Sea Duck Joint Venture
Annual Project Summary
FY2022 (October 1, 2021 – September 30, 2022)

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: 2022 (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 will 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 2022, we had planned to deploy PTTs in Newfoundland, Labrador, and New Brunswick, however sea ice and heavy snow cover was expected to restrict access to Labrador colonies and we switched Labrador for Nova Scotia. Glen Olsen's team oversaw the New Brunswick surgeries and Stephane Lair's team the surgeries in Nova Scotia and Newfoundland. 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.

We also deployed 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.

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 capture schedule is provided in Table 1.

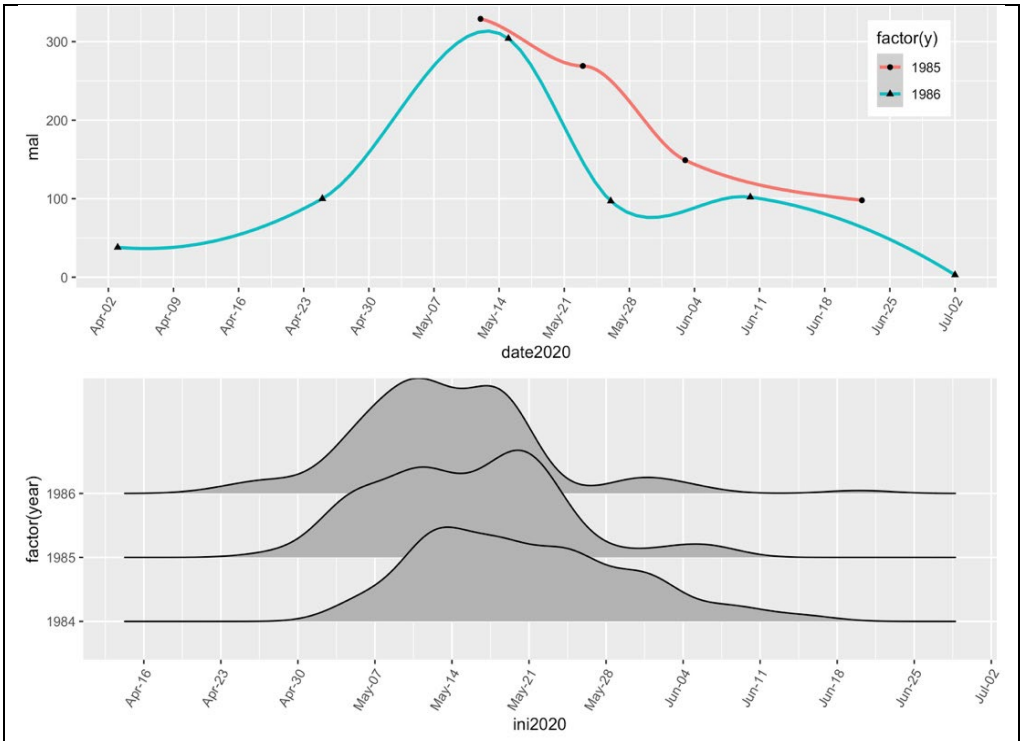

Figure 2. Index of males attending the colony and nest initiation dates for eiders nesting on Spruce Island, NB, 1984 to 1986.

