these data are contributing to undergraduate and graduate theses on seabird foraging behavior at several academic institutions

Winter GPS Tagging of Roseate Terns in Northeast Brazil

Contact: John Herbert, MassAudubon, jherbert@massaudubon.org
Collaborators: Rafael Revorêdo, Centro de Estudos e Monitoramento Ambiental (CEMAM), PCCB-UERN, Universidade Federal do Rio Grande do Norte; Keenan Yakola, Oregon State University; Don Lyons, National Audubon Society, Seabird Institute; Joan Walsh, American Museum of Natural History

In February 2024 we initiated a study using GPS telemetry to track Sterna dougallii (Roseate Tern) in northeast Brazil to better understand the non-breeding behavior and habitat use of this endangered species. This is the first time this technology has been applied to Roseate Terns in Brazil. Preliminary data from 15 tagged individuals, with successful data retrieval from 11 birds, reveals novel information about foraging patterns along Brazil's vast semi-arid coastal region and previously undocumented migration stopover and roosting sites. The terns conducted daily commutes between offshore foraging areas 30 to 80 km away near the 100 m depth isobath and coastal nocturnal roosting sites. These findings are significant in light of expanding offshore wind energy prospecting/development and other anthropogenic threats that increase collision risks for seabirds in the region. Furthermore, three tagged birds retained their devices for as long as 103 days, thereby covering the spring migration period and providing the first tracking/movement data on Roseate Tern migration routes, and their overlap with human-made structures. Our study provides proof-of-concept for the effectiveness of GPS telemetry in tracking Roseate Terns during non-breeding periods and demonstrates its potential to identify places where they may confront, providing crucial data for urgent conservation planning in this

critical region for the species. By integrating data from Brazil into global conservation efforts, we can better protect Roseate Terns across the Atlantic, shaping both local and international policies to minimize human impacts on migratory seabirds.

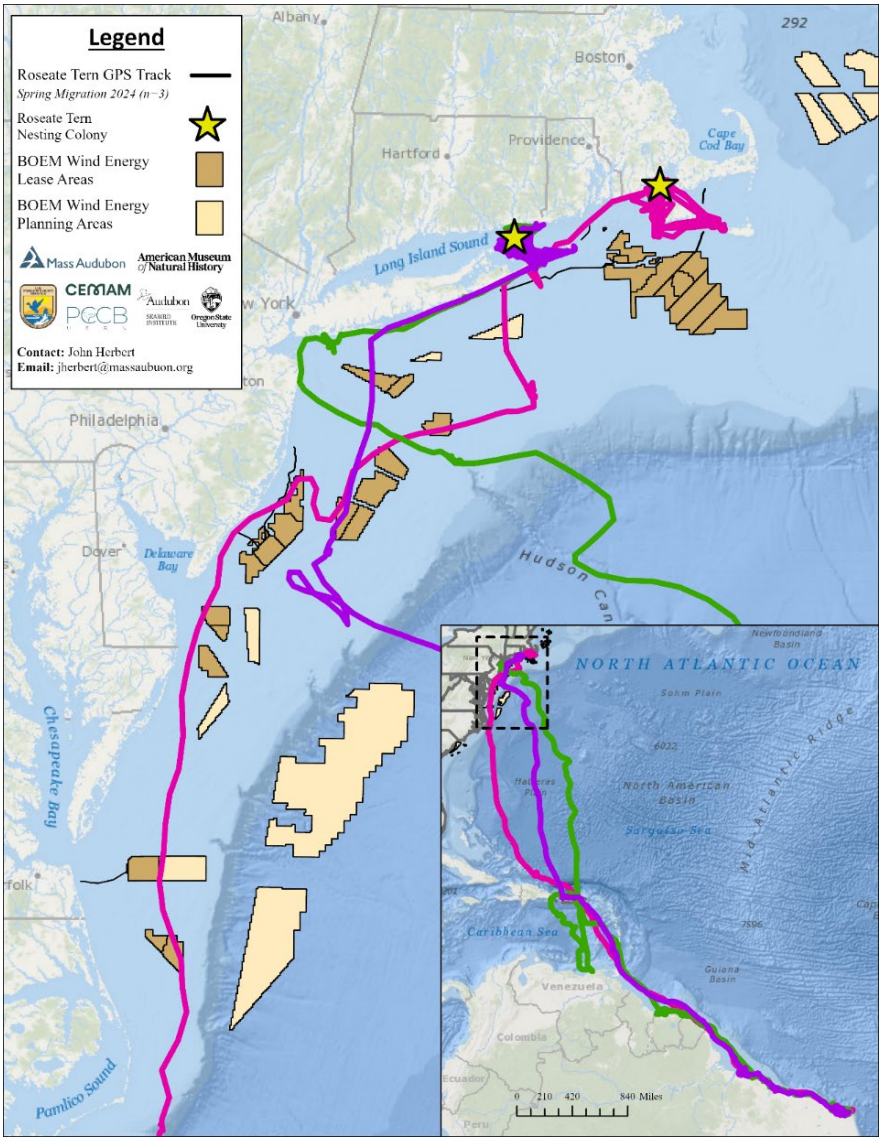

Figure. Complete northbound migratory pathways of three Roseate Terns (*Sterna dougallii*) in 2024. Individuals were tagged using PathTrack nanoFix GPS tracking devices. Tagging occurred from late-February to early-March 2024 in Galinhos, Brazil and arrived at the breeding colonies in New York and Massachusetts in mid-May 2024. Map features the three separate migration routes from the mid-Atlantic to southern New England offshore waters and their overlap through offshore wind energy lease areas and energy planning areas. Inset map features the full migratory pathway from departing the northern coast of Brazil to the breeding colonies.

Tracking Movements of Terns That Use New England Staging Sites

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Collaborators: Carolyn Mostello, Massachusetts Division of Fisheries and Wildlife; Stephanie Koch, & Eleen McGourty, U.S. Fish and Wildlife Service, Refuges Program; Clay Graham & Jill Tengeres, U.S. Fish and Wildlife Service, Migratory Birds Program; Lyra Brennan, John Herbert, Rose Caplan, & Jamie Infanti, MassAudubon

With funding from Bureau of Ocean Energy Management, we (U.S. Fish and Wildlife Service, Massachusetts Division of Fisheries and Wildlife and Mass Audubon) are collaborating on a study that uses GPS-RF tags and an array of base-stations to track movements of Common Terns. The focus of the study is to assess tern movements during the breeding and post-breeding period relative to offshore wind lease areas. In 2024, we tagged 60 Common Terns and deployed an array of 5 base stations at key breeding and staging sites in Massachusetts. The base stations are configured to download GPS data from the tags when the terns are in proximity. The study is conducted in coordination with several other projects using similar technology, from Nova Scotia to New York, leveraging large sample sizes of tagged terns and base stations throughout the broader region. We will attempt to retrap tagged terns next breeding season with the aim of recovering full-annual-cycle data stored on the tags.

Preliminary Overview of the 2024 Tracking of Non-breeding Great Shearwaters (*Ardenna gravis*) from Stellwagen Bank National Marine Sanctuary

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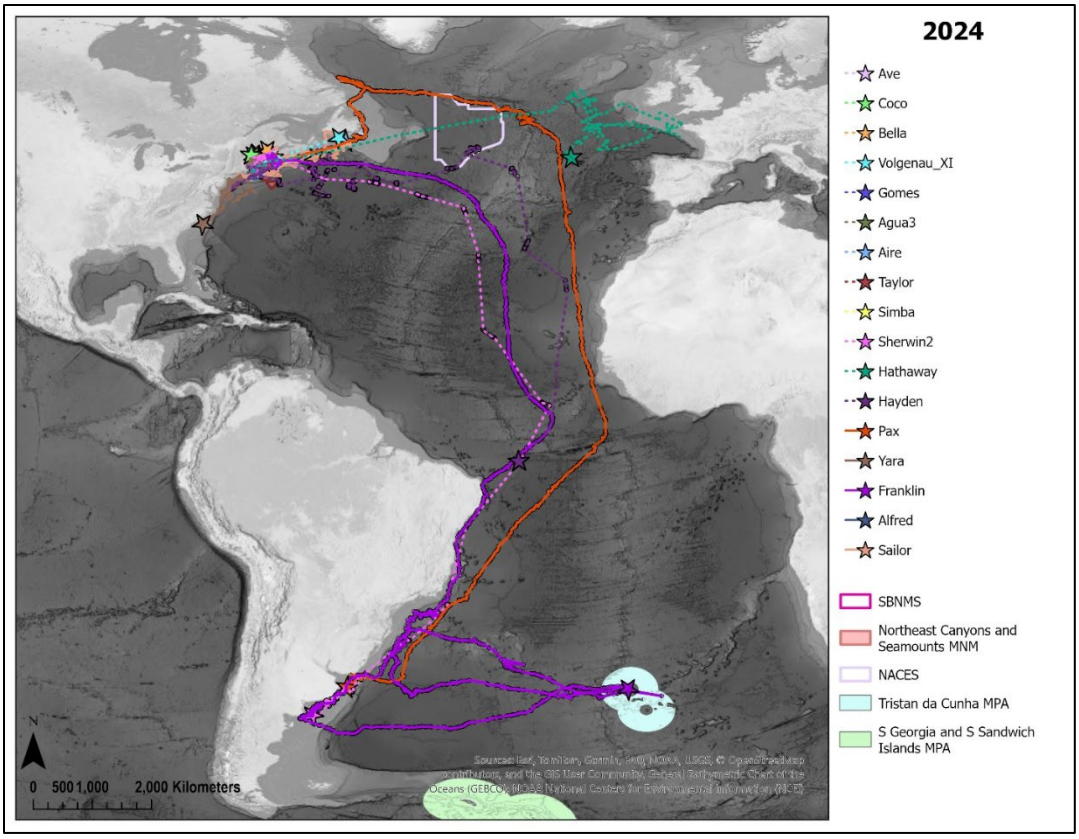
Collaborators: Linda Welch, U.S. Fish and Wildlife; Kevin Powers, Tammy Silva, Michael Thompson, Stellwagen Bank National Marine Sanctuary

