Gulf of Maine Seabird Working Group (GOMSWG) 39th Annual Summer Meeting Report

Meeting held virtually and in-person at Hog Island Audubon Camp, Bremen, ME, on August 11, 2023

Visit the website: gomswg.org

Contents

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Introduction

The Gulf of Maine Seabird Working Group (GOMSWG) is a collaborative effort among state and federal agencies, universities, non-governmental organizations, and private citizens that have been working to monitor, manage, and restore populations of colonial nesting seabirds in the Gulf of Maine for over 35 years. Despite this combined effort, many seabird populations still face significant threats and challenges from predators, declining availability of prey species, climate change, sea level rise, human disturbance, invasive species, and threats during migration. Many of the management agencies are also facing declining budgets that challenge our ability to manage the colonies. It is through our combined effort and sharing of knowledge that seabirds stand the best chance of overcoming the challenges they now face.

Meeting activities included summaries of island activities, reported in geographical order from Massachusetts north to Canada, and a series of short research presentations in the afternoon. A table with 2023 GOMSWG census results will be distributed concurrently with this report and/or made available at the GOMSWG website (gomswg.org).

Island and Site Reports

Massachusetts

Preliminary Massachusetts Seabird Numbers

Carolyn Mostello, MassWildlife
19 September 2023

In Massachusetts, about 100 sites typically support breeding Roseate Terns (*Sterna dougallii*), Common Terns (*Sterna hirundo*), Arctic Terns (*Sterna paradisaea*), Least Terns (*Sternula antillarum*), Black Skimmers (*Rhynchops niger*), or Laughing Gulls (*Larus atricilla*). Based on preliminary data, these seabirds were distributed among Massachusetts' regions in roughly the following distributions. (The Gulf of Maine includes the North Shore, South Shore, Lower Cape, and some of the Upper Cape region.)

2023 Region	**Roseate Tern**	**Common Tern**	**Arctic Tern**	**Least Tern**	**Black Skimmer**	**Laughing Gull**
North Shore	0	22	0	377	0	0
South Shore	0	2	0	341	0	0
Upper Cape	0	5	0	690	0	0
Lower Cape	39	19,589	0	1,095	0	6,641
Buzzards Bay	3,540	6,746	0	308	0	0
Elizabeth Is.	18	1,594	0	73	0	0
Martha's Vineyard	34	364	0	529	22	0
Nantucket	1	189	0	153	0	0
2023 TOTAL	***3,632***	***28,511***	***0***	***3,565***	***22***	***6,641***
2022 TOTAL	*3,170*	*27,000*	*0.5*	*4,131*	*23*	*5,200*
% change	14.6	5.6	-100.0	-13.7	-4.3	27.7

Bird I. and Ram I., Buzzards Bay. The Massachusetts Division of Fisheries and Wildlife protected, managed, and monitored Common Terns and Roseate Terns on Bird and Ram Islands in Buzzards Bay. The number of nesting Common Terns increased 12.0% to 3,085 pairs on Bird and 17.9% to 3,650 pairs on Ram. Roseate Tern numbers decreased 3.7% to 1,956 pairs on Bird but increased by 69.6% to 1,584 pairs on Ram, the highest count on record. Productivity was fair to good for Common Terns (0.80 fledglings/nest on Bird and 1.05 fledglings/nest on Ram) and fair to good for Roseate Terns (1.07 fledglings/nest at Bird and 1.37 at Ram). Great Black-backed Gulls on Bird and

Black-crowned Night Herons on Ram preyed on eggs and chicks, slightly impacting productivity. Over a period of about two weeks, a mink killed or injured approximately 90 terns, mostly Roseates.

Penikese I., Buzzards Bay. The Massachusetts Division of Fisheries and Wildlife protected, managed, and monitored terns on Penikese Island in Buzzards Bay. Common Terns slightly decreased (1.8%) to 1592 pairs. Roseate Terns decreased 53% to 18 pairs. We did not see or hear any Arctic Terns. Common Tern nesting success appeared to be very good, despite predation: hatching success was 79.3%, fledging success was 86.5 %, and productivity was 1.89 fledglings/nest. Roseate Tern nesting success was high: hatching success was 81.2%, fledging success was 96.9 %, and productivity was 1.34 fledglings/nest. An estimated 99 pairs of Great Black-backed Gulls and 791 pairs of Herring Gulls nested. Mean clutch size for Herring Gulls was 2.8 eggs/nest and hatching success was 82.5%. Mean clutch size for Great Black-backed Gulls was 2.85 eggs/nest and hatching success was 86%.