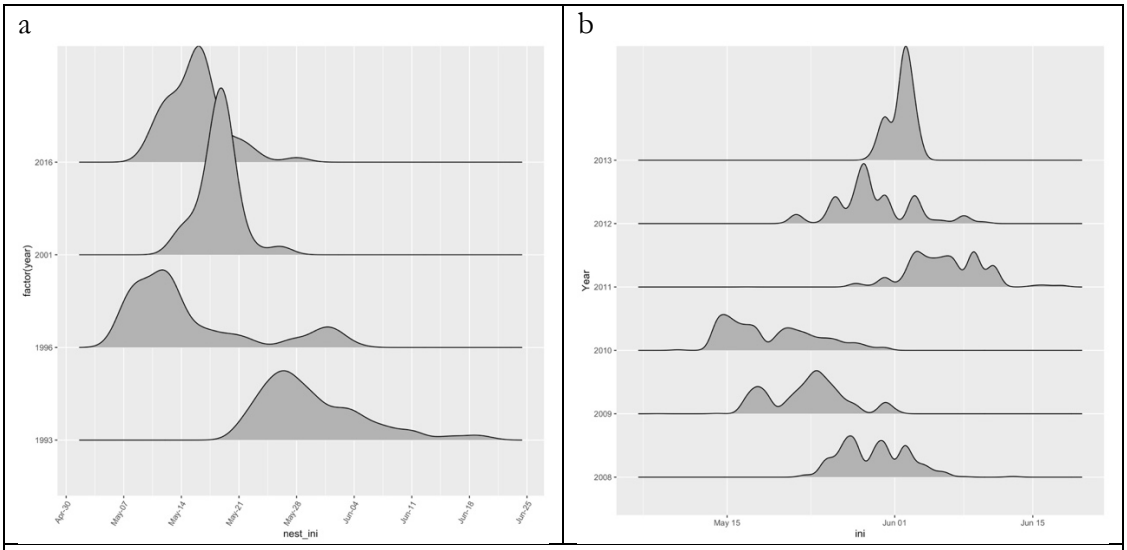

Figure 3. Nest initiation dates for eiders nesting in St. John Bay, Newfoundland (a) and Table Bay, Labrador (b).

Table 1. Proposed 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	2022

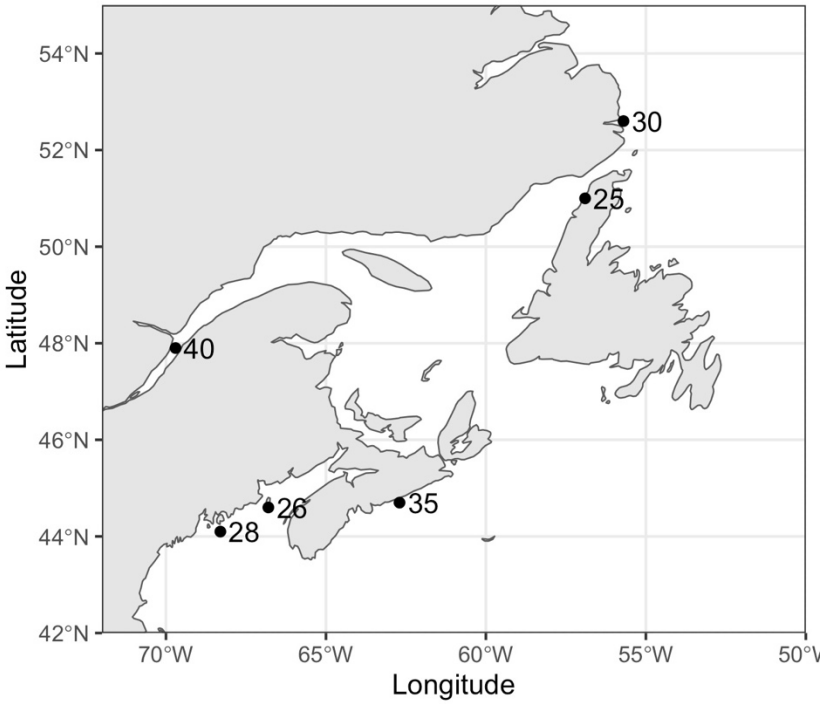

Figure 1. Study area and planned deployments of PTTs on Common Eiders.

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 2022 – Between 19 April and 24 May we captured 151 Common Eiders around colonies in New Brunswick, Nova Scotia and Newfoundland (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, 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, 1year (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; however, a large portion of the females captured were < 2 years old. 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.

