Sea Duck Joint Venture
Annual Project Summary
FY2023 (October 1, 2022 – September 30, 2023)

Project Title:
Identifying demographic bottlenecks and habitat use to support the recovery and management of American common eider: a range-wide, full life-cycle telemetry project: 2023 (SDJV Project #162).

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Project Description:
The target population for this project is the American subspecies of the common eider (*Somateria mollissima dresseri*). The project will address elements of Science Need 1 (Improve understanding of population delineation, migratory connectivity and key habitat use of sea ducks by targeting geographic gaps from previous satellite telemetry studies), Science Need 6 (breeding propensity) and Science Need 11 (evaluation of body condition documented shifts in species distributions). This study will also contribute to future harvest assessments for this population.

Methods – The main component of the study requires the deployment of ~184 PTTs. PTTs where to be distributed across their entire breeding range (28 in Maine, 26 in New Brunswick, 35 in Nova Scotia, 40 in Quebec, 25 in Newfoundland and 30 in Labrador; Fig. 1). In 2023, we had planned to deploy PTTs in Labrador and Nova Scotia. Glen Olsen's team oversaw the Nova Scotia surgeries and Stephane Lair's team the surgeries in Labrador. We used of Microwave Telemetry's implantable double battery PTTs (https://www.microwavetelemetry.com). The model weighs ~65 g and has a battery life expectancy of ~2025 h. The PTTs were programmed on a duty-cycle of 2 h ON and 18 H off during the breeding season and 3 h ON and 52 h off for the remainder of the year.

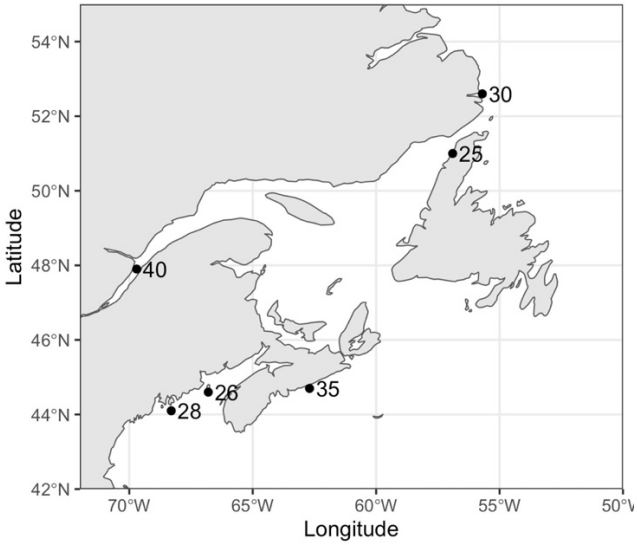

Figure 1. Study area and planned deployments of PTTs on Common Eiders.

We also planned to deploy 25 g solar powered GPS-GSM tags (OrnitTrack 25, https://www.ornitela.com). These tags were attached to the contour feathers on the birds back using Tesa ® tape and the edges of the tape were glued with thick UV glue to limit the bird's ability to lift the edges of the tape when preening. They were to be deployed on pre-breeding female eiders at the 2021 deployment site in Québec.

Timing – We are attempting to capture females around the colonies just before they initiate clutches. We used data from known laying or hatch date collected in New Brunswick between 1984 and 1986, and by candling eggs in northern Newfoundland in 1993, 1996, 2001 and 2016, and in southern Labrador in 2008-2012. In New Brunswick, peak nest initiation dates varied by less than a week across years with the first nests being laid in the first week of May (Fig. 2). The initiation dates in northern Newfoundland and southern Labrador can vary by more than two weeks depending on sea ice and snow conditions (Fig. 3), and we chose the year with the earliest phenology to time captures realizing these may have to be adjusted based on conditions. For Maine, Québec and Nova Scotia we did not have data to estimate nest initiation dates and we relied on local knowledge to determine the appropriate timing. The proposed capture schedule is provided in Table 1.