Monomoy National Wildlife Refuge

Eileen McGourty, Fish and Wildlife Biologist - USFWS
Heather Williams, Zoe Bates, Sara Rodrigues, Jameson Brenner, Biological Interns – ACE for USFWS

Minimoy Island

Tern Census

In 2023, seventeen visits were made to the island. The first visit was on April 27th prior to the arrival of terns. The last visit was on August 6th A census was completed on June 16 and a total of 47 common tern nests with eggs were counted. This is a significant decrease in nesting pairs compared to 2022 which had 334 pairs. No productivity data was collected for terns on Minimoy, though the island was visited 9 times after the census was complete and no productivity was noted. One laughing gull nest and one herring gull nest were counted during census while no black-backed gull nests were noted. One Roseate tern was seen flying above during census.

Table 1. Number of tern nests found during census window on Minimoy from 2019-2023. Numbers in parentheses reflect nests found outside of the census window.

Year	COTE	ROST	LETE	LAGU
2019	1	0	0	Not documented
2020	2	0	0	Not documented
2021	80*	0	0	Not documented
2022	334	0	0	1
2023	47	0	0	1

*Based on a flush count of 100 common terns on June 17th and adjusted with 0.8 correction factor.

Black Skimmer

No black skimmers were observed attempting to nest on Minimoy this year, but at least 4 individuals were observed in the area several times.

North Monomoy Island

Tern Census

In 2023, North Monomoy Island was visited 10 times between April 13th and September 5thth. No official census was done during the June 5-20th window but visits on May 31 and June 30 had no nesting terns. It is suspected that no terns nested on North Monomoy in 2023. No nesting skimmers were noted either.

Table 2. Number of tern nests found during census window on North Monomoy from 2019-2023. Numbers in parentheses reflect nests found outside the census window.

Year	COTE	ROST	LETE
2019	No census	No census	No census
2020	No census*	No census*	No census*
2021	0	0	0
2022**	0	0	0
2023	No census	No census	No census

*Census not conducted due to the COVID-19 pandemic.

** Count occurred on June 22, outside the official census window of June 5-20.

Gull Census

In 2023, though great black-backed gulls and herring gulls were observed nesting on North Monomoy, gull nests were not counted this field season. Gull census is typically conducted every five years with the most recent census completed in 2018. The Atlantic Coast states have planned the coordinated waterbird survey for 2023-2024, Massachusetts will be completing their census in 2024.

Wading Bird Census

In 2023, a wading bird census was not conducted on North Monomoy Island. No nesting wading birds were noted on the island during a May 31 visit when historical nesting areas were scanned for wading birds. Though no nesting wading birds were observed, several snowy egrets were noted feeding in the marsh. The wading bird colony that had last been censused on North Monomoy in 2019 has moved to South Monomoy Island. Changes to habitat and the presence of coyotes on North Monomoy Island may have impacted this colony. Coyotes had a constant presence on North Monomoy again during the 2024 season and control was conducted between April 7 and June 25 with a total of 7 predator control visits and the removal of two adult male coyotes. Due to continued shoaling on the east side of North Monomoy, coyotes easily moved between North Monomoy Island, South Beach, and South Monomoy Island.

Table 3. Number of wading bird nests found on North Monomoy from 2019-2023 during census window.

Year	BCNH	GREG	SNEG	GLIB
2019	252	48	94	0
2020	No census*	No census*	No census*	No census*
2021	No census*	No census*	No census*	No census*
2022	0	0	0	0
2023	No census**	No census**	No census**	No census**

*Census not conducted due to the COVID-19 pandemic.

**Census not conducted due to lack of nesting birds observed on May 31. Colony moved to South Monomoy Island.

South Monomoy Island

Tern Census

Common Terns

In 2023, we were once again able to conduct a complete census of terns on South Monomoy Island. Refuge staff and volunteers conducted the census June 6th to the 9th. The nesting area is delineated into 60m^2 grids, and all nests were tallied by grid number. The total raw nest count was 19,132. We used a Lincoln Index of 1.02 to adjust our raw count to 19,515. The Lincoln index used was the 5-year average; no Lincoln Index was conducted this year. The raw count of 360 nests from the productivity plots counted during census was added to the Lincoln Index adjusted total for a final estimate of 19,875 nests on South Monomoy Island. A B-census was not conducted; however, based on the number of nests initiated in productivity plots after June 20th, we estimated there to be an additional 3,174 nests in the colony during the B-period.