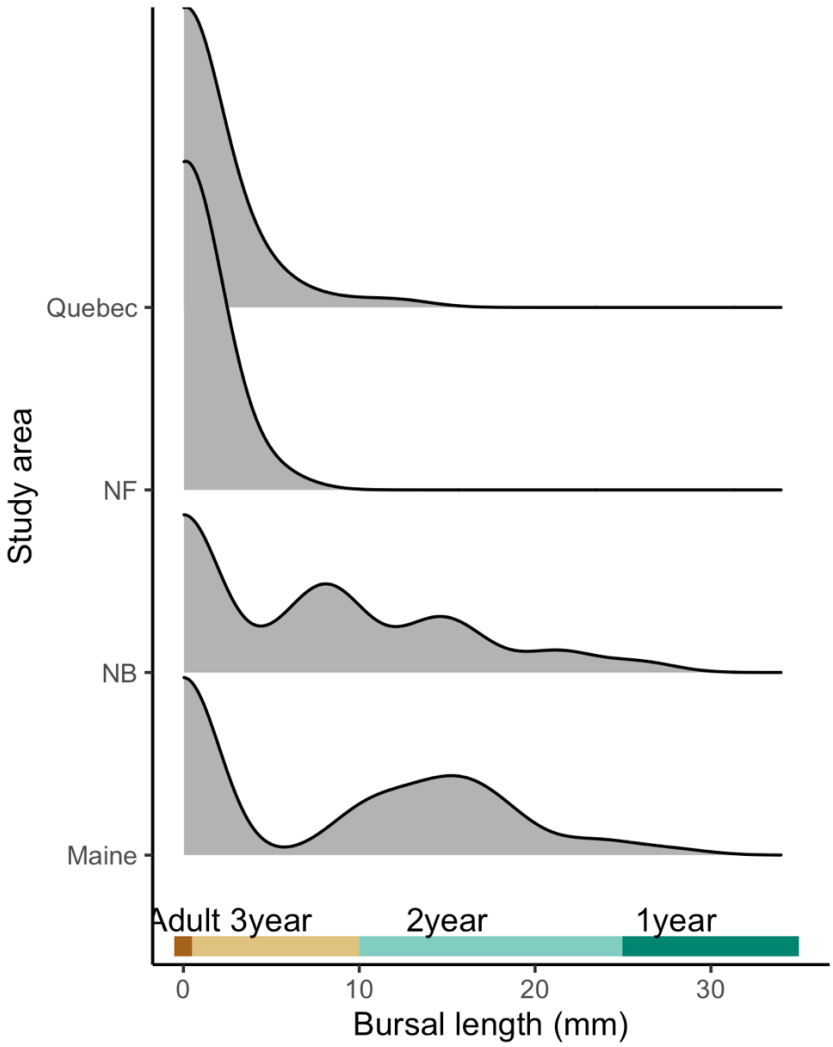

Figure 4. Distributions of probed bursal measurements from female Common Eiders captured at breeding colonies by study area.

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. 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.

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

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

[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
Female	Whole Blood	68	46	33[1]	40	0
	Plasma	68	46	31	40	0
	Feathers	60	46	31	40	0
	Skin	29	44	28	40	0
	HPAI	0	0	34	40	1
	Antimicrobial	0	0	34	6	0
Male	Whole Blood	24	36	18	31	1
	Plasma	18	36	7	31	1
	Feathers	24	36	7	31	1
	Skin	6	35	5	31	1
	HPAI	0	0	20	35	3
	Antimicrobial	0	0	19	24	1

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

Deployments –

Nova Scotia: We attempted to catch females at a single colony on John's Island near Pubnico in southwestern Nova Scotia between 20 April and 1 May. During the first week of trapping we observed less than 15 pairs in the vicinity of the colony. There were about 100 pairs in the general area that were dispersed in small foraging groups. We experienced strong westerly winds for almost the entire period we were in the area. These winds restricted net sets to the eastern side of the island which was not ideal as the water was too shallow to work the boats within 150-300 m from the shoreline. The few birds that were using the site loafed on the rocks and were not interested in the decoy set. No birds were observed on the island suggesting we were too early.

After a week of trapping on John's Island it was clear that we would not capture an adequate sample of females and we released the veterinarians to save costs. A local naturalist identified a site on Grey Island near McNutts Island in Shelbourne Bay that may have ~200 breeding pairs of eiders. We visited the colony on 28 May and flushed ~120 pairs from around the island. We trapped there the following day and deployed 2 GSMs on females. This site was not great for trapping over water as there were large North Atlantic sea swells that produced surf around most of the island.

On 2 May we returned to John's Island to evaluate timing for breeding for 2023. Few birds were using the site and we were able to capture and deploy two additional GSMs on females. We suspect we would not be able to capture enough pre-breeding females to fill the sample size at these sites.