Stellwagen Bank National Marine Sanctuary (SBNMS) continued its ongoing (2013 – present) program investigating the movements, habitat use and food habits of Great Shearwaters (*Ardenna gravis*) through the use of PTTs (10+ per year), stable isotope analysis of exhaled gas, blood and feather samples, and fecal DNA. 2024 marked the tenth year of data collection for this project and saw the deployment of 17 PTTs (MTI PTT-100 12g Solar PTT) on Great Shearwaters. Maximum transmitter duration was six months, and median was 2 months. PTTs were deployed in late June and early July in southern SBNMS and birds were tracked across the Gulf of Maine, North Atlantic, and even as far as Inaccessible Island, with the first tracked breeding male of the program. More analysis and results to come.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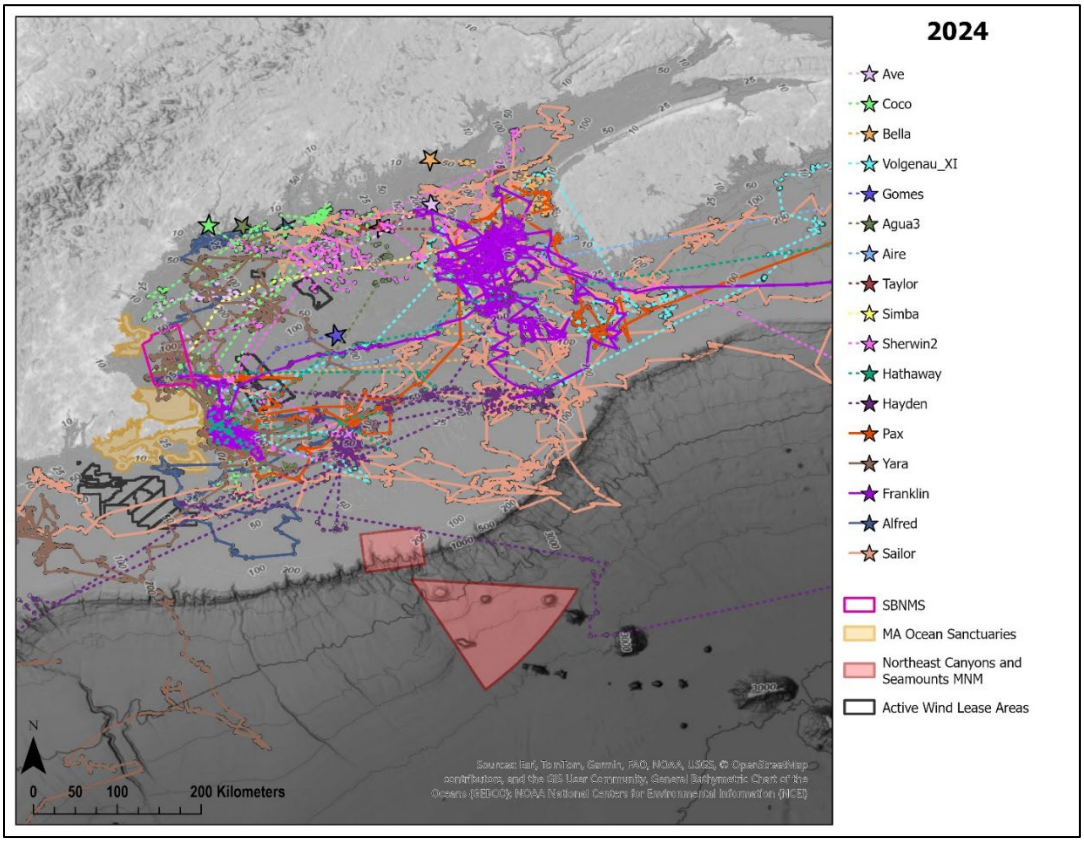
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Forage Ecology, Diet & Prey

Project Poop: Using Fecal DNA to Document Seabird Diet

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Collaborators: Ruth Boettcher, Virginia Dept of Wildlife Resources; Linda Welch, Kris Vagos, Helen Manning, and Eileen McGourty, U.S. Fish and Wildlife Service; Paula Shannon and Don Lyons, National Audubon Society; Liz Craig, Shoals Marine Lab; Lindsay Addison, Audubon North Carolina; Chelsey Stephenson, National Park Service; Diann Prosser, USGS Eastern Eco Sci Center; Kate Goodenough, Univ. of Central Oklahoma; Chelsea Sweeney Virginia Tech; Carolyn Mostello, MA Div Fish and Wildlife; Min Huang, CT DEEP; Emily Heiser; New Jersey Fish and Wildlife; Janet Thibault, South Carolina Dept of Natural Resources; Collin Stempien, Audubon Delta; Lisa Ferguson, The Wetlands Institute; Daniel Gallant, Parks Canada; David Brinker, Maryland Dept of Natural Resources; Shawn Craik and Alexis Saulnier, Acadia University; Adam DiNuovo, Audubon Florida; Christina Davis, New Jersey Fish and Wildlife; Carmen Johnson, North Carolina Wildlife Resources Commission; Chelsea Weithman, Sarah Karpanty and Kelsi Hunt, Virginia Tech Shorebird Program; Margaret Rubega University of Connecticut; Joan Walsh, American Museum of Natural History

Based on an AMBC survey conducted in the fall of 2023, the Seabird Colonies and Adjacent Waters and the Forage Fish Working Groups determined that very little seabird diet information was being collected at many of the colonies on the Atlantic coast. Many of the managers lacked the capacity to conduct field-intensive observations of chick feedings to determine diet. While colony managers know this information is very valuable for us to interpret seabird productivity values, we also wanted to determine if warming sea temperatures are causing shifts in the diets of piscivorous seabirds. Beginning in 2024, Project Poop, which uses DNA in seabird feces to document seabird diet, was implemented to address this research need. We focused collection efforts on black skimmer and common terns, and samples were sent to Dr Gemma Clucas at Cornell University for analysis. During the 2024 breeding season, 475 skimmer samples were collected from seven states representing 13 colonies. For common terns, partners were able to collect 1,332 samples across 24 colonies, representing eight states and two Canadian provinces. We anticipate continuing this effort in 2025.

Multi-metric Energetic Analyses for Seabird Prey in the Northeast Atlantic

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Collaborators: Sarah Guitart, University of Massachusetts Amherst; Abby Remick, University of Maine, School of Marine Sciences, Darling Marine Center; Linda Welch & Jill Tengeres, U.S. Fish and Wildlife Service; Natasha Gownaris, Gettysburg College

In the Northwest Atlantic Ocean, climate change is impacting seabirds and other species by altering the timing and abundance of prey availability. Climate can also drive changes in fish energetic content and nutrition, with implications for the growth and survival of their predators. This phenomenon has been previously documented in the Pacific Ocean for sandlance (Ammodytes sp.) and for a range of forage fish from the continental shelf habitats of the

Atlantic. However, there is a need for updated and expanded energetics data on prey species that live in estuarine and nearshore habitats, particularly for size classes important to colonial nesting seabird species across the region. Here, we present preliminary data for samples collected across two years (2022-2023) and two locations (Buzzards Bay, MA and Petit Manan Island, ME) as a demonstration for future analyses anticipated with ongoing collections. Preliminary data include key prey (Atlantic silverside, butterfish, hake, herring, rock gunnel, sandlance, stickleback, and squid) measured using multiple energetic metrics including macronutrient values for % protein and % lipid content determined by colorimetric assays, carbon to nitrogen (C:N) values from stable isotope analyses, and KCal per unit weight determined by bomb calorimetry. This project seeks to engage scientists and managers working on seabird colonies to collect and contribute dropped prey to fill size and species gaps and supplement samples collected during routine fish trawl and seining surveys along the U.S. Northeast coast in 2025.

Fisheries Bycatch

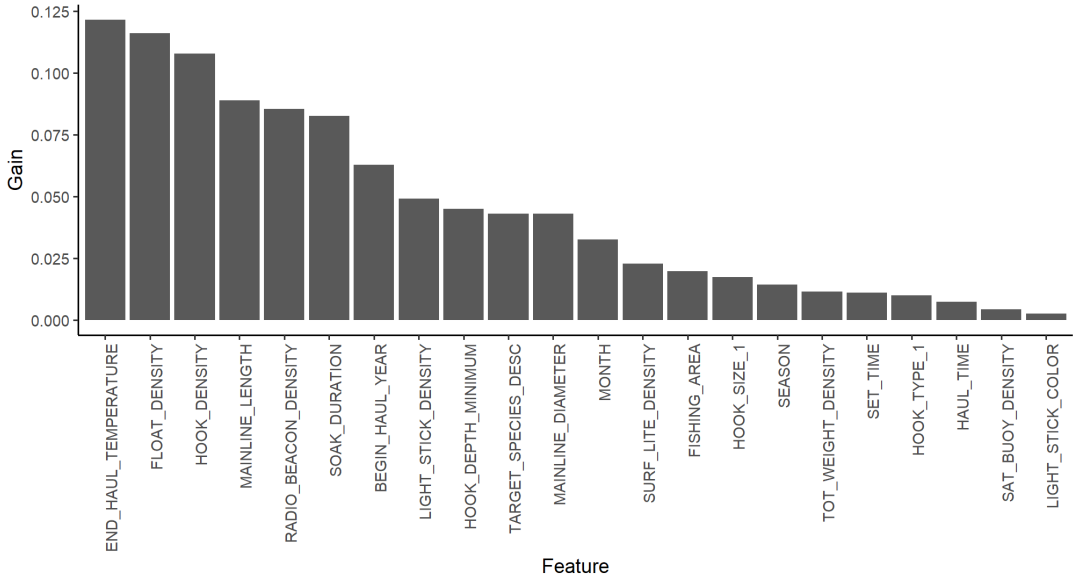
Evaluating the Performance of Machine Learning Approaches for Estimating Seabird Bycatch in U.S. Atlantic Pelagic Longline Fisheries