Roseate Terns

Forty pairs of nesting Roseate Terns were counted during the A-census window and 6 during the B-period on South Monomoy Island. Of the 46 pairs monitored, 2 were found with chicks, and 44 had eggs or a combination of eggs and chicks. Of the 68 eggs observed, at least 42 hatched. A total of 36 chicks fledged according to GOMSWG

standards, and two of these were from B-period nesters. Forty-six is the highest recorded number of Roseate Tern nests on South Monomoy Island.

Least Terns

In 2023, a least tern census was completed by plover monitors over several days. A total of 611 nesting least terns were counted in 5 separate colonies this year. The largest colony was at the connection area at the northeastern end of the island with a total of 500 incubating adults estimated on June 12th. A total of 946 least tern were counted in the connection during the census, but the number of incubating adults was not counted. It was estimated that 500 pairs of least tern were nesting in this area. The next largest colony was found on the south tip of the island at 49 incubating adults counted on June 16th. The colony just north of Powder Hole with 17 incubating adults was also counted on June 16th. The colony at the Lighthouse Landing was counted on June 16 and 17 with a total of 7 incubating adults. A new colony was found on the east side of the Overwash with 38 incubating adults. Productivity of least terns was not monitored but qualitative observations show poor productivity in the connection area due to overwash and predation issues, poor productivity at the Lighthouse Landing site, fair productivity at Powder Hole and good productivity at the south tip and east side of the Overwash. Predation and over wash from storm events continue to significantly impact these colonies. No B-period census was conducted.

Laughing Gulls

Laughing gulls nest within the common and Roseate tern colony on the north tip of South Monomoy Island. Due to limited management over the past several years the laughing gull population has expanded within the colony, competing for nesting space and food resources with nesting terns. This year laughing gull nests were destroyed within 13 grids throughout the colony to reduce the laughing gull nesting population on the island. The grids chosen for destruction had high numbers of both laughing gull and common tern during the 2022 census. These 13 grids were managed for laughing gull nests three times over the course of the nesting season. The first round of nest destruction occurred on May 30th and 31st, prior to the gull and tern census. Because of this our laughing gull census number of 7,751 is an adjusted number. It was determined based on the clutch size of nests destroyed with the assumption that 1 and 2 egg clutches would have laid continuation nests which would have been counted during census but that pairs with a 3-egg clutch or larger would not have had enough time to renest. With that assumption we added an additional 1,447 pairs as 58% of the 2,495 nests destroyed had clutches ≥ to 3 eggs.

Table 4. Number of tern nests and laughing gull nests found on South Monomoy from 2019-2023. Numbers in parentheses reflect nests found outside the census window.

Year	COTE *	ROST	LETE	LAGU
2019	14343	4 (8) ***	12**	3659
2020	No census	0 (4)***	39***	No census
2021	No census	5 (5)***	619	No census
2022	18026	18 (4)	595	5200
2023	19875	40 (6)	611	7751****

*Adjusted estimate based on Lincoln Index.

**It is estimated that there were 268-285 pairs of least terns present during the census window prior to the official June 20th count but abandoned most nesting attempts due to predator activity.

***Full census not conducted due to limited staffing. Numbers represent a minimum number of pairs.

****Adjusted laughing gull census number due to nest destruction prior to census.

Wading Bird Census

The wading bird colony moved back to South Monomoy Island from North Monomoy Island between 2020 and 2021, years when no census occurred due to the COVID pandemic. The colony is located just south of the tern colony and north of Powder Hole. In 2023, the wading bird census was conducted on South Monomoy Island on May 24th. A total of 236 black-crowned nigh-heron, 74 great egret, 161snowy egret and 30 glossy ibis nests were counted. This represents a 54% increase in the number of nesting great egrets, 71% increase in nesting snowy egrets and a 6% decrease in the number of black-crowned night-herons. The number of nesting glossy ibis has more than doubled since 2022. A pair of yellow-crowned night-herons is suspected to have also nested in the colony but could not be confirmed.