New Brunswick: In New Brunswick, we captured females around several colonies in the Grand Manan Archipelago. Thirty-four females and 34 males were captured between 30 April and 6 May, and PTTs were deployed on 26 females and GSMs on 2 females. Additional PTTs and GSMs were available to deploy, but the crew had to leave for another project. Due to a lack of equipment and supplies, genetic samples were collected on Whatman cards instead of stored in Longmire buffer, no wing measurements were taken, and few males were measured or sampled.

Labrador: Conditions in Labrador were not ideal for boat travel and trapping as there was heavy snow cover and sea ice on the west coast of northern Newfoundland and southern Labrador during late March and April. Sea ice was expected to impede access to islands and make it difficult to set over-water mist nets and we opted to run Northern Newfoundland instead of Labrador in 2022. On 5 June 2022, we visited Cartwright and colonies on Table Bay, Labrador to assess conditions. A band of sea ice was still sitting 3-5 km of the coast which would make the +50 km boat run to Table Bay difficult. When we visited the colony in Table Bay, 100's of females were already sitting on eggs and the inner part of the Bay had been ice free for some time.

Newfoundland: The proposed capture dates for Newfoundland was 1 to 10 May. However, on 15 April there were still >2 m of snow in the St. Genevieve Bay area and locals felt there would be a delayed snow melt. In addition, there was heavy sea ice on the north coast of the Great Northern Peninsula blocking access to the colonies. We checked sea ice conditions daily on St. Genevieve Bay from 3 – 11 May and sea ice was leaving the bay on 11 May and we started catching birds on 15 May. We trapped for several days, and it was quickly apparent that the females were able to access the colony and initiate nesting in early May despite the sea ice and deep snow cover – we were catching mostly males and the females we were catching had well developed brood patches or were carrying oviductal eggs. As we had missed the pre-breeding period, we switched to catching hens off the island using mist and dip nets. We deployed a total of 40 PTTs. We did not deploy GSMs as most hens had already initiated breeding.

Survival – We lost two PPT tagged birds in Québec, two in New Brunswick and one in Newfoundland within 40 days of deployment and these early mortalities were removed from subsequent summaries. From the Quebec and Maine deployments in 2021 we have data for a complete annual cycle (Fig. 5). Two of the tagged birds were shot for a harvest rate of ~3% which

is similar to the reporting rate estimated from band recoveries (Allen et al. 2019). Up to mid-February we did not lose additional birds and survival was very high (~0.97). However, from spring migration through breeding and brood-rearing/moulting, we lost 8 additional birds from Quebec and 4 birds from Maine resulting in very low annual survival rates (0.82; CI 0.63-0.94 and 0.76; CI 0.60-0.89 in Maine and Québec, respectively). Mortality rates are 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. At least three colonies in Québec experienced mass die-offs of eiders from infections of HPAI. Most of the birds tagged in Québec were captured around the colony on Isle Gros Pot, where an estimated 11% of the females nesting on this colony may have died from HPAI (ECCC unpubl. data). No mass die-offs were reported for Maine, and we are uncertain what may have caused survival to be low.