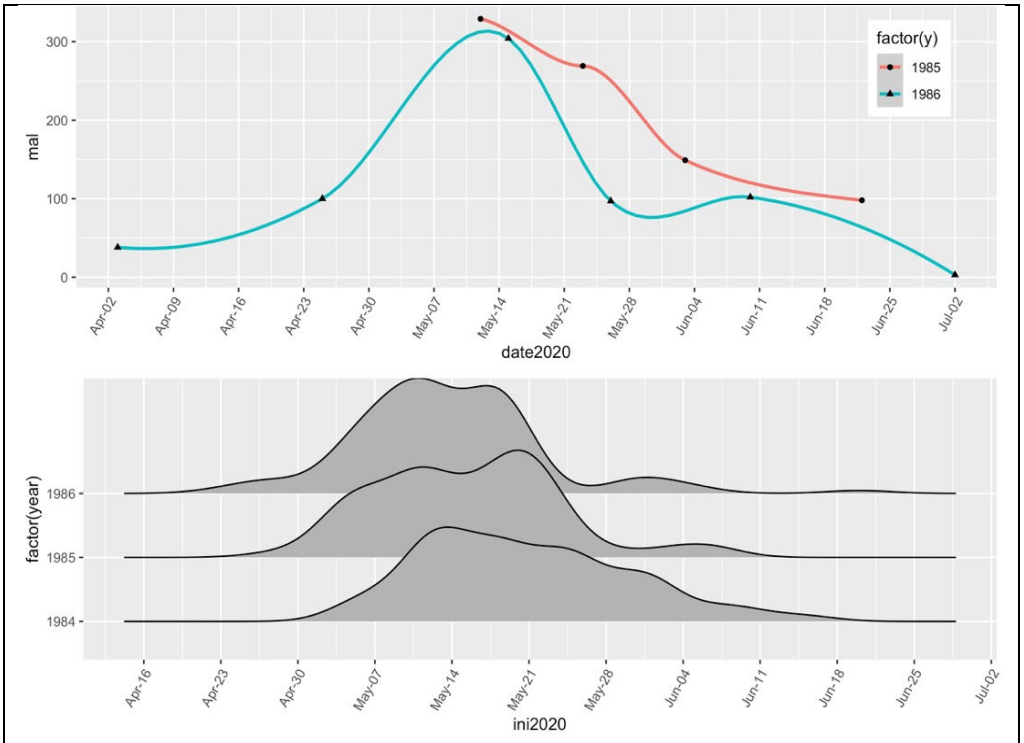

Figure 2. Index of males attending the colony and nest initiation dates for eiders nesting on Spruce Island, NB, 1984 to 1986.

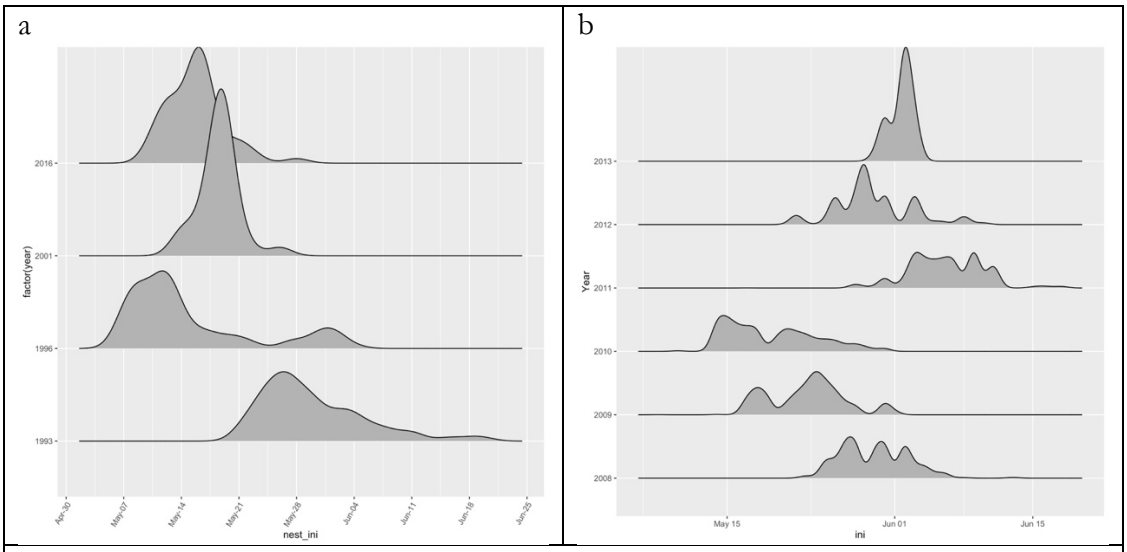

Figure 3. Nest initiation dates for eiders nesting in St. John Bay, Newfoundland (a) and Table Bay, Labrador (b).