Table 5. Numbers of nesting wading birds on South Monomoy Island from 2019-2023.

Year	BCNH	GREG	SNEG	GLIB
2022	246	54	110	12
2023	236	74	161	30

Productivity

Common terns had above average productivity in 2023, fledging an average 1.36 chicks per nest attempt. This number is above the long-term average of 1.24 chicks fledged per nest. Productivity success was based on 407 A-count nests that were monitored in 35 fenced productivity plots.

Roseate Terns had average productivity in 2023, fledging an average 0.85 chicks per pair for A-period nesters, this is in line with the long term average of 0.82 fledglings per pair but still below the goal of 1 chick fledged per nesting pair for the refuge. Average clutch size was 1.58 eggs per nest attempt with an average of 1 egg hatched per nest attempt. Productivity was likely impacted by black-crowned night herons frequently seen within the colony.

Table 6. Breeding parameters for common and roseate terns on South Monomoy Island in 2023 during the A-period.

Species	Clutch size	Hatching success	Fledging success	Productivity (fledglings/nest)	Nests monitored
COTE	2.56	79.3%	67.2%	1.36	407
ROST	1.58	63.3%	82.9%	0.85	40

Tern Provisioning

Staff conducted a total of 10 hours and 54 minutes of feeding stints from June 18th to July 19th. Stints were typically an hour long, but two stints were cut short due to inclement weather between June 18th and June 22nd. Prey item, length, and recipient were recorded throughout each stint. Refuge staff recorded 99 total feedings during about 11 hours of observation. The average recorded length of prey items was 1.47 culmen lengths which was down from 2.2 in 2019, but similar to the average of 1.32 in 2022. Sand lance was the most common prey item, constituting 76.77% of the items observed. Other delivered prey items included herring (7.07%) and shrimp (15.15%), with only 1 feeding of an unknown item. More feeding stints would have been beneficial but were not performed due to time constraints and limited staff.

Table 7. Principal prey items (percent) in common tern chick diet on South Monomoy Island in 2023.

Prey Item	# of Feedings	Percentage
Sand Lance	76	76.77
Shrimp	15	15.15
Herring	7	7.07
Unknown	1	1.01

Laughing Gull Kleptoparasitism

Stints were continued this year to monitor the number of kleptoparasitism attempts made by laughing gulls on common terns. A total of 31 kleptoparasitism stints were conducted throughout the colony this year between June 10th and August 6th, totaling 30 observational hours. Events of kleptoparasitism were recorded during all except 4 of the 31 stints. A total of 397 kleptoparasitism attempts were observed, with an average of 12.8 attempts per hour. Results show that laughing gulls were successful 57.43% of the time, common terns were successful 22.67% of the time, items were dropped 2.52% of the time, and the outcome was unknown 17.38% of the time.

Predator Activities and Control Efforts

In 2023, staff placed game cameras within the colony to assist with identifying predators. This was done as time allowed and did not follow a standardized protocol for deployment location or timeframe, though camera settings were identical. Cameras were deployed starting on June 10th and the final camera was retrieved on July 30th for a total of 66 trap nights. Cameras were most commonly deployed near productivity plots but were also placed on

beaches around the colony or at certain sights where predator presence was suspected. The most common predator caught on camera was black-crowned night heron with 30 photos, followed by coyote with 16 photos, Norway rat with 4 photos, and laughing gull with 1 photo. Both adult and juvenile black-crowned night heron were caught on camera, indicating the possibility that adults are teaching their offspring to hunt in the tern colony. Additional predators in the colony were northern harrier, greater black-backed gull, herring gull, grackle, red-winged blackbird, bald eagle, and peregrine falcon.

Coyotes were seen on the island throughout the nesting season and inside the colony once hatching began. At least one pair of coyotes denned on the island. The den was removed along with a total of 6 adults between April 8th and June 23rd. In addition to coyote control, 2 adult greater black-backed gulls and 2 adult herring gulls were removed from within the colony. This year was the first time staff confirmed the presence of rat on South Monomoy Island. Many dead adult terns were found stashed in bushes where rat burrows were found. A total of 6 rats were removed from the colony but sign of rat has now been documented through the island. Laughing gull nests within the colony were also destroyed. A total of 6,906 nests were removed from 13 grids within the colony between May 30 and July 16. The majority of nests were renests as nest destruction was conducted three times within the same 13 grids during the season. Common terns moved into these grids after laughing gull nests were removed. Herring gull and greater black-backed gulls nests within the colony were also destroyed between May and early July with 116 and 275 nests removed respectively.