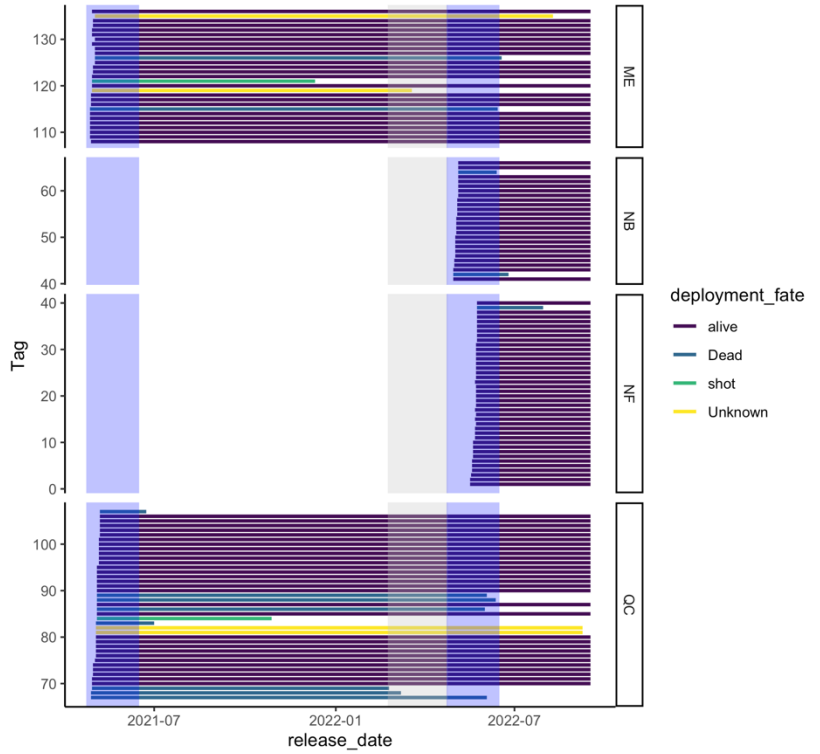

Figure 5. Fate of 136 PTT tagged Common Eiders from deployment to 20 September 2022 by study area. The blue bars roughly identify the nesting period and grey bar the period when spring migration occurs.

Tracking – Figure 6 provides an overview of all satellite data collected during the first 1.3 years of the project. We have not analyzed the tracking data, but with such a large volume of data, patterns are already emerging. For example, most females tagged in Maine and Québec overwintered in a relatively small area between Nantucket Island and Cape Cod, and some females tagged in Northern Newfoundland in 2022 had already migrated to this area by mid-September. Many of the eiders breeding in the St. Lawrence Estuary, Québec using one of two migratory corridors over Maine during the fall, and most females returned to their breeding area in spring using a coastal route through the Bay of Fundy crossing into the Gulf of St. Lawrence over the isthmus between New

Brunswick and Nova Scotia. Birds from Newfoundland 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.

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.