Table 1. Capture dates for each study area.

Area	Capture Period	Year
ME	27 Apr to 7 May	2021
QC	27 Apr to 7 May	2021
NB	27 Apr to 7 May	2022
NS	22 Apr to 2 May	2022
NF	1 to 10 May	2023
LB	12 to 22 May	2023

Project Objectives:

The primary objectives for this study are to document the current rates of non-breeding and pre-breeding body condition of American common eiders across their breeding range, and to establish a large geo-spatial database from tracking data with which we will examine multiple aspects of the movement ecology of *S. m. dresseri*, but particularly their current habitat use throughout the annual cycle. Specifically, our objectives are:

1. Deploy up to 184 PTTs on adult female common eiders.
2. Develop new methodology to assess the breeding status of common eiders.
3. Estimate relative levels of breeding propensity and body condition across the breeding range of American common eider.
4. Identify the periods in the annual cycle when mortality of adult females occurs.
5. Using telemetry data to identify marine habitat use, assess marine ecosystem changes in eastern North America and identify drivers of altered abundance and habitat use by American common eiders.
6. Identify inshore benthic habitat used by common eiders to inform impact assessment and marine spatial planning processes, as well as coastal and marine protected area planning and establishment.

Preliminary Results:

Captures & Sample Collection 2023 – Captures were to commence ~25 April 2023 on Isle Gros Pot, Québec to deploy the GSM tags. The colony on Isle Gros Pot was one of the sites of the 2021 Québec deployments. In spring 2022, there were mass mortalities on the colony following an outbreak of HPAI. In addition, a red fox gained access to the colony over the winter of 20201/22 which further disrupted breeding. When opening the Duvetnor facilities at the site in late April 2023, employees reported signs of fox activity on the Isle Gros Pot colony. The purpose of the GSMs was to collect detailed location and behavioural data of nesting female eiders, and because presence of foxes usually causes large disruptions in breeding, we delayed the deployment of the GSMs until spring 2024.

In spring 2022, we attempted to capture pre-breeding females near several colonies in Southwestern Nova Scotia. For several reasons, capturing eiders in the waters surrounding the colonies was difficult. On 3 June 2022, we also visited the proposed capture sites in Labrador by helicopter. At that time, some females had already initiated clutches and access to the sites was not possible by boat due to the extensive cover of sea ice on the entire southern coast of Labrador. Due to the challenges of capturing pre-breeding females in Nova Scotia, and accessing colonies in Labrador during the pre-breeding period, we captured females off nests in Nova Scotia and Labrador in 2023. To ensure we had access to the Labrador colonies regardless of ice conditions, we used a helicopter to access the colonies.

Between 20 May and 5 June 2023, we captured 50 female Common Eiders around colonies in Nova Scotia and southern Labrador (Table 2). Female ages were determined by bursal measurements, adult males ages were based on plumage (Fig. 2b). Prior to the field season we examined bursal measurements for eiders collected at an eider colony in late April and early May in New Brunswick from 1984 to 1987 (Hicklin unpubl. data) and no birds at the colony had a measurable bursa. We were surprised to the number of females captured in Maine and New Brunswick with bursal measurements up to 25 mm in length. We are unaware of any studies that report the relationship between age and bursal measurements for Common Eiders. For now, we created a preliminary age key based on the observed distribution of bursal length from Hicklin's (unpubl. data) collections. Age classed were:

1. Bursa = 0 mm or noted as present, Adult (> 3 years old),
2. Bursa > 0 & ≤ 10 mm, 3year (not quite 3 years old),
3. Bursa > 10 & ≤ 25 mm, 2year (not quite 2 years old), and
4. Bursa > 25 mm, juvenile (not quite 1 year old).