Avian Influenza

Avian influenza did not seem to be an issue in the colony this year though we did sample several birds we found freshly dead. Our first sample was taken on May 25th and our last sample was on August 1st. We sampled 13 common terns, 1 roseate tern, 1 laughing gull, 1 herring gull, 1 greater shearwater and 1 common shearwater between May 25th and August 1st. Swabs have been sent to Tufts University for analysis.

Common Tern Fledgling Mortality

High mortality of fledgling common terns was observed in the colony around mid to late July until colony monitoring concluded at the beginning of August. Ultimately, about 19% of all fledged chicks from productivity plots were found dead post-fledge. This number is likely a low estimate, as not all dead fledglings would be recovered by staff. After consulting with local wildlife rehabilitators and other wildlife biologists in the area, staff concluded that this die-off was likely due to starvation. In addition to finding large numbers of dead fledglings in the colony many appeared lethargic, weak, unbalanced, and emaciated. In addition to the high rates of laughing gull kleptoparasitism, perhaps low food availability due to a spike in nearby ocean surface temperatures in mid-July are to blame.

Other research

Fecal samples were collected within the tern colony on South Monomoy Island in collaboration with Cornell University and Gemma Clucas as part of a larger study. Samples were collected during the incubation and chick-rearing period from both common tern adults and chicks. In total 16 adult samples were collected during the incubation period and another 24 during the chick-rearing period. Forty samples were collected from common tern chicks.

New Hampshire

Isles of Shoals

Liz Craig, Director of Seabird Science, Shoals Marine Laboratory (SML)
Willow Dalehite & Orena Wong, Seabird Technicians, SML
Additional collaborators and summer interns listed below

White and Seavey islands

Tern Census

Common Terns

- COTE census was conducted over 5 days within June 10th to 19th, 2023
- Unadjusted census:
  - 572 nests on White Island
  - 2,426 nests on Seavey Island
  - Lincoln Indices were calculated for White Island and Seavey Island (divided into sections with indices ranging from 1.03 to 1.06 on White and 1.00 to 1.13 on Seavey)
- Adjusted census:
  - 598 nests on White Island
  - 2566 nests on Seavey Island
  - **Total estimated population was 3,165.** Similar to census count last year (3,066).

Roseate Terns

- 151 ROST nests were established on Seavey Island within the census window (before 20 June 2023; up from 124 in 2022).
- B-wave ROST nests brought the season total to 172 (up from 147 in 2022).

Arctic Terns

- 0 ARTE nests were established in 2023 for the first time in the program history.

Table 1. Number of tern nests found on White and Seavey islands from 2016-2023

Year	COTE	ROST	ARTE
2016	2,985	83	3
2017	3,210	92	2
2018	2,175	55	1
2019	2,900	61	1
2020	3,280	96	1
2021	3,412	112	1
2022	3,066	124	1
2023	3,165	151	0

Productivity

Common Terns

- 8 fenced plots (~10x12 ft) containing 77 nests
- Nests were monitored until chicks reached “fledge” age (15 days)
- Productivity was low for COTEs (0.39 chicks per nest) in comparison to recent years. Contributing factors to low COTE productivity may have included inconsistent food availability (diet consisted of mostly sand lance earlier in the season shifting to high diversity prey later in the season) and frequent rainy weather throughout the chick rearing period. The colony experienced average predation pressure in 2023.

Roseate and Arctic terns

- ROST and ARTE nests were monitored individually until chicks reached "fledge" age (5 days for ROST and 15 for ARTE)
- Productivity was average for ROSTs (0.87 chicks per nest) in comparison to recent years. There was high mortality of B chicks this summer.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on White and Seavey islands from 2016-2023. Only nests with known outcomes were used for ROST & ARTE calculations.