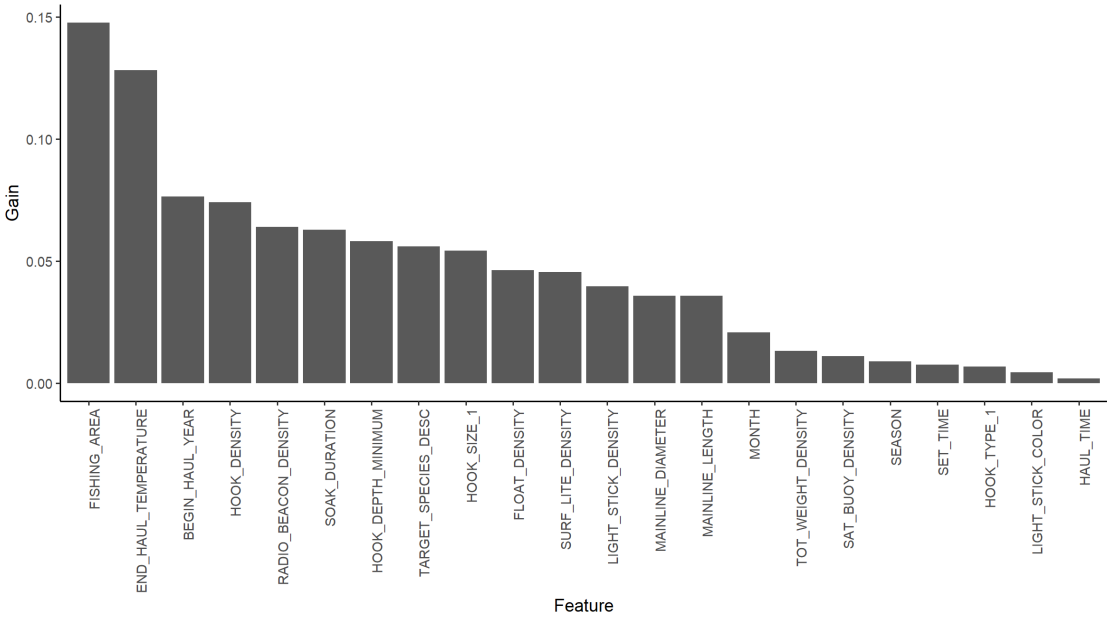
Contact: Iman Pakzad, Department of Fish and Wildlife, Virginia Tech, ipakzad@vt.edu
Collaborators: Yan Jiao, Department of Fish and Wildlife, Virginia Tech.

In the Western North Atlantic U.S., seabird bycatch in the pelagic longline fishery continues to be a serious concern. Previous analysis of the Pelagic Observer Program (POP), which monitors the Atlantic longline fishery bycatch, including seabirds, showed that there were significant differences in the gear usage between vessels that catch seabirds and those that do not. This study aims to use those differences found in previous studies to create machine learning models that may predict which vessels are likely to catch birds based on the gear and fishing tactics used. The objective of this study is to develop a machine learning model to predict seabird bycatch events and further identify vessel related fishing tactics that might affect seabird bycatch probabilities. In total 18 different tactics across four categories: effort, depth, lures, and miscellaneous, as well as 7 environmental variables were used to create decision tree, random forest and XGBoost models. Because the events with seabird bycatch observed are less than 1%, relatively rare, using both raw and weighted data sets ranging from 10x to 50x weighting were used. and was bootstrapped with 50 random stratified samples. Accuracy, sensitivity, specificity and cross validation were used to evaluate the model performances. Variable selection varied both by model type and by the level of weighting. With the decision tree models, between 4 to 7 variables were selected and all were equally weighted within the model. The decision tree model most consistently identified hook size and fishing area as significant. The random forest model alternatively identified 7 to 9 variables as influential and with a fairly linear decline in influence between variables. Alternatively, random forest models consistently identified all the effort related gears, float density, radio beacon density and haul temperature as significant. Lastly, XGboost was the most varied, selecting between 4 and 9 variables as significant and becoming

more parsimonious with increased weighting. Additionally, as weighting increased, the influence of the top 2 variables increased drastically (see Figure 1 and 2). XGboost models consistently identified hook density, fishing area and temperature as significant. With overall classification using the whole data set, random forest models and XGboost both achieved 99.9% or higher Accuracy and sensitivity with the 10x weighting. Decision trees at best achieved a 91% accuracy and 60.7% sensitivity at the 50x weighting. Further refinement of the input variables is required for the final prediction models, as with boot strap validation no model was able to achieve even 50% sensitivity. The best models of the boot strapped set were the decision tree models with 40x and 50x weight with highest mean sensitivities of 42.25% and 42.5% respectively for bird haul identification.

Figures 1 and 2: Gini plots of variable importance for the XGboost weighted model (above) and the 50x weighted model (below).





Disease & Mortality

Assessment of HPAI Risk In and Around Acadia National Park, Maine

Contact: John Anderson, College of the Atlantic, jga@coa.edu
Collaborators: Bik Wheeler, Resource Management, Acadia National Park; Wendy Puryear, Tufts School of Veterinary Medicine

Acadia National Park is best known for its holdings on Mt Desert Island, and more recently for additional land on the Schoodic Peninsular. Although unknown to many visitors, Acadia also has fee ownership or easements on over 100 other islands between the Penobscot Bay Shipping Channel and Schoodic. Of these, at least 13 (Figure 1) have current or recent records of nesting seabird populations.

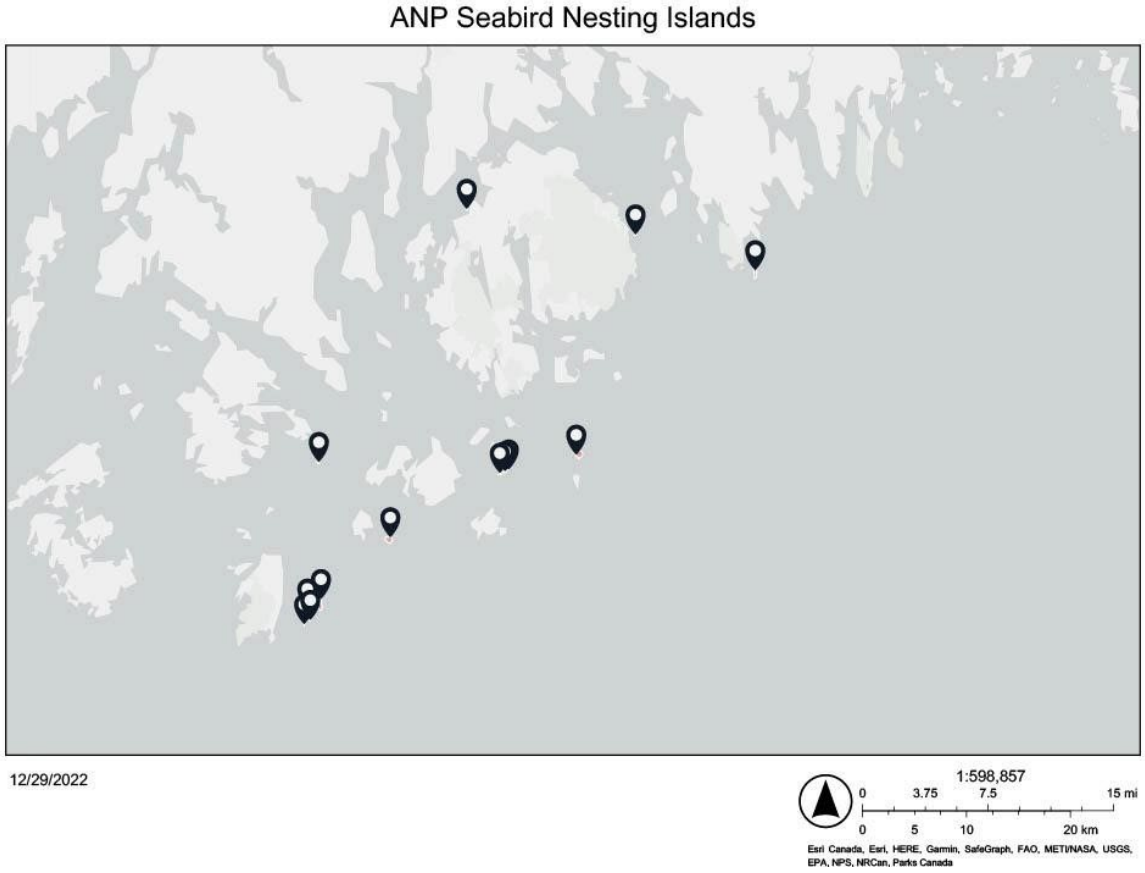


Figure 1. Location of historically important seabird islands under NPS fee ownership or easement.

Recently there has been increasing concern among ornithologists and public health officials about the potential impact of avian influenza on both wild populations of birds and domesticated breeds of chickens. This concern has only been heightened by reports of transmission of "bird flu" to domestic mammalian livestock and thence to farm workers. As a result of concerns about

possible risk to the visiting public at Acadia, my team and I were asked to investigate populations of seabirds on islands in the vicinity of Mt Desert, and to initiate studies of movement patterns among gulls. This latter component involved monitoring both the movements of the birds to and from breeding sites to other areas within Acadia, and also post-breeding dispersal. The latter is important in estimating possible infection of birds in other areas of their range. The project has the added benefit of providing park managers with up to date estimates of population health on park islands.

Starting in 2023, we have conducted ground counts on all major park seabird islands and continued long-term work on Great Duck and Mt Desert Rock. Besides censusing the islands we also captured adults and chick and conducted oral and cloacal swabs in order to determine whether birds were active carriers of HPAI. On Great Duck and Mt Desert Rock, we took blood samples for assessment of influenza antibody presence. All captured birds were banded using both Federal metal bands and "field readable" orange plastic bands with unique letter/number letter codes. A total of 18 herring Gulls were fitted with "backpack" GPS tracking devices from Cellular Tracking.

In both 2023 and 2024 we saw small numbers (< 40 total) of dead gulls on all islands visited including Great Duck and Mt. Desert Rock, where we were able to monitor colonies throughout the season. While this number is anecdotally more than we have seen in previous years, it nowhere approaches the scale of mass mortality reported elsewhere. None of the oral swabs from the Park or COA islands tested positive for HPAI. Forty five out of 54 tested birds on COA islands tested positive for some form of avian influenza antibodies, meaning that they had been exposed at some previous time but had recovered. . We hope to follow up the possibility of other pathogens in future seasons.

Identifying the Exposure and Response of Understudied Waterbird Species to Avian Influenza Viruses

Contact: Diann Prosser, United States Geological Survey Eastern Ecological Science Center, dprosser@usgs.gov

Despite the exceptional host range impacted by the ongoing outbreak of 2.3.4.4 highly pathogenic H5NX avian influenza in North America, the majority of research into this viral threat remains focused on historic vector species like waterfowl. This presentation will provide a brief recap of the current HPAI situation in North America and then discuss ongoing and completed research exploring how infection with avian influenza impacts a broad array of waterbird species. Specifically, this talk will explore our contributions to the limited data available for understudied species such as summarizing findings of challenge study efforts with wild birds native to North America, and conducting surveillance sampling in non-waterfowl species to identify seroprevalence rates and inform population immunity status. We will discuss how this array of information is currently being used to attempt to understand the role of broader waterbird species in the transmission and persistence of avian influenza viruses, as well as future directions for this effort. We will also identify potential areas of collaboration with other

scientists such as how our effort to pair disease sampling of waterfowl with ongoing marking projects to understand how infection impacts movement ecology could be expanded to broader waterbird species.