The bursal depths in Hicklin's study were dissected out and the length measured to the nearest mm with a ruler. At least in Surf Scoters, bursal depths measured this way were 2 times longer than probed measurements (Gilliland & Savard 2021), and we suspect our probed measurements may overestimate age using Hicklin's data. Figure 3 summarizes the age-structure of the eiders that were captured. As expected, most of the birds caught around the colonies in Quebec were of breeding age. Females were caught off nests in Nova Scotia, Newfoundland and Labrador and most were adults with a few three-year-old females. The number of 2year age class females captured was very high suggesting production and survival of the Maine 2019 and New Brunswick 2020 cohorts may have been good, or there were inaccuracies with the bursal probing.

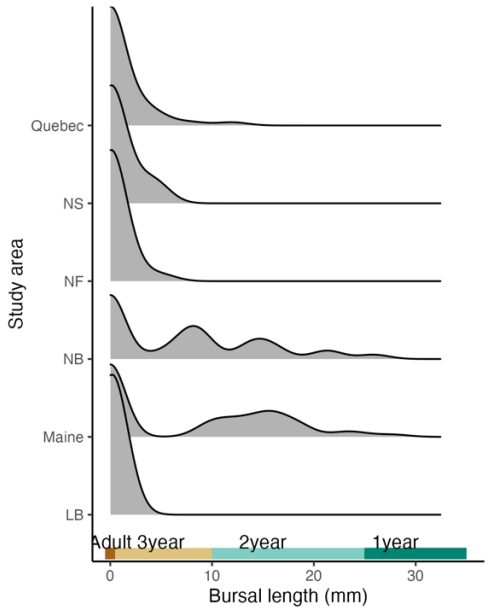

Figure 4. Distributions of probed bursal measurements from female Common Eiders captured at breeding colonies by study area.

In 2021, we collected tissue samples for contaminants, genetics, the yolk precursors vitellogenin (VTG), triglycerides, isotopes, and possibly thiamine analyses. In 2022, we collected additional samples to test for HPAI and antimicrobial markers to test for exposure to finfish aquaculture feed. In 2023, we collected all samples except the antimicrobial markers. The samples are currently stored at facilities at BRI, UQAM and Acadia University. We will eventually look for a facility to store the samples long-term. A breakdown of the sample sizes is provided in Table 3.

Table 2. Age and sex of Common Eiders caught in Maine and Quebec in 2021, New Brunswick, Nova Scotia and Newfoundland in 2022, and Nova Scotia and Labrador in 2023.

Sex	Age[1]	ME	QC	NB	NL	NS[2]	NS[3]	LB
Female	juvenile	3	0	1	0	0	0	0
	second year	28	1	8	0	0	0	0
	third year	3	8	10	6	0	6	5
	adult	33	37	12	34	5	19	20
	missing	1	0	3	0	0	0	0
Male	second year	2	0	9	0	0	0	0
	adult	63	36	25	35	3	0	0
Totals		133	82	68	78	8	25	25

[1] Preliminary estimates of age based on probed bursal measurements.

Table 3. Tissue samples collected from Common Eiders caught in Maine and Quebec, 28 April to 7 May 2021.

		Study Area					
Sex	Tissue type	ME	QC	NB	NF	NS	LB
Female	Whole Blood	68	46	31[1]	40	25	25
	Plasma	68	46	31	40	25	25
	Feathers	60	46	31	40	25	25
	Skin	29	44	28	40	25	25
	HPAI	0	0	34	40	26	25
	Antimicrobial	0	0	34	6	0	0
Male	Whole Blood	24	36	18	31	0	0
	Plasma	18	36	7	31	0	0
	Feathers	24	36	7	31	0	0

1. The crew did not have Longmire Buffer and genetic samples were collected on Whatman Cards.

2023 Deployments – In Nova Scotia we caught 25 females off nests with dip nets from a colony on Grey Island near in Shelbourne on 23 and 24 May, and from a colony on John's Island near Pubnico in southwestern Nova Scotia on 25 May. In all we deployed of 23 PTTs on eiders in Nova Scotia. In Labrador we caught 25 females off nests with dip nets from a colony on Suglo and Hidden Forest Islands in Table Bay, Labrador 5 and 6 June and deployed 25 PTTs.