Species	Year	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2016	2.25	1.56	0.80	247
	2017	2.00	1.81	0.35	62
	2018	1.84	1.38	0.45	45
	2019	2.11	1.61	0.85	66
	2020	2.19	1.86	0.57	70
	2021	2.16	1.01	0.33	116
	2022	1.99	1.46	0.96	72
	2023	1.71	1.15	0.39	77
ROST	2016	1.69	1.23	0.94	83
	2017	1.60	1.23	0.91	87
	2018	1.18	0.86	0.82	64
	2019	1.72	1.36	1.02	61
	2020	1.64	1.43	0.91	94
	2021	1.77	1.05	0.62	73
	2022	1.81	1.61	1.31	88
	2023	1.44	1.02	0.87	120
ARTE	2016	2.00	1.00	0.50	2
	2017	2.00	1.50	1.00	2
	2018	1.00	1.00	1.00	1
	2019	1.00	1.00	0.00	1
	2020	1.00	0.00	0.00	1
	2021	1.00	0.00	0.00	1
	2022	1.00	1.00	1.00	1
	2023	-	-	-	0

Tern Provisioning

- COTE and ROST nests were monitored for diet.
- Remote observation cameras were used to record video of each COTE and ROST nest every 1-2 days starting 23 June 2023. COTE and ROST observations concluded 28 July 2023. Complementary provisioning data were collected by observers in blinds to compare to camera observations. Data from camera recordings will be collected in fall 2023.

- Diet items included herring, hake, sand lance, butterfish, cunner, mummichog, lumpfish, goosefish, gadid, pipefish, snipefish, mackerel, Acadian redfish, Northern sennet, squid, euphausiid, flying ant, wasp, dragonfly, beetle, and moth.
- Partnering with Dr. Gemma Clucas at Cornell Lab of O to conduct DNA metabarcoding of feces to determine diet to species level.

Predator Activities and Control Efforts

Gulls:

- Used human presence, as well as pyrotechnics and lasers to dissuade gulls from lingering and predating.
- Managed predation with pyrotechnics and lasers: 20 pyrotechnics were used between 10 May and 31 July (down from 40 in 2022)
- Lethal control: removed 4 GBBG (4 adults and 1 juvenile with wing injures)

PEFA:

- Infrequent visits in May and one in late July

Other Avian:

- RUTU from the end of May through early June and again in late July.

Muskrats:

- Due to predation issues in previous years, muskrats were trapped at their den on White using conibear traps. Only 1 muskrat was trapped (down from 6 in 2022).

Other Mammalian:

- No other mammalian predators were observed on White or Seavey islands between 10 May and 31 July 2023.

Other Nesting Species

- Common Eider: at least 40 nests (2 on White and 38 on Seavey; up from 36 total in 2022)
- Spotted Sandpipers: at least 15 nests (3 on White and 12 on Seavey; up from 12 total in 2022)
- Song Sparrow
- Barn Swallow
- Used eBird for daily bird list to share bird diversity data from White and Seavey.

Other Isles of Shoals islands

Alcids

This was the second year of concerted monitoring efforts for Black Guillemots on the Isles of Shoals with two dedicated 2023 interns, Noah Milsky and Abbey Yang. As of July 30, there were 41 known BLGU nests across 4 neighborhoods on Appledore Island (21 nests on Appledore) and another 4 neighborhoods on Smuttynose Island (20 nests on Smuttynose) -- similar to the numbers observed in 2022. Nests were labeled with epoxy markers to facilitate continued monitoring into the future.

Long-legged wading birds

A mixed-species colony of long-legged wading birds has re-established on Appledore Island as of 2020. 2023 nest counts were conducted at the end of the breeding season (24 August 2023) when chicks had fledged. A combination of nest ID and adult counts were used to estimate breeding colony size and relative species abundance. Species included Snowy Egret (122 pairs), Great Egret (26 pairs), Glossy Ibis (31 pairs), and Black-crowned Night-Heron (3 pairs).

American Oystercatchers

Our team identified 1 AMOY nest on Appledore Island and 2 on Lunging Island in 2023.

Gulls

Gulls continue to be monitored on Appledore Island by the Gulls of Appledore team led by Sarah Courchesne and Mary Elizabeth Everett. Both Great Black-backed Gulls and Herring Gulls continued to breed on Duck Island, Appledore Island, Smuttynose Island, Star Island, Lunging Island, and Square Rock.

Double-crested Cormorants

Double-crested Cormorants continued to breed on Duck Island, Lunging Island, and Square Rock. Drone-based survey of Lunging Island and Square Rock conducted with Gemma Clucas in 2023.