Standardizing the Response: Decision Tools for Robust Marine Bird Mortality Assessments

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Collaborators: Andrew M. Ramey, USGS Alaska Science Center; Stephanie Avery-Gomm & Gregory J. Robertson, Environment and Climate Change Canada; Marc Romano & Megan Boldenow, U.S. Fish and Wildlife Service, Alaska Region; Jennifer M. Mullinax, Department of Environmental Science and Technology, University of Maryland; Scott Pearson, Washington Department of Fish and Wildlife; Philip W. Atkinson, British Trust for Ornithology; Diann J. Prosser, USGS Eastern Ecological Science Center

Given a rise in anthropogenic, environmental, and disease-related stressors contributing to marine bird mortality, there is a critical need to improve the rigor of mortality assessments. Deficits in data collection and mortality estimation often hinder managers' ability to document the scales of losses and assess population level impacts. Resources, capacity, and assets to assess mortality vary across jurisdictions (federal, state, indigenous, local, etc.), and guidance to support mortality estimation is often unavailable or unclear. Here, we present a decision support tool designed to help managers identify and evaluate survey options to assess marine bird mortality across diverse scenarios. The objective of the decision tool is to guide improved data collection and availability which will increase the ability to robustly estimate mortality, given situation-specific attributes and constraints. The tool is designed to guide response when a mortality event is initially encountered and offers suggestions for assessment and reporting procedures in the absence of - or to complement - existing protocols. The tool also aids users in exploring further assessment and monitoring options by posing questions about species prioritization, mortality spatial extent, and the potential magnitude of impacts on affected species. Finally, identification of appropriate survey methods, that address imperfect detection when a complete census is not possible, may be determined by exploring event-specific scope and species characteristics. Ultimately, this tool aims to facilitate and improve standardization of mortality assessments and equip managers with a practical resource to navigate the decision making process for marine bird mortality estimation.

Marine Debris & Pollution

Accumulation of Per- and Polyfluoroalkyl Substances (PFAS) in Coastal Birds and Food Webs in South Carolina

Contacts: Patrick Jodice, U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, pjodice@g.clemson.edu; Juliet Lamb, The Nature Conservancy, New York Division; Amber Litterer, South Carolina Cooperative Fish and Wildlife Research Unit

Collaborators: Rainer Lohmann & Rachel Nelson, University of Rhode Island, Graduate School of Oceanography; Anna Robuck, U.S. Environmental Protection Agency; Janet Thibault & Felicia Sanders, South Carolina Department of Natural Resources

PFAS are anthropogenic pollutants that are ubiquitous in human and natural environments and highly persistent. PFAS are released into the environment via several pathways, including use and disposal of consumer products, manufacturing activities, and application of aqueous fire-fighting foam (AFFF), particularly at DoD sites. Joint Base Charleston is a known location of AFFF contamination, with high concentrations of PFOS, PFOA, and PFBS previously observed in soil, surface water, and groundwater on or surrounding the base. It is unclear if or to what extent PFAS from this site migrate into the adjacent Ashley River and into downstream estuarine and marine habitats. Multiple taxa within Charleston Harbor, including both prey and predator species, have been documented to contain elevated concentrations of PFOS, and recent work from our group likewise identified high levels of PFOS and other PFAS in the eggs of brown pelicans from the region for the first time (Wilkinson et al. 2021).

To investigate the bioaccumulation and biomagnification of PFAS in coastal birds that rely on environments and food webs downstream from Joint Base Charleston within the Charleston, SC region, we combined field sampling with biologging efforts and have begun to analyze PFAS levels in spatially explicit samples.

During the 2024 field season, we focused on two species: Eastern Brown Pelicans (*Pelecanus occidentalis carolinensus*) and American Oystercatchers (*Haematopus palliatus*). We deployed satellite tags with high temporal resolution on breeding adults of both species. Additionally, we sampled eggs, feathers, and blood from both species. Blood was spun down and separated into serum samples for PFAS, biomarker, and protein analyses. Twenty-one American oystercatcher adults and fifteen brown pelican adults had complete samples collected (i.e., an egg from the nest, a deployed transmitter, feathers for stable isotope analyses, and a serum sample for PFAS analyses). Twenty-five brown pelican chicks had complete samples collected (i.e., feathers for stable isotope analyses and a serum sample for PFAS analyses). Additionally, we collected prey samples including Eastern oysters, trawled fish, and regurgitated fish as well as spatially explicit biotic and abiotic matrices including water, plankton, sediment, air, and marsh vegetation.

Thus far, we have analyzed the water samples for 54 target PFAS compounds using a high-resolution liquid phase chromatography mass spectrometer (Figure 1). We have also collected over 1 million GPS locations from tags deployed on both species. We have begun to analyze highly revisited areas and the associated underlying levels of PFAS contamination to determine potential exposure pathways (Figure 2). Future work will include analyzing environmental, prey, and avian samples to determine bioaccumulation and biomagnification potentials as well as inter- and intra-specific differences in space use and associated total PFAS body burdens.

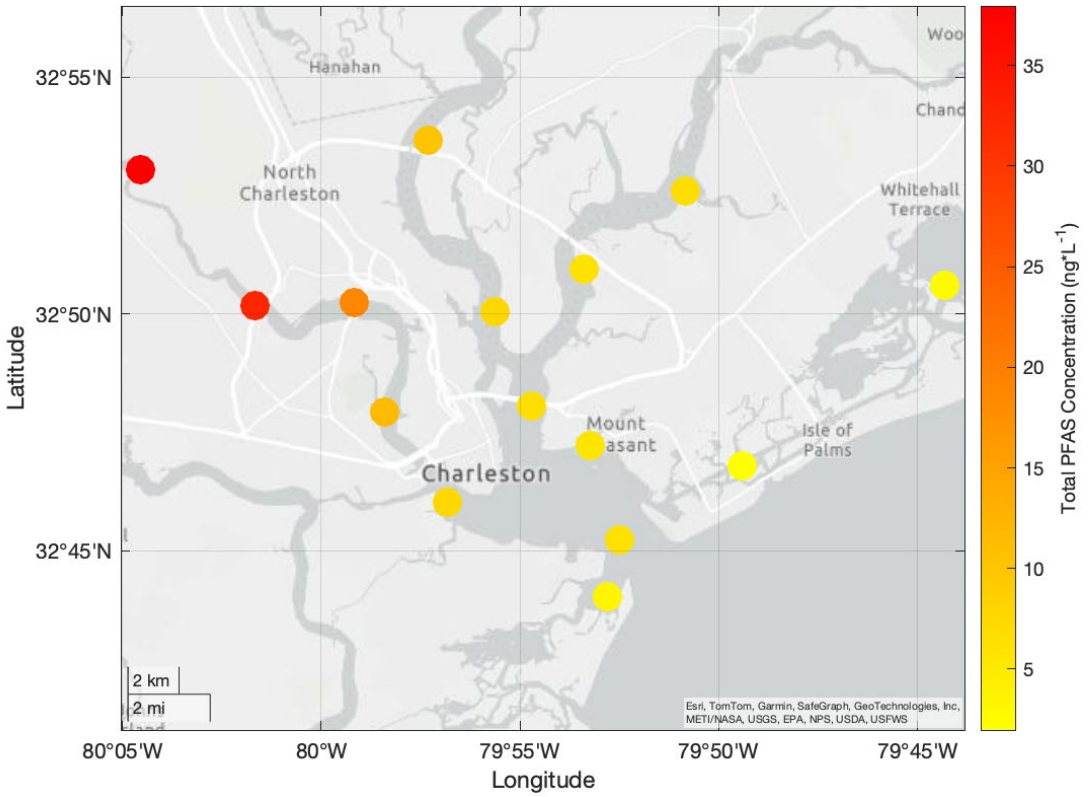

Figure 1. Total PFAS concentration in water samples from 15 sampling sites throughout Charleston Harbor and the Atlantic Intracoastal waterway, July 2024.

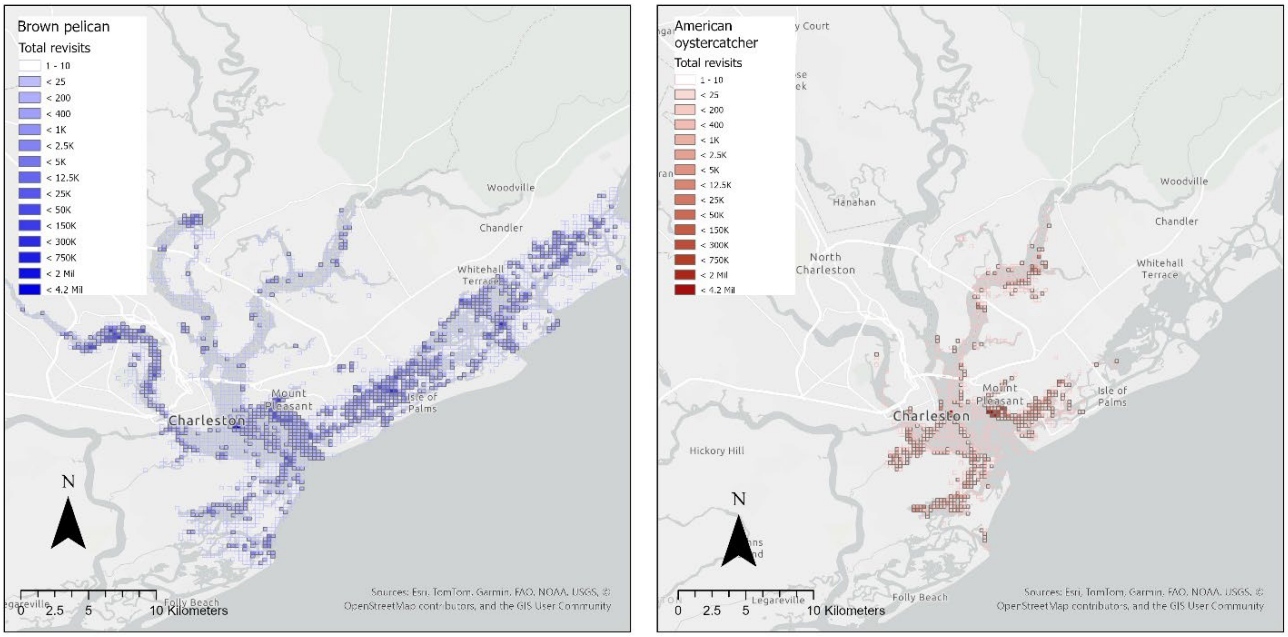

Figure 2. Number of revisits within 250m x 250m grid cells in the Charleston Habor region during the breeding season for Brown Pelicans and American Oystercatchers, April – June 2024 (preliminary data).