Survival – The fate of females implanted with PTTs broken down by study area is summarized in Table 4. Within 60 days after release, we had three, two, three and one mortalities from the deployments in Newfoundland, New Brunswick, Quebec, Labrador and Nova Scotia, respectively. During the late winter 2023 we lost 2 transmitters deployed in New Brunswick in 2022 and 3 transmitters deployed in Maine in 2021 due to low battery voltage. Figure 5 shows the sensor data from one of the tags that the battery failed pre-maturely (PTT 212554). Sensor one, records the body temperature (a reading of 191/192 is the normal body temperature) suggesting the bird was alive at the end of the transmissions. Three in every four transmissions from sensor 3 records the battery voltage with the fourth transmission recording season cycle count (data from the season cycle is the diagonal pattern in Fig. 5 B). Late in the seasons' 4 cycle, the battery appears to fail as the voltage fall precipitously beginning in late December 2022. The last location for this bird was received on 2023-03-22 followed by a gap of several months when a final message was received on 2023-08-09. The other four transmitters had very similar patterns that suggest battery failures.

Table 4. Fate of 182 female Common Eiders tagged with PPT broken down by study area up to 19 Sept 2023.

Study Area	Alive	Data Acquisition Stop	Implant Temperature Drop	Shot	Voltage Drop	Sum
LB	20	0	3	0	0	23
ME	20	3	2	1	3	29
NB	19	2	3	0	2	26
NF	35	2	3	0	0	40
NS	22	0	1	0	0	23
QC	29	3	8	1	0	41
Sum	145	10	20	2	5	182

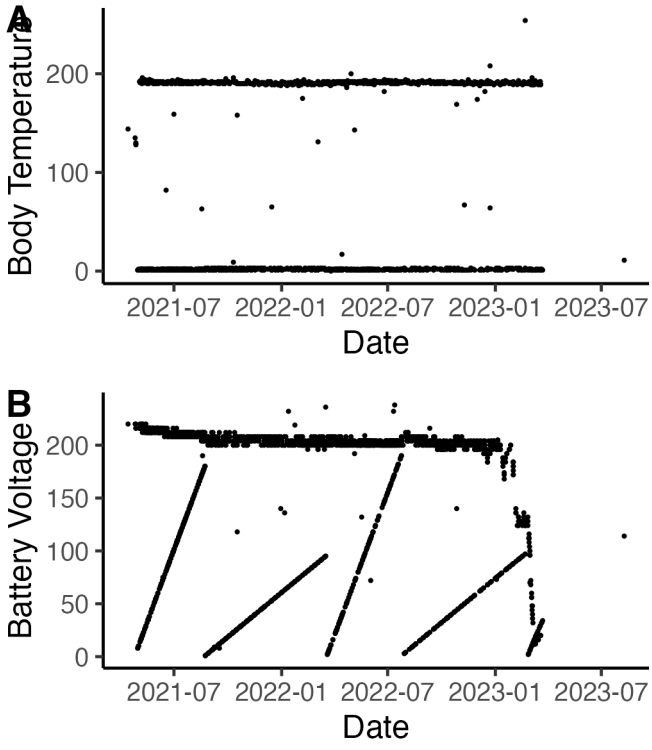

Figure 5. Sensor 1 (Body temperature; panel A) and sensor 3 (Battery voltage; panel B) readings from PTT 212554 from May 2021 to July 2023.

Figure 6 shows the fate of each bird over the life of the tag. We estimated annual survival for each full bird-year by dividing the number alive at the end of the by the number alive at the beginning of the year. We removed the initial mortalities following deployment by starting the year 60 days after deployment. We treated bird with fates of "implant temperature drop", "data acquisition stop" and

shot (Table 4) as mortalities, birds with tags that failed due to battery voltage drop were removed from the estimate in the year the tag failed.

Two of the birds tagged in 2021 were shot in the following hunting season suggesting a harvest rate of ~3% which is similar to the reporting rate estimated from band recoveries (Allen et al. 2019). We have not pulled the band recoveries to estimate harvest for the 2022 season. Confidence intervals for the survival estimates were wide and over-lapped for all year-study areas (Table 5). The data suggests survival was relatively low for females in Maine and Quebec in 2021/22 (Table 5.) and were higher in all study areas in 2022/23. Mortality rates in 2021/22 were much higher than estimated from the banding data for Maine (~0.10; Allen et al. 2019) and Québec (~0.08; Giroux et al. 2020). This may be the result of 2022 HPAI infections. Several of the females that died returned to the vicinity of the colony, and a two or three of the females may have visited nesting islands, but none of mortalities occurred on the colonies suggesting estimates of impact HPAI based only mortalities detected colonies likely underestimate the overall impact of HPAI on the population. No mass die-offs were reported for Maine, and we are uncertain what may have caused survival to be low.