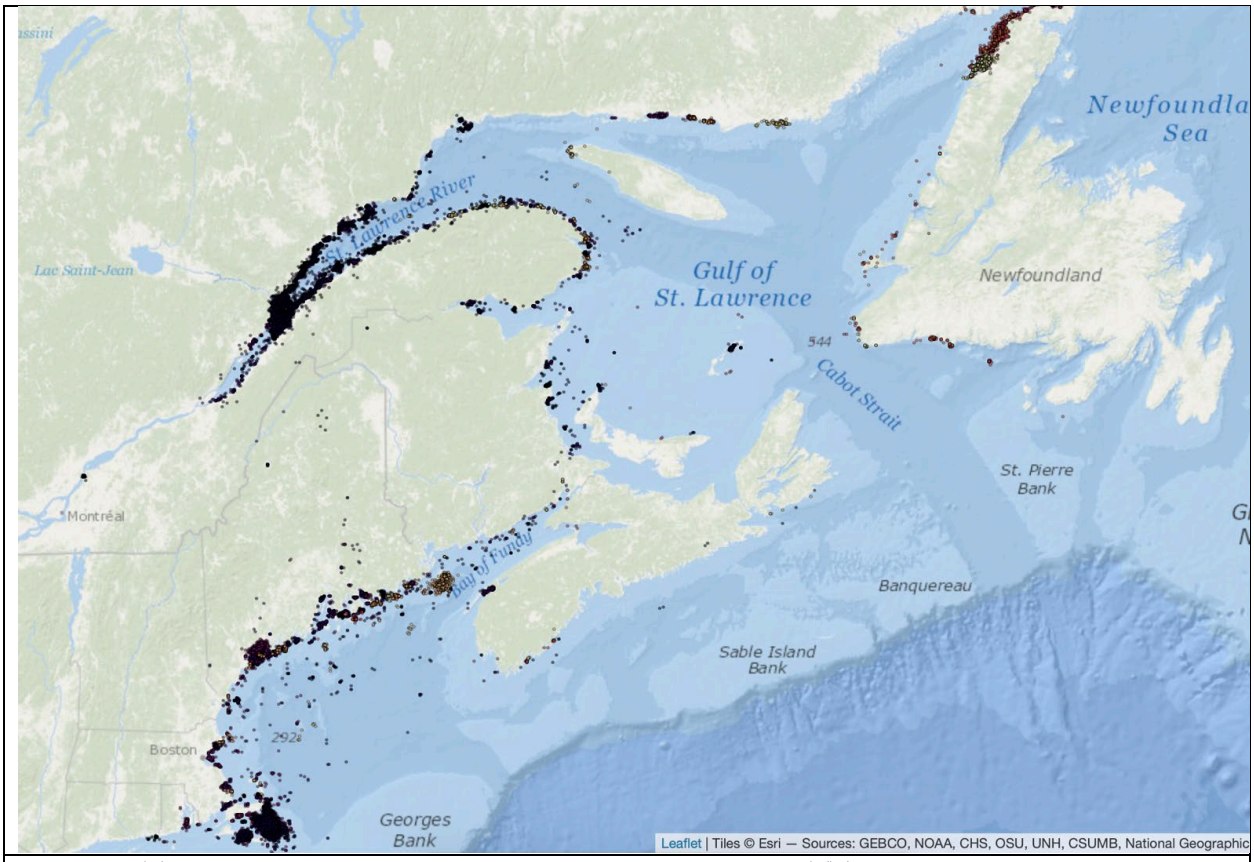

Figure 6. Tracking data from all Common Eiders tagged with PTTs from 1 May 2021 to 20 September 2022.

Project Status:

Similar to 2021, there were many challenges that had to be overcome to deliver the field program in 2022. Border restrictions between Canada and the USA, and within Atlantic Canada had been removed, but many Covid-19 protocols remained in place. In addition, HPAI imposed many more protocols and restrictions on the project.

There are seven items that will need to be evaluated/addressed: 1) in 2021, the sample of GSMs were not deployed in Québec as the boat was sunk at the end of the project, 2) no PTTs were deployed in Nova Scotia, 2022, 3) wing length was not collected from females and little data collected on males in New Brunswick, 4) birds in Newfoundland were captured after nests were

initiated, 5) there is a gap in deployments along the north shore of the Gulf of St. Lawrence, Québec, 6) HPAI and fox in Québec colonies in 2022, 7) sea ice conditions in Labrador.

1) No GSMs deployed in Québec – we will attempt to run a field crew in the St. Lawrence Estuary, Québec in 2023 to deploy GSMs.
2) No PTTs were deployed in Nova Scotia, 2022 – we will have to return to Nova Scotia in 2023 to deploy PTTs. Our experience in 2022 suggests capture of an adequate sample of females during the pre-breeding season will be difficult as colonies are small and widely distributed, and the North Atlantic sea swell create a large surf zone around many of the islands making over-water trapping impossible. We may attempt to capture birds in the winter or in mid-incubation in spring of 2023. We covered the cost for BRI to deploy in New Brunswick using ECCC funds in 2022 which leaves the SDJV funds available for 2023 deployments.
3) Wing length was not collected from females and little data collected on males in New Brunswick. Missing wing lengths from New Brunswick birds will mean that we cannot use wing in any comparison of body condition across study areas, and we will not be able to evaluate condition for males from New Brunswick.
4) Birds in Newfoundland were captured after nest initiation which will prohibit the use of VTG to evaluate breeding status for this site.
5) Gap in deployments along the north shore of the Gulf of St. Lawrence, Québec – C. Lepage has secured funding for the purchase of 15 additional PTTs to deploy on the North Shore and brought in Parks Canada as a new partner to help with deployments. We still need to raise funds for deployment costs and ARGOS Data.
6) 2022 was the first year to measure breeding status for the females tagged in Maine and Québec in 2022. In 2021 we tagged birds on Isle Gros Pot in Québec, and in 2022 there was a mass die-off of females from infections of HPAI and a red fox was present on the colony. Mortality of females was also high during the 2022 breeding period for the sample of females tagged in Maine in 2021 and conditions may not have been ideal to estimate rates of non-breeding at these sites.
7) There is likely to be sea ice on the Labrador coast during the pre-breeding period. This will restrict regular travel by boat and limit ability to maintain over-water mist nets. We plan to work from an old Ducks Unlimited camp in Table Bay with the veterinarians setup in Cartwright (Fig. 7). It is ~50 km run from Cartwright to Table Bay by boat and it can be difficult to make this run on a regular basis when there is sea ice. We've chosen this site as the Labrador Current moves sea ice down the Labrador coast and the inner part of Table Bay remains ice free, even during periods of onshore winds. To ensure access to the colonies we will move equipment (zodiacs, decoys, outboards and fuel) to the camp by skidoo in the winter. Depending on snow conditions, travel to Table Bay from Cartwright may be possible by skidoo during the pre-breeding period. We will base a helicopter in Cartwright, and the helicopter will be used to transport birds and equipment between Table Bay and Cartwright. If it is not possible to work the over-water mist nets, we will capture females off nests during incubation.