Coastal Foraging Increases Mercury Concentrations In a Breeding Seabird: Insights From Isotopes, Biologging, and Prey

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Collaborators: Rose M. Lacombe, Canadian Wildlife Service, Environment and Climate Change Canada, Gatineau, Québec; Kyle H. Elliott, Department of Natural Resource Sciences, McGill University; Raphael A. Lavoië, Science and Technology Branch, Environment and Climate Change Canada, Québec

Mercury is a widely distributed, naturally occurring contaminant in the environment and concentrations can vary substantially across spatial and temporal scales. As mobile marine predators, seabirds offer a unique opportunity to directly link foraging tactics with mercury burdens, because temporal variation in mercury can be related to spatial variation in foraging. Seabirds are used as sentinels for monitoring mercury distributions and potential toxicity across aquatic ecosystems because they are mobile, long-lived predators, often feeding at high trophic positions across broad foraging areas. Breeding razorbills (Alca torda) forage in various habitats around colonies, which can affect their mercury burdens. Here, we explore how mercury concentrations in red blood cells are influenced by foraging tactics (movement and trophic ecology) using GPS tracking and stable isotope dietary analysis (δ15N, δ13C, and δ34S), as well as by environmental signals, assessed through prey observations using nest-based cameras in two years (2021 and 2022) in breeding razorbills in the Gulf of St-Lawrence, Canada. Total mercury levels varied significantly between years, and all individuals exceeded low-risk toxicity thresholds. In the higher mercury year, razorbills foraged closer to the coast and had lower δ13C and δ34S values, suggesting a shift in foraging tactics. Although prey species composition did not change between years, individuals in the high mercury year brought back smaller prey and more items per load. These findings suggest that elevated mercury concentrations in razorbills may be linked to foraging in more coastal areas. Thus, small-scale changes, such as a shift to inshore coastal foraging, may expose seabirds to cumulative freshwater/terrestrial inputs and potentially higher mercury concentrations in prey. By investigating ecotoxicological risks associated with foraging-related contamination using multiple simultaneous approaches, our study provides insights into how feeding tactics can drive mercury contamination in sympatric seabirds foraging in coastal environments. Future applications of this method could be critical to informing conservation measures and identifying important conservation areas for seabird populations.

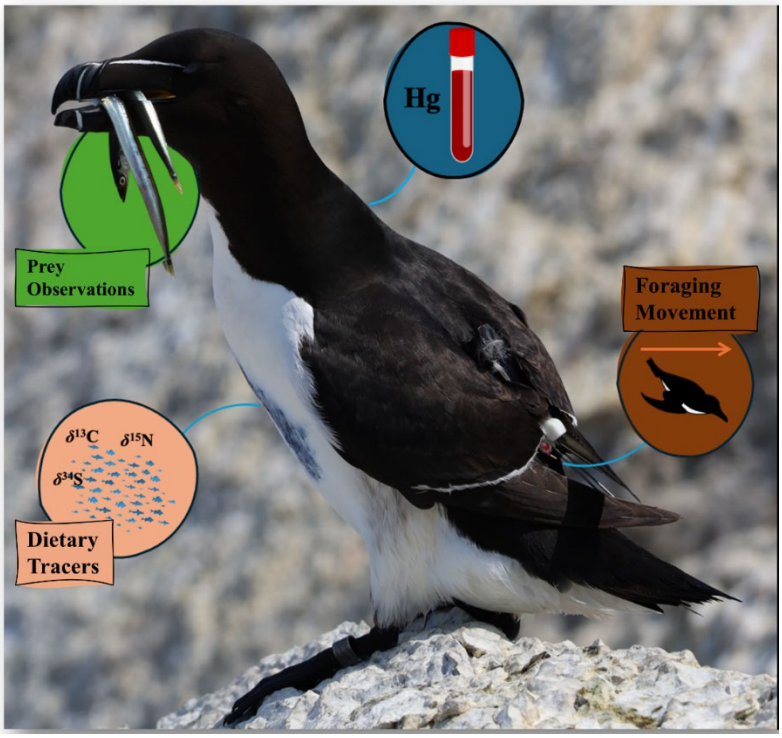

Figure 1. Summary of study using a three-pronged approach to investigate what drives Razorbill mercury burdens between years: GPS-tracking, stable isotopes analyses, and prey observations. Photo: R. Lavoie.

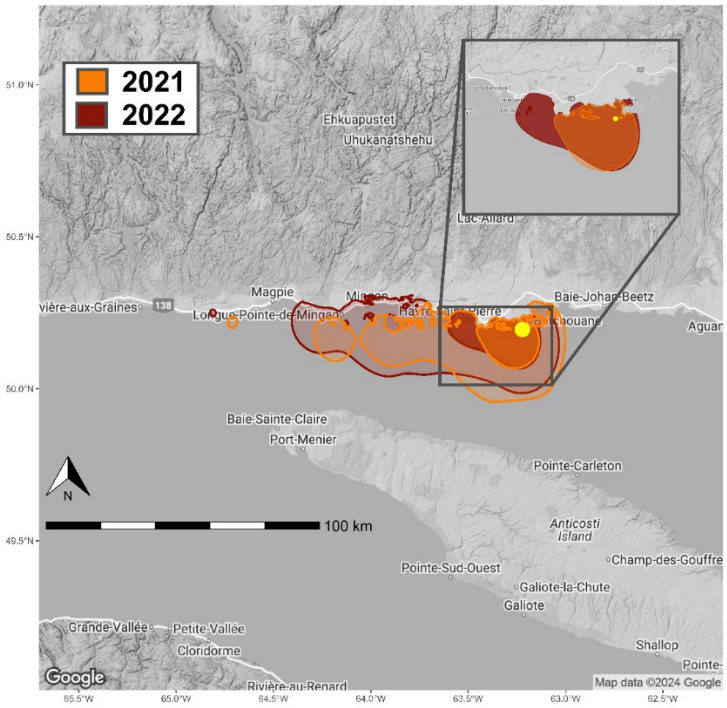

Figure 2. Interannual foraging areas of razorbills breeding at Betchouanes Island, Canada in 2021 (lower mercury year) and 2022 (higher mercury year). The darker contour represents 50% and the lighter contour represents the 95% foraging utilization distributions. The inset depicts 50% contours, and the colony location is identified by a yellow circle.

Spatial Distribution and Trophic Transfer of Mercury in the Gulf of St. Lawrence Using Northern Gannets as Biological Samplers

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Collaborators: Benjamin Barst, David Pelletier, Pauline Martigny, Magella Guillemette, & Marc Amyot

Mercury (Hg) distribution within ecosystems is influenced by various environmental factors, making it crucial to understand where and how Hg varies in ecosystems. To explore these, we used an innovative method that uses northern gannets as biological samplers of regurgitated fish in the Gulf of St. Lawrence, Canada. We mapped out the catch locations of gannet prey, identified using GPS devices, and related those locations to the fish total Hg (THg) concentrations and factors that can potentially explain contamination levels. In small fish species, trophic position, calculated from compound-specific stable nitrogen isotopes in amino acids, emerged as the most influential predictor of THg concentrations. For large fish species, THg concentrations were best explained by δ13C, indicating higher Hg concentrations may be related to inshore habitats. Our findings point to habitat-dependent variability in THg concentrations across multiple trophic levels (Lacombe et al. 2024. STOTEN). We also tested a newer method to estimate the biomagnification of mercury in northern gannet food webs. Compound-specific stable isotope analysis of amino acids (CSIA-AA) provides a method to estimate baseline δ15N values of food chains, allowing less biased estimates of trophic positions for animals. Better trophic position estimates can improve our understanding of contaminant biomagnification. We calculated trophic positions with various CSIA-AA equations for four species of fish and northern gannets. We examined how CSIA-AA-derived trophic positions changed our mercury biomagnification metrics (showing how important contaminant magnification is between each trophic level) and compared these with trophic position estimates and metrics obtained from traditional bulk stable isotope analysis. The biomagnification metrics for the CSIA-AA equations ranged from 10 to 19, while bulk stable isotope analysis produced a metric of 43, one of the highest TMFs recorded yet in the literature. We show that important differences in biomagnification estimated using different approaches may go undetected when using a single approach (Lacombe et al. 2024. Envr. Poll.). Our studies could have many potential uses in the future, including the identification of vulnerability hotspots for fish populations and their predators, or assessing risk factors for seabirds themselves by using biologically relevant prey.