Table 5. Annual survival for PTT tagged female Common Eiders estimated with the year starting at post-breeding.

Study Area	Year	Annual Survival	95% CI	
			Lower	Upper
ME[1]	2021/22	0.862	0.688	0.951
ME	2022/23	0.909	0.710	0.987
NB	2022/23	0.905	0.699	0.986
NF	2022/23	0.900	0.764	0.966
QC[1]	2021/22	0.821	0.670	0.913
QC	2022/23	0.906	0.750	0.975

1. Years with mass mortalities resulting from HPAI

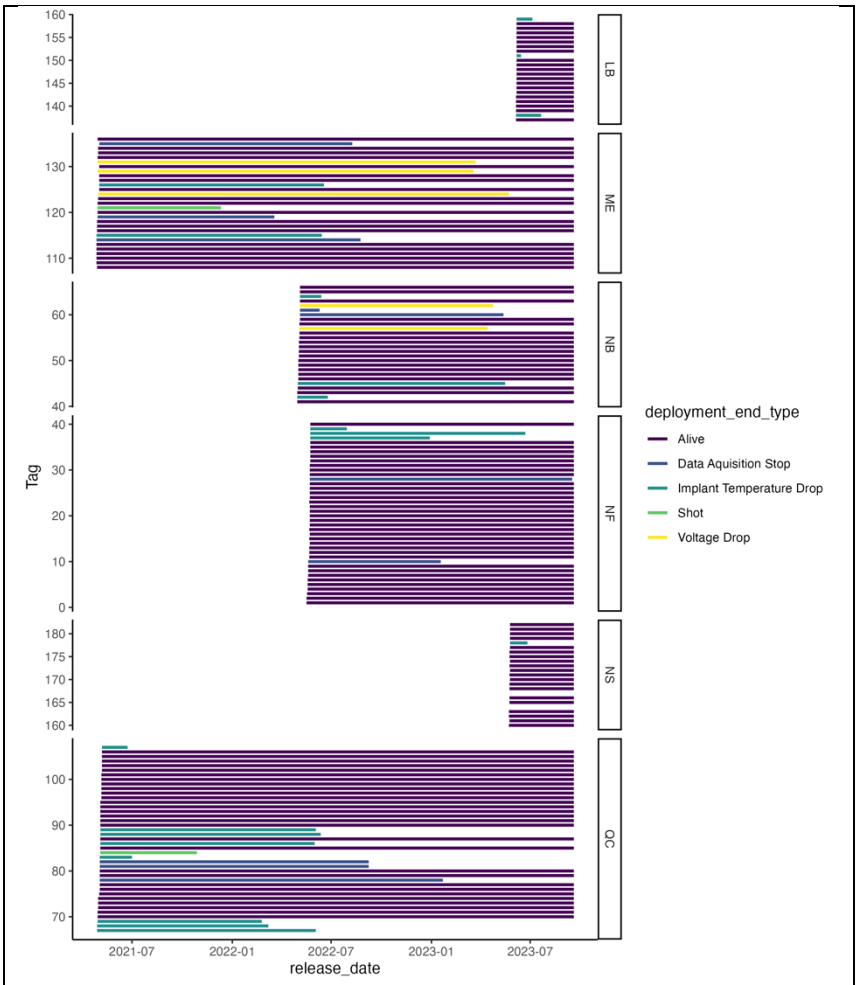

Figure 6. Fate of 182 PTT tagged Common Eiders from deployment to 19 September 2023 by study area.