Research:

- Collected HPAI samples from gulls and terns in collaborations with Wendy Puryear at Tufts
- Collected GPS locations for all censused tern nests. Evaluating spatial distribution of birds and nest site selection wrt habitat characteristics and management.
- ∉ Continued application and evaluation of hypersaline spray for habitat management for terns at the neighborhood/mesohabitat scale. Specifically investigated salt in combination with controlled burn in 2023.
- ∉ Tern fecal collection (for DNA metabarcoding) and visual diet observations conducted to determine diet with Gemma Clucas.
- ∉ Camera monitoring of ROST diet
- ∉ Passive bioacoustic monitoring of terns with UNH graduate student Valerie Eddington and undergraduate Joe Brosseau (PI Laura Kloepper)
- ∉ Exploration of historic tern diet data and reproductive success/growth wrt fisheries data.
- ∉ Exploration of butterfish presence in diet over time and implications for growth/survival of chicks (manuscript published this summer: https://doi.org/10.5751/ACE-02440-180201).
- ∉ Deployed 19 GPS tags on Common Terns to pair provisioning data with foraging. Data were used to inform boat-based fish sampling by grad student Aliya Caldwell.
- ∉ BLGU diet and reproductive success by SML intern Abbey Yang
- ∉ BLGU response to investigator disturbance by SML intern Noah Milsky
- ∉ Drone-based exploration of Double-crested Cormorant and gull nesting distribution with Gemma Clucas.
- ∉ Body burden of Hg in comparison to foraging behavior (stable isotopes) in breeding seabirds by former SML intern Lenny Laird.

Maine

Stratton Island, Maine

Benjamin Becker, Island Supervisor – National Audubon Society Seabird Institute

Tern Census

An island-wide Common Tern nest count was conducted on June 9-10. Arctic and Roseate Tern nests were found and counted throughout the season. Although 107 Roseate Tern nests were found during the season, 21 nests failed before the GOMSWG census, resulting in a census total of 86 nests. Arctic Terns had 4 active nests during the GOMSWG census. The Common Tern nest count of 987 nests was corrected with a Lincoln index of 1.036 to 974 nests, and the addition of 42 marked study nests brought the total count to 1,065 nests. The Least Tern census was performed on June 15, with 75 nests found. Over the course of the season, many Least Tern nests were lost to weather and predation, making distinguishing between later new nests and re-lays unfeasible. 91 Least Tern nest starts were recorded throughout the season, though many were likely re-lays.

Table 1. GOMSWG census results on Stratton Island, 2018-2023.

Year	COTE	ARTE	ROST	LETE
2018	1206	8	128	122
2019	1244	9	125	84
2020	1159	5	114	0
2021	1315	10	140	63
2022	1369	8	138	91
2023	1065	4	86	75

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 46 nests in the Common Tern plots fledged 0.41 chicks per nest. Roseate Tern productivity was calculated at 0.92 chicks fledged per nest using the B-chick weight method. However, this is almost certainly unrealistic because the Roseate Tern colony faced predation by American mink. No dead chicks were found, however several adult breeding Roseate Terns were discovered dead next to their nests with mink-related wounds, and stints dedicated to identifying surviving Roseate Tern hatchlings during the period of predation turned up incomplete counts of the number of known chicks banded. From the 4 Arctic Tern nests followed, 1 chick was seen successfully fledged, giving a minimum productivity of 0.25. Least Terns hatched chicks from 45 nests, and July 27 had the highest Least Tern fledgling count with 4-5 fledglings seen, suggesting a minimum productivity of 0.05. Least Tern chicks faced very high predation from Black-crowned Night-Herons this season.

Table 2. Tern productivity on Stratton Island, 2021-2023.

Species	Year	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	2021	2.56	2.46	0.71	79
	2022	2.23	2.03	1.31	65
	2023	**2.04**	**0.67**	**0.41**	**46**
ROST	2021	1.83	1.47	1.02	95
	2022	1.82	1.52	1.25	92
	2023	**1.63**	**1.32**	**0.92***	**104**
ARTE	2021	1.69	0.55	-	13
	2022	2.00	1.63	0.75	8
	2023	**1.75**	**1.25**	**0.25**	**4**

*Productivity number does not account for significant amounts of predation that affected the Roseate colony in 2023.