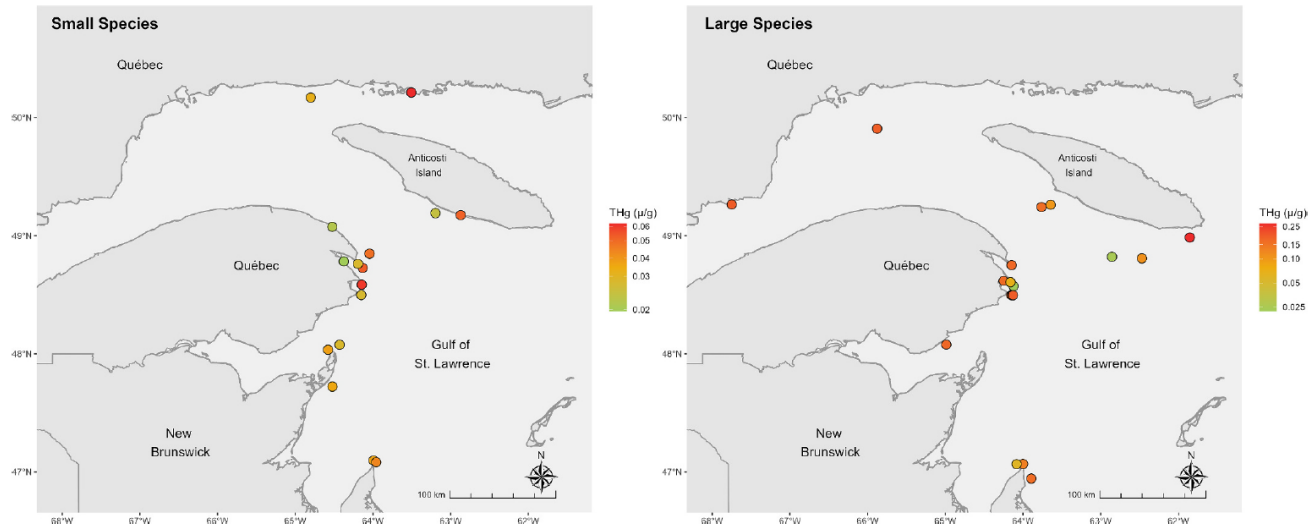

Fig. 1. Total mercury (THg, reported in µg/g dw) for each regurgitated fish sample according to the mean foraging location of northern gannets in the trip directly preceding the regurgitation. Small species consist of sandlance (*Ammodytes* spp.) and capelin (*Mallotus villosus*), while large species consist of Atlantic mackerel (*Clupea harengus*) and rockfish (*Sebastes* spp.).

Figure 1 from Lacombe et al. 2024. *STOTEN*

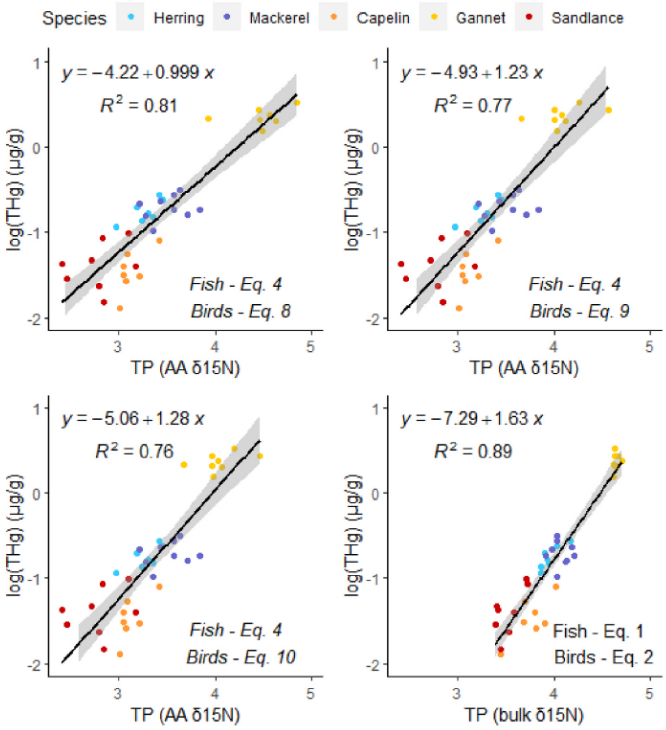

Fig. 2. Relationship between log-transformed total mercury (log(THg)) and trophic position (TP) calculated from experimental equations using compound-specific stable isotope analysis of amino acids (AA) in northern gannets and their prey. The shaded region represents the 95% confidence interval of the slope of each relationship.

Figure 1 from Lacombe et al. 2024. *Envr. Poll.*

Per- and Polyfluoroalkyl Substances (PFAS) in Northern Gannets

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Per- and polyfluoroalkyl substances (PFAS) represent a class of pollutants of anthropogenic origin that are highly persistent in the environment, leading to accumulation and adverse effects of these substances in animals and humans. The aim of the present study was to identify the relationship between the concentration of PFAS compounds and certain biological variables in northern gannets (i.e., sex, body condition, stage of egg development, egg mass, maternal transfer, migration patterns, trophic position and feeding area). To do so, 35 females and 8 males from Île Bonaventure (Gulf of St. Lawrence, Québec, Canada) were sampled. Blood and eggs were analyzed for 17 PFAS. PFOS, PFNA, PFUdA and PFDA were the highest PFAS found in the birds' blood and eggs. PFOS concentration interacted significantly with the biological variables, including 1) a significant difference between sexes, 2) a significant increase with developmental stages and egg mass, and 3) a significant decrease with body condition. A preferential transfer from female to egg for long-chain compounds (more than 10 carbon atoms) was observed, with the exception of PFOS. Future plans include the incorporation of geolocation (to assess migration patterns in relation to PFAS) and stable isotope (to assess trophic position and foraging area in relation to PFAS) data in the analyses, as well as the development of molecular biomarkers to evaluate the toxic response in these individuals.

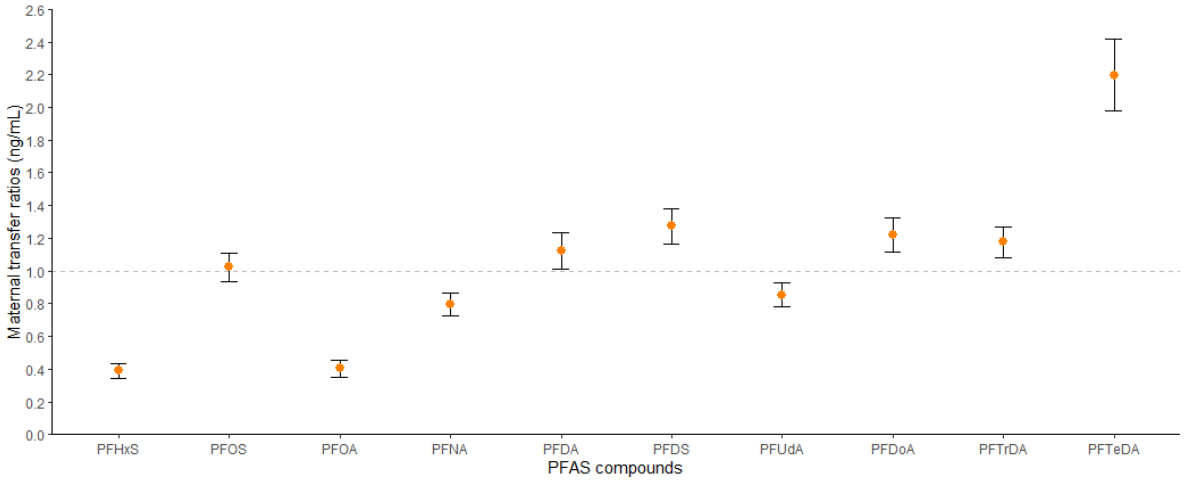

Figure 1. Maternal transfer ratios (ng/mL, i.e. concentration in egg/concentration in female) from 32 female Northern Gannets (*Morus bassanus*) and their respective eggs according to 10 PFAS compounds found over the detection limit (classed by chain-length).

Figure 2. Northern gannets (*Morus bassanus*) colony at Île Bonaventure, Gulf of St. Lawrence, Québec, Canada. Photo: Laurianne Richard (2024).

Offshore Wind Development – Assessment, Guidance & Planning

Framework for Assessing the Cumulative Effects of Offshore Wind Energy Development and Other Pressures on Aerofauna in Atlantic Canada

Contact: Megan Ferguson, Birodiversity Research Institute, megan.ferguson@briwildlife.org
Collaborators: Kate Williams, M. Wing Goodale & Evan Adams, Biodiversity Research Institute; Paul Knaga, Canadian Wildlife Service, Environment and Climate Change Canada, NS, Canada; Stephanie Avery-Gomm, Environment and Climate Change Canada, Science Technology Branch, Wildlife Research Division

We present a framework for assessing cumulative effects to aerofauna (herein limited to birds and bats) from offshore wind (OSW) activities to assist in developing regional management strategies for Atlantic Canada. The proposed cumulative effects assessment (CEA) framework implements a population- or species-centric approach and is based on best practices currently used in Europe, the United States, and Canada. The framework was designed primarily to inform the process of delineating specific boundaries for individual OSW project areas ("sites") that developers may bid on within the preliminary regional boundaries identified for OSW development by the Regional Assessment Committees for Nova Scotia, and Newfoundland and Labrador. Our aim is to develop a cohesive and flexible CEA framework that could be applied to

a variety of receptors (i.e., species or Valued Ecosystem Components) that differ in the amount and type of ecological information available for analysis. Our analytical strategy uses spatial optimization methods to minimize the value of a cumulative effects metric (i.e., the variable or parameter used to indicate the presence or magnitude of cumulative effects). The combination of possible sites that may be selected to form a valid solution to the optimization problem may be constrained by factors such as minimum or maximum OSW site size, total area of all OSW sites within the region, total energy produced in the region, and avoidance of areas of concern (e.g., based on pre-defined ecological, social, economic, or logistical factors). Given sufficient spatially explicit information about the density of the selected receptor(s), magnitude of the selected pressures, and cause-effect pathways linking the receptors and pressures, we can tune the spatial optimization algorithm to find solutions that minimize population-level impacts to a receptor or community from the cumulative effects of all pressures. Interpreting the resulting cumulative effects metric in the context of predefined decision criteria provides a standardized, transparent method for making decisions about the future of offshore wind development in Atlantic Canada.

SCRAM 2: Modeling the Movements of Listed Shorebird and Seabird Species to Estimate Collision Risk With Offshore Wind Turbines

Contact: Holly Goyert, Biodiversity Research Institute, holly.goyert@briwildlife.org
Collaborators: Evan Adams, Andrew Gilbert, Julia Gulka, Julia Stepanuk, & Kate Williams, Biodiversity Research Institute; Pamela Loring, U.S. Fish and Wildlife Service Migratory Birds Program

Collision risk models are used globally to estimate the risk of avian collisions with offshore wind energy turbines. In the United States (US), a stochastic collision risk model and publicly accessible online web application was released in 2022, called the Stochastic Collision Risk Assessment for Movement (SCRAM). This decision support tool uses movement data from tracking studies to characterize collision risk in three federally listed avian species that are exposed to offshore wind energy development: the Red Knot (Calidris canutus), Piping Plover (Charadrius melodus), and Roseate Tern (Sterna dougallii). Given a lack of surveys designed to target listed shorebirds or seabirds offshore the US, movement models were developed using automated radio telemetry data to estimate collision risk for these species across the US Atlantic Outer Continental Shelf. Phase 2 of the project (2023-2024) included updates to the SCRAM models and tool to incorporate new sources of data (e.g., satellite-based tracking technology), improve the models, and increase the functionality of the online platform. These updates to SCRAM decreased computation time, enhanced model performance, and reduced both the variability and uncertainty of model results. Current limitations include lack of spring migration data from birds tagged at overwintering sites. Additionally, SCRAM 2 assesses risk to breeding and post-breeding Roseate Terns but not migrating Roseate Terns. To address these limitations, planned updates to SCRAM in Phase 3 (2024-2026) include further advancement of the movement and flight height models (e.g., with new species and datasets from innovative tags), and collaboration with international subject matter experts.