Tracking – Figure 7 provides an overview of all satellite data collected during the first 3.3 years of the project. To date, the telemetry data has provided ~170,000 locations from 182 PTTs. We have not analyzed the tracking data, but with such a large volume of data, patterns are already emerging. For example, some females tagged at all breeding sites have overwintered in a relatively small area between Nantucket Island and Cape Cod. Many of the eiders breeding in the St. Lawrence Estuary, Québec used one of two migratory corridors in the fall: one route was overland crossing directly over Maine and down to Cape Cod, and a second route that is used in the fall and spring follows the coast along Maine and through the Bay of Fundy crossing into the Gulf of St. Lawrence over the isthmus between New Brunswick and Nova Scotia into St. Lawrence Estuary. Birds from Newfoundland and Nova Scotia that have migrated to the Nantucket area rapidly passed down the Atlantic coast of Nova Scotia and crossed directly to the Cape Cod area over the Gulf of Maine. The chronology of migration appears to vary across the breeding sites, with females breeding in the St. Lawrence Estuary remaining in the Gulf of St. Lawrence, while many of the females breeding in Nova Scotia and Newfoundland's depart their breeding area in the summer or early fall.

Data from the project are automatically downloaded to MoveBank (https://www.movebank.org; search for Atlantic Eider PTT), Seaturtle (http://www.seaturtle.org/) and BRI servers. Data are downloaded every 3 months in DS, DIAG and CSV formats, the data is compiled and stored on a Google Drive accessible by all project partners and saved to ECCC's servers.