One of our major challenges has been capture of females during the pre-breeding period using over-water mist nets. It is possible as the crews in Maine, New Brunswick and Québec have demonstrated. However, it can be difficult in areas where there is sea ice, number of breeding birds are small or where there are no appropriate geographic features for setting the net (e.g. protected coves and points, water depths to run boats, etc.).

The primary purpose to capture birds pre-breeding was not to bias the sample of birds tagged to successful breeders, and to evaluate the use of VTG levels for assessment of breeding status. In Nova Scotia there were only a small number of birds attending the colony and these birds were not foraging but spent most of their time hauled out and loafing on rocks. They were not interested in the decoy set and the only birds that we captured were flushed from the shoreline and herded then driven into the net. There are specific situations where capture of females on arrival to the colony is relatively easy; however, it has been difficult or requires a significant effort to capture an adequate sample to assess breeding status using VTG at the level of the population.

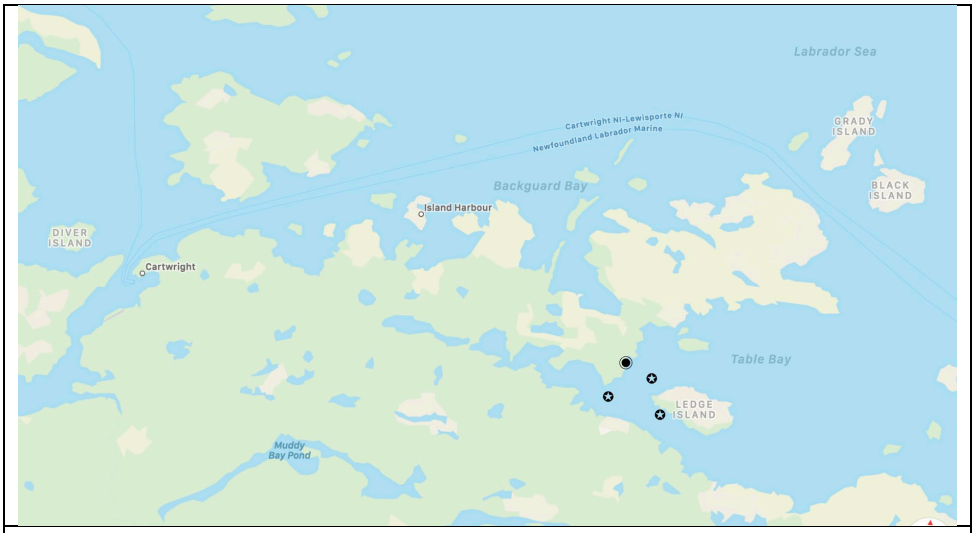

Figure 7. Proposed site for captures in Labrador in 2023, and locations of DU cabin (◉) and easily accessible eider colonies (✪).

New Components –

1) In 2022, we initiated a MSc student under Mark Mallory at Acadia University and Franny Buderman at Penn State. She will focus her studies on using the PTT data to classify breeding status. We've raised an additional $45K CAD for this component
2) We are looking for someone to take on modelling habitat use across the populations range. We are in discussion with DUC and IWWR to take the lead on this component. ECCC has set aside $40K CAD for this component.

Acknowledgements:
Field Crew: Lee Millett, Asha Grewal, Stephanie Avery-Gomm, Josh Cunningham, Mark Maddox, Jessie Wilson, Kristine Hanifen, Dustin Meattey, Sarah Wong and Devaughn Dyson. Logistics: Mark Mallory, Glen Parsons, Sarah Gutowsky, Alix d'Entremont, Calvin d'Entremont, Soni Gatta, Curt Chambers and Wayne Barney. Veterinarians: Stéphane Lair, Jalenques Marion, Julie Pujol, Glenn Olsen, Juliette Raulic and Benjamin Jakobek.

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