Multi-topic & Other

Monitoring the Impacts of Climate Change and Environmental Pollutants on Common Loons and Aquatic Ecosystems in New York's Adirondack Park

Contact: Griffin Archambault, Research Biologist, Adirondack Center for Loon Conservation, research@adkloon.org
Collaborators: New York State Energy Research and Development Authority (NYSERDA), SUNY-ESF, New York State Department of Environmental Conservation, Calvin College, Wildlife Conservation Society (WCS), University of Vermont

In this project, the Adirondack Center for Loon Conservation (ACLC) utilizes the Common Loon (Gavia immer) as a sentinel species of the impacts of climate change and airborne pollutants on aquatic ecosystems in New York's six-million acre Adirondack Park. Since 1998, the ACLC and its collaborators have been monitoring the Adirondack loon population to assess its exposure to environmental mercury pollution, and the risk mercury exposure poses to the reproductive success of Adirondack loons.

Results from our first decade of study on Adirondack loons indicated that birds with elevated mercury levels had reduced reproductive success compared to loons with low mercury exposure. The resulting drop in airborne emissions as a result of regulations (e.g., Clean Air Act Amendments of 1990, Mercury and Air Toxics Standards rule) has led to chemical recovery of many formerly acidic Adirondack lakes, and to significant reductions in mercury deposition across the Northeast. Correspondingly, mercury levels in Adirondack loons plateaued after 2010, and loon reproductive success was no longer as significantly impacted by mercury exposure compared to other factors.

Our monitoring and analyses indicate that climate change, among other factors, is now a significant threat to loon survival and productivity. Climate change-related torrential rain events reduce loon nesting success through nest flooding. A phenomenon increasing in frequency is the "molt-migration mismatch," in which lakes now freeze later with warmer winters, loons fail to migrate prior to "ice-up" and their catastrophic winter wing molt, and they are subsequently "iced-in." Additionally, climate change could lead to increased exposure of loons to avian diseases, such as avian malaria, with the range expansion of disease vectors and cause loon breeding ranges to retract northward due to temperature tolerance limitations. Thus, the Adirondack loon population could become an ecological sink, as the Park is currently at the southern limit of the species' breeding range.

Continued monitoring and rescue efforts contribute to our understanding of the threats mercury and climate change pose to the Adirondack loon population and the aquatic ecosystems they inhabit. The nesting success of breeding loons on approximately 100 Adirondack study lakes is monitored annually to determine causes of nest failure, and to assess if nest flooding related to heavy and consistent rainfall during the loon incubation period continues to be a significant factor impacting the hatching of loon eggs. Breeding loons are captured, banded, and non-lethally sampled to collect blood and feathers to estimate total mercury body burden and to conduct complete blood counts and analyses for exposure to hemoparasites. Inviable loon eggs

are collected for contaminant testing from failed nest attempts. In addition, any rescued iced-in loons are examined to determine the status of their molt and document if a lack of flight feathers contributed to their inability to migrate prior to ice-in.

Results from this project will contribute to a broader scientific understanding and increased public awareness of the threats environmental pollutants and climate change pose to loons and the aquatic ecosystems they inhabit.

Restoration of New York's Common Loons Lost in the 2003 Buzzards Bay Oil Spill

Contact: Griffin Archambault, Research Biologist, Adirondack Center for Loon Conservation, research@adkloon.org
Collaborators: SUNY-ESF's Adirondack Ecological Center, New York State Department of Environmental Conservation, fishing outfitters, and lake associations in NY's Adirondack Park

The goal of this project is to restore breeding Common Loons in New York's Adirondack Park that were killed by the 2003 Bouchard Barge 120 oil spill in Buzzards Bay, Massachusetts and Rhode Island. This project will be conducted by the Adirondack Center for Loon Conservation in collaboration with SUNY-ESF's Adirondack Ecological Center, New York State Department of Environmental Conservation, fishing outfitters, and lake associations in NY's Adirondack Park, a six-million-acre mosaic of private and public lands and waters.

In the last two decades, Adirondack loon reproductive success has shown a steady decline, with fewer nesting pairs and fewer chicks hatching and surviving to fledging. There has also been an increase in the morbidity and mortality of adult loons due to fishing line entanglement, lead poisoning, human disturbance, conspecific interactions, and predation by Bald Eagles.

Thus, to restore the loons lost in the B-120 spill and address the current concerns of reduced loon productivity and increased morbidity and mortality, the objectives of this project are to:

1. **Increase the reproductive success of Common Loons breeding in NY's Adirondack Park.** A variety of management efforts including deployment of loon nest rafts, avian guards, and signage/buoys around loon nest sites, as well as collaboration with Adirondack lake associations to inspire community-based environmental stewardship, will be implemented over the five years of the project.
2. **Reduce the morbidity and mortality of Adirondack loons.** We will use a combination of community outreach programs, loon rescues, and rehabilitation to reduce exposure of loons to fishing-related threats, morbidity, and mortality, including:
   a. A Lead Tackle Buy-Back Program implemented Adirondack fishing tackle outfitters
   b. Fishing line recycling containers distributed throughout the Park
   c. Establishment of three loon rescue teams at key locations in the Park
   d. Establishment of a loon rehabilitation facility at the Adirondack Ecological Center in Newcomb, NY

The expected outcome of this project is to restore the loon-years lost in the Buzzards Bay oil spill by:

1. Increasing loon reproductive success on managed nest sites compared to unmanaged sites and

historical productivity
2. Reducing loon morbidity and mortality through:
   a. Increased utilization of non-toxic fishing tackle by Adirondack anglers and removal of lead fishing tackle from use
   b. Increased response time, efficiency, and success of capturing distressed Adirondack loons
   c. Veterinary-supervised diagnosis, treatment, and rehabilitation of distressed loons
3. Expanding public awareness of conservation concerns affecting Adirondack loons
4. Establishing an Adirondack lake community stewardship program to increase community activities to protect loons

The effectiveness of this project at restoring loon-years lost in NY's Adirondack Park as a result of the B-120 oil spill will be assessed through annual and five-year statistical analyses of loon reproductive success, rescue attempts, health, and by monitoring the survival and productivity of released banded birds. The following parameters will be tracked:
1. Monitoring Adirondack Loon Reproductive Success
2. Implementing the Lead Tackle Buy-Back, Fishing Line Recycling, and Loon-Friendly Lake Certification Programs
3. Quantifying Loon Rescue Effort and Success
4. Establishment of a Loon Rehabilitation Facility

Purple Sandpiper Overwintering Population Status Assessment

Contact: Elliot Johnston, Maine Natural History Observatory, elliot@mainenaturalhistory.org
Collaborators: Julie Paquet, Jen Rock, Yves Aubry, Environment and Climate Change Canada; Glen Mittelhauser, Maine Natural History Observatory; Brad Zitske, Kelsey Sullivan, Chris West, Maine Department of Inland Fisheries and Wildlife; Liana DiNunzio, Alan Kneidel, Brad Winn, Shiloh Schulte, Manomet; Sam Miller, Rhode Island Department of Environmental Management; Kat Christie, Delaware Department of Natural Resources and Environmental Control; Caleb Spiegel, U.S. Fish and Wildlife Service; Rebeca Linhart, University of Rhode Island.

Local declines of overwintering Purple Sandpipers have been observed along the Atlantic Flyway over the past several decades. This relatively understudied shorebird lacks a recent, robust population status assessment that would allow a better understanding of abundance, trends, and distributional shifts. In many states and provinces, Purple Sandpipers frequent offshore islands and ledges that are typically unsurveyed in community science datasets such as eBird and Christmas Bird Count. This project is coordinating existing and new winter surveys for Purple Sandpipers along the Atlantic Flyway to update population estimates. At the 10th Western Hemisphere Shorebird Group meeting in New Brunswick in August 2024, the Purple Sandpiper Working Group held their inaugural meeting to discuss research priorities for this species and highlighting ongoing efforts across states and provinces. There are active population status assessments happening in Atlantic Canada (Julie Paquet and Jen Rock) and Maine (Glen Mittelhauser and Elliot Johnston), and surveys are planned for this winter in Massachusetts (Alan Kneidel, Liana DiNunzio, Brad Winn, Shiloh Schulte). There are also planned efforts to track Purple Sandpipers during spring staging and migration periods to assess exposure to offshore wind development and better understand migratory corridors (Rebeca Linhart, Peter Paton). The working group met again in November 2024 to coordinate winter surveys across the flyway, with

Rhode Island (Sam Miller) and Delaware (Kat Christie) joining the provinces and states with planned surveys. Those interested in the working group are invited to join by contacting Elliot Johnston (elliot@mainenaturalhistory.org).

Common Loons (*Gavia immer*) and NELSWG (Northeast Loon Study Working Group)

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Collaborators: Lee Attix, Loon Conservation Associates, ME; Edwin Barkdoll & Billy Helprin, College of the Atlantic, ME; Danielle D'Auria, Maine Dept. Inland Fisheries & Wildlife; Eric Hanson, Vermont Center for Ecostudies; Tracy Hart, Maine Audubon; Jay Mager, Ohio Northern University; Ellen Martinsen, Univ. of Vermont; Jim Paruk, St. Joseph's College, Maine; Lucas Savoy, Biodiversity Research Inst., Portland, ME; Nina Schoch & Griffin Archambault, Adirondack Center for Loon Conservation, NY; Inga Sidor, David Needle & Megan Munis, NH Veterinary Diagnostic Laboratory, Univ. of New Hampshire; Harry Vogel & John Cooley, Loon Preservation Committee, Moultonborough, NH

In 1992 biologists and citizen scientists studying Common Loons in the six New England states and New York formed a regional working collaborative. Since its inception the group has also included participants from adjacent areas in Canada and studies both loons breeding on fresh water and wintering on the ocean.