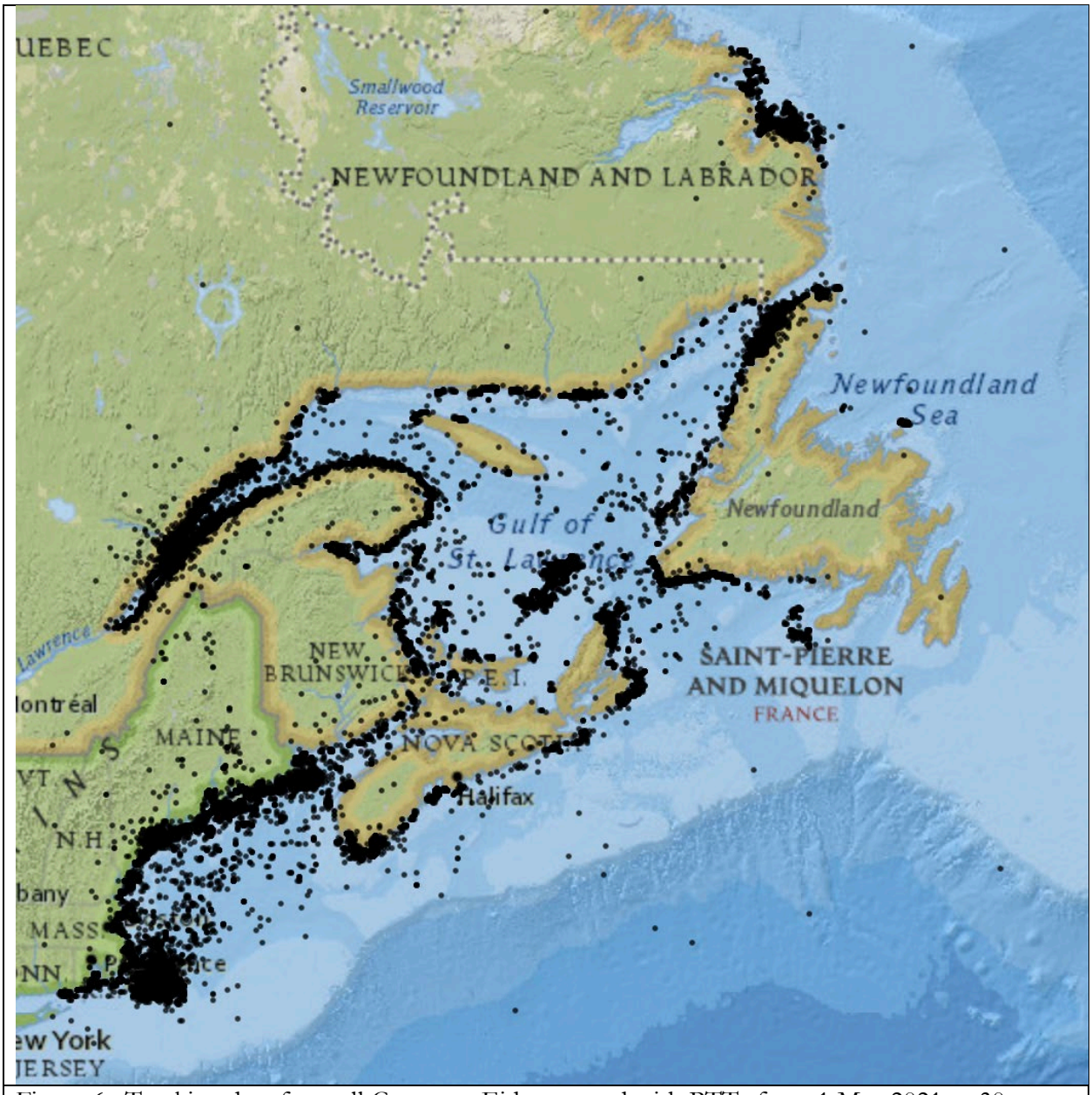

Figure 6. Tracking data from all Common Eiders tagged with PTTs from 1 May 2021 to 30 September 2023.

Project Status:

In 2021, the sample of GSMs were not deployed in Québec as the boat was sunk at the end of the project, and not deployed in 2022 or 2023 because HPAI and foxes disrupted breeding on the

colony targeted for GSM deployment, and there is a gap in deployments for birds breeding along the north shore of the Gulf of St. Lawrence, Québec, from their breeding range south of Maine, and for the wintering areas to the south of Massachusetts and in eastern Newfoundland.

1) No GSMs deployed in Québec – we have an inventory of GSM tags purchased for the 2021 field season. Consultations with Ornetila suggests the batteries in the tags should be good. We will test the tags in fall 2023 and attempt to deploy them in spring 2024.
2) CWS has received a significant amount of internal funding over FY22 and FY23 which has resulted in a surplus of SDJV funds. With the surplus in funds, we will purchase +20 PTTs to be deployed on the Lower North Shore in Quebec and up to 20 PTTs to be deployed in Rhode Island that will cover two of the gaps in coverage of the telemetry data. We also have enough surplus funds to cover the deployments of GSMs in Quebec and the PTTs in Quebec and Rhode Island.
3) In partnership with Labrador Inuit, we've made a separate proposal to deploy 25 PTTs in Northern Labrador. If successful in funding the program, these tags should fill the remaining gaps in coverage of wintering area in Newfoundland and allow us to describe the affiliations between breeding and wintering areas for most of the eiders breeding in the northwest Atlantic region.

New Components –

1) Is reported last year, we initiated a MSc student under Mark Mallory at Acadia University and Franny Buderman at Penn State. Th focus of her study is using the PTT data to classify breeding status. However, with the mass mortality of eiders resulting from HPAI infections in 2022, we've added an additional component to her study to investigate the possible affects of HPAI on survival.
2) With some additional funding from the SDJV and CWS we hired a Emile David to document the field component of the study. Emile is a videographer from Quebec and is a passionate sportsman (Emile David) who's work is focused on fishing, hunting, and traditional practices. Emile accompanied the field crew in Nova Scotia and southern Labrador.

Acknowledgements:
2023 Field Crew: Lee Millett, Shane Keegan, and Devaughn Dyson. Logistics: Glen Parsons, Sarah Gutowsky, Alix d'Entremont, Calvin d'Entremont , Regina Wells and Sara Pearce Meijerink. Veterinarians: Stéphane Lair, Benjamin Jakobek, Glenn Olsen and Kathleen McAulay. Pilot: Rich Martin.

References:

Allen, R. B., D. G. McAuley, and G. S. Zimmerman. 2019. Adult Survival of Common Eiders in Maine, Northeastern Naturalist 26, 656 671. https://doi.org/10.1656/045.026.0320

Gilliland, S.G. & Savard, J.-P. 2021. Variability in remigial moult chronology and nutrient dynamics of Surf Scoters *Melanita perspicillata*. *Wildfowl* 71: 193-220. Nov. 2021. ISSN 2052-6458. Available at: <https://wildfowl.wwt.org.uk/index.php/wildfowl/article/view/2760>.

Giroux, J.-F., Patenaude-Monette, M., Gilliland, S.G., Milton, G.R., Parsons, G.J., Gloutney, M.L., Mehl, K.R., Allen, R.B., McAuley, D.G., Reed, E.T. and McLellan, N.R. 2021. Estimating Population Growth and Recruitment Rates Across the Range of American Common Eiders. Jour. Wild. Mgmt., 85: 1646-1655. https://doi.org/10.1002/jwmg.22122