The group meets annually (in 2025, March 13/14 in Moultonborough, NH) to review previous year's findings, plan next year's work, and to coordinate and prioritize common goals. People interested in loons can attend in person or virtually. The group currently consists of biologists from state and federal agencies, conservation NGOs, veterinarians, and independent citizen scientists. We also communicate with loon biologists throughout the US, Canada and abroad.

Members are involved in monitoring and management during the breeding season, banding (about 100 per year) & telemetry, behavioral studies, public education, rescue and rehabilitation of birds in distress, and recovery of cadavers for post-mortem examination (about 150 per year). Live birds captured for banding have samples (blood, feathers, swabs) obtained for a variety of research efforts. Ongoing studies include morphometrics, toxicology, and pathology with specific interests in climate change, and emerging pathogens. The group is involved with studies on avian malaria, ingested microplastics, population genetics, and an attempt to characterize the common loon microbiome.

Beginning in 2020 members of NELSWG collaborated with others studying loons across the U.S. and Canada to form 3 Virtual International Working Groups: Stewardship & Citizen Science, Rescue & Rehabilitation, and Field Research. The more than 200 people in these Working Groups have regularly scheduled Zoom meetings, make presentations at professional meetings, and are developing an extensive collection of resources on loon biology, conservation, and policy in a series of GoogleDrive folders.

Investigating Sources of Decline in the Black-legged Kittiwake (*Rissa tridactyla*) in Eastern Canada (Colony Management & Monitoring)

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Collaborators: Matthieu Beaumont, Environnement et Changement Climatique Canada; Jean-Francois Rail, Environnement et Changement Climatique Canada; Sabina Wilhelm, Environment Canada; David Iles, Environment Canada; Sarah Gutowsky, Environment Canada; Gemma Clucas, Cornell University; Antoine Plouffe-Leboeuf, Parcs Canada; Gaston Déry, Reserve Naturelle de l'Île aux Pommes

Black-legged kittiwake breeding populations have been declining in eastern Canada since the 1980s. These populations have been subject to a long-term monitoring program (1982-present) by the Canadian Wildlife Service (a branch of Environment Canada), but little research has been conducted to identify and explain the reasons behind black-legged kittiwake declines. Our project aims to determine the influence of multiple biotic and abiotic factors on population trends and breeding success of black-legged kittiwakes. In the summer of 2024, we monitored black-legged kittiwake activity at five colonies situated through the Gulf of St. Lawrence through the entirety of their breeding, incubation, and chick-rearing periods (May-August). This monitoring aims to describe the influence of two biotic factors hypothesized to be contributing in some way to observed population declines: prey availability and predation. Colonies were monitored constantly with trail cameras to determine the presence, identity, and impact of predators on breeding black-legged kittiwakes. To date, we have identified four species that actively preyed on black-legged kittiwake eggs or chicks during the 2024 breeding season. Fecal samples were collected from black-legged kittiwakes at our focal colonies to determine their dietary composition at two points during the breeding season – egg incubation and chick rearing. These samples will be analyzed for the presence of genetic material of prey, and comparisons will be made of the dietary makeup of each colony, and any dietary shifts over the course of a breeding season. Our project will also collate Canadian Wildlife Service monitoring data from black-legged kittiwake colonies across eastern Canada and historical environmental data to create explanatory models describing the impact of said environmental variables on the distribution and abundance of black-legged kittiwakes. Through combining field- and modelling-based approaches, we aim to identify the most important factors that have contributed to the observed population declines in black-legged kittiwakes in eastern Canada, and make informed conservation recommendations to preserve the integrity of their breeding and foraging habitats. As the project continues, we plan to incorporate the deployment of GPS and GLS loggers to better understand the breeding, foraging, and migratory movements of black-legged kittiwakes in eastern Canada.

Figure 1. Black-legged kittiwakes constructing nests on Ile Bicquette in the Gulf of St. Lawrence. These nests were monitored for the entirety of the 2024 breeding season.

Figure 2. A black-legged kittiwake tending to its two chicks.

Figure 3. Map of the Gulf of St. Lawrence highlighting five locations where black-legged kittiwake colonies were monitored during their 2024 breeding season.

Ecology of the endangered Diablotin Black-capped Petrel *Pterodroma hasitata*

Contact: Yvan Satgé, Clemson University, ysatge@clemson.edu.
Collaborators: Patrick Jodice, U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, pjodice@clemson.edu; Ernst Rupp, Grupo Jaragua; Brian Patteson, Seabirding Pelagic Trips; Brad Keitt, American Bird Conservancy.

The Black-capped Petrel (Pterodroma hasitata, also known as Diablotin) is a gadfly petrel endemic to the Caribbean and present in the Caribbean Sea, the Gulf of Mexico, and the western North Atlantic. In December 2023, the species was listed as endangered under the U.S. Endangered Species Act. Two phenotypes have been described: a smaller dark form and a heavier pale form, which are genetically distinct. In March 2024, we tracked two breeding adults of each phenotype from Loma del Toro, and Valle Nuevo, in central Dominican Republic where phenotypes breed in sympatry allochronically. We used this dataset and those collected in April 2014 (three dark-form adults breeding at Loma del Toro, southwest Dominican Republic) and May 2019 (five adults of each phenotype captured at sea off Cape Hatteras), to assess possible differences in marine distributions and connectivity between phenotypes. In 2014, 2019, and 2024, we tracked petrels for 162.6 ± 32.2 d, 102.1 ± 74.2 d, and 129.0 ± 54.1 d, respectively. During the breeding period, phenotypes appeared to have distinct foraging distribution, with dark forms mostly staying in the Caribbean basin, and pale forms travelling to Gulf Stream waters in the Atlantic basin. During the non-breeding period, phenotypes had significantly distinct distributions, independent of time of year: dark forms used waters of the Carolinian marine ecoregion, and light forms used pelagic waters of the Virginian ecoregion, to the north. Although limited sample sizes prevent broad inferences, these differences in distribution suggest possible differences in exposure and vulnerability to marine threats, which can have differential repercussions on the viability of this imperiled species.

During the last year, we published an article in Marine Ornithology suggesting a link between high mercury levels and a diet dominated by fish species, including a high proportion of mesopelagic groups.

SATGÉ, Y.G., JANSSEN, S.E., CLUCAS, G., RUPP, E., PATTESON, J.B. & JODICE, P.G.R. 2024. Mesopelagic diet as pathway of high mercury levels in body feathers of the endangered Black-capped Petrel (Diablotin) Pterodroma hasitata. Marine Ornithology 52: 261 – 274. (Available at http://www.marineornithology.org/article?rn=1591)

Nonbreeding Common Loon Ecology and Mortality

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Common Loon nonbreeding mortality must be considered in the context of life history events (adult wingmolt, cross-continent migration) and local ecosystem events (food failure, extreme weather, exposure to algal toxins, etc.).

Access to Common Loons in marine environments is challenging due to their wide dispersion, and limitations of boat surveys during winter weather.

But moribund loons beach themselves and/or take refuge in sheltered inlets. Thus, seasonal mortality events can be sampled, and roughly quantified, with special attention to "scavenger beaches". Essential is '*collegial patience'*.

Cumulative understanding gained over decades, by many workers:
1) Common Loons spend 4-plus months wintering on the Gulf of Mexico. Their Atlantic coast nonbreeding presence approaches five months.

2) Adult Common Loons go flightless in full remigial molt for est. 5-6 weeks of this period.
KEY ARGUMENT: This makes them a "sensitive species" in the marine environment.

3) Much of Common Loon annual mortality occurs late during this residence, when they exhibit emaciation and failure to complete wingmolt (juveniles and second-year Common Loons are not yet on this cycle, and remain flighted throughout, as do Red-throated Loons, which suffer relatively little winter mortality).

4) Shelf waters are prime winter habitats on both coasts; as demonstrated by Kevin Kenow, et al.'s satellite tag study of several years (2021); and by aerial or boat survey and other direct observation.

5) Common Loons dive deep for near-benthic-feeding in these shelf habitats, as found by Kenow et al.'s pressure sensors in leg-attached data loggers (2023). Adult wingmolt may well be a favorable adaptation for deep-diving, but it drastically reduces Common Loon mobility, and thus increases vulnerability to both extreme storm stress and regional food failure. I observed this lethal combination in the large (many hundreds) 1993 NC "emaciation mortality" event (Spitzer 1995, and in prep.), which I studied with USFWS and USGS colleagues (Augspurger et al. 1998). I had a long-term, multi-year base at the NOAA/NMFS lab in Beaufort, NC, with access to several resident fisheries biologists (menhaden) and marine biologists.

6) Predictable food availability shapes Common Loon winter and autumn stopover distribution and abundance, and adults return to the same region over many years (Paruk et al.'s trapping and tagging studies, 2015). Post-1993, Common Loon abundance at formerly prime Carolinas coastal Onslow Bay and Long Bay sites was dramatically diminished, presumably by the mortality event and by prolonged many-year reduction of the young of year menhaden prey base (Spitzer 2007, and in prep., USFWS aerial surveys during 1990's).

7) Common Loon coastal mortality patterns must also be considered in relation to other ecosystem events. The increasing frequency of "red tide" dinoflagellate algal toxin events as one proceeds down the Florida Gulf peninsula may reduce density and then limit winter range of long-lived Common Loons. Loons would be subject to these debilitating neurotoxins in aerosol forms—which kills manatees. Also, large-scale mortality of fish prey base is often observed.

8) The St. Marks National Wildlife Refuge on Apalachee Bay FL, south of Tallahassee, offers a unique opportunity for quantitative study of **Common Loon spring migration dawn departure.** I took this data with volunteers for five early springs in the last decade (2012, 2013, 2014, 2016, 2020). We observed extreme sensitivity to weather conditions, with no flights on days of rain or poor visibility. Additionally, during the first half of my three-week study period, some migrants would soon return, "aborting the mission". This could be due to physical limitations, not quite ready to go, or unforeseen weather well over the horizon (once at least).

KEY ARGUMENT: To survive, Common Loons require a long aquatic landing and takeoff. I observed very careful Common Loon migration departure behaviors that demonstrate their "aerial intelligence" when faced with potentially lethal grounding conditions, during this dangerous "Life History Event" (Spitzer book manuscript in prep.). I encourage others to continue this fascinating work, while enjoying spring on the Florida Gulf coast.