Tern chick provisioning

5 Common Tern nests were observed, along with a 3x3m plot of unmarked nests with a total of 379 feedings. Chick diet primarily consisted of sandlance, euphasiids, and hake, comprising 35%, 12%, and 8% of deliveries, respectively. Herring, last year's primarily delivered food, dropped from 31% in 2022, to 3% in 2023. 10% of prey items were not identified to species. 12 Roseate Tern nests were observed with a total of 212 feedings. Diet primarily consisted of sandlance at 77% of deliveries. 12% of prey items were not identified to species.

Predation

As part of an effort to reduce Herring and Great Black-backed Gull populations on Stratton and Bluff Islands, eggs in all gull nests found on Bluff Island were poked early in the season. 46 Herring Gull nests totaling 120 eggs, and 16 Great Black-backed Gull nests totaling 41 eggs were poked on Bluff Island. These nest counts are a significant decline from 2021's numbers, which saw 79 Herring Gull nests totaling 222 eggs, and 31 Great Black-backed Gull nests totaling 86 eggs. 3 Great Black-backed Gull nests were found Little Stratton, and 1 on Stratton. All nests were removed. One Great Black-backed Gull was eating tern eggs at the start of the season and was shot, and others were seen occasionally preying on older tern chicks later in the season.

Black-crowned Night-Herons were a significant predator in 2023. Signs of predation began on the dunes as chicks began to hatch, with heron footprints seen in the sand, loud tern disturbances at night, and missing chicks from marked nests. At least two adult individuals were witnessed actively predating the colony every night during the month of June and early July. Most Common Tern nests on the dunes were completely predated, and on June 29, almost all Least Tern chicks were predated. After the dunes were void of nests, both night-herons moved to the eastern side of the island to continue predation there. On the night of July 1, one night-heron was shot, and the other was shot on July 7 with a .22 night-vision rifle. Signs of predation discontinued after the second night-heron was removed. Over 90 man-hours were conducted to stop the night-herons from predating the colonies. Night-heron activity typically started between 9-10pm, and continued throughout the night until sunrise.

At the start of June, signs of an American mink were seen on the island, with a latrine area and a predated tern carcass. However, signs of the mink did not resume until early July, when 3 adult Roseate Tern carcasses were found with bite marks on their necks. Common Tern chick carcasses were seen with similar wounds, and chicks were disappearing throughout the next 2 weeks. The area of the field became completely devoid of chicks, along with missing and predated chicks seen throughout the southeastern beach. Black Guillemot burrows may also have been predated. The latrine area seen earlier became active again, and 10 traps were laid out during 7/20-7/29, however nothing was caught during that time. Signs of the mink ceased after 7/20, and more predation was not witnessed.

In late July and early August, a young Peregrine Falcon was witnessed actively hunting the colony throughout the days, stopping to roost or eat in the forest and cliffs on the northern parts of the island. Bangers and screamers deployed to deter the falcon showed no lasting effect.

Wading Birds

The 2023 wading bird census was conducted on May 18 and 21. Researchers use mirror poles to view nest contents and egg templates to identify nests to species. 122 Glossy Ibis, 106 Snowy Egret, 51 Great Egret, and 2 Black-crowned Night-Herons nests were identified.

Common Eiders

No Common Eider census was conducted in 2023.

American Oystercatchers

3 Nests were identified on Little Stratton and 1 on Stratton. 2 additional nests were suspected near Gull Meadow and on Heron Beach on Stratton. Chicks were seen on Stratton on June 6, and more than 4 fledglings were seen later in the season.

Black Guillemots

5 Black Guillemot burrows were confirmed in 2023, with 3 on Stratton Island and 2 on Bluff Island. Of the 3 nests on Stratton, 2 were suspected of being predated by mink, and the other probably failed after chicks hatching. Prey was observed being brought back to Bluff, and 2 juvenile guillemots were seen between the islands in August.

Double-crested Cormorants

Double-crested Cormorant nest census was conducted on June 2. An average was determined from four observers counting all nests seen via boat. An estimate of 124 DCCO nests was found on Bluff Island, down from 179 in 2022.

Visitors

In 2023, Stratton was open for visitation. York Co. Audubon had out 12 guests for their teen birding tour on July 15. On July 23, PNYC brought out 25 visitors. Several small VIP groups were also brought out over the course of the season. Only a handful of unscheduled visitors landed on island, primarily individuals on small watercraft.

Outer Green Island, Maine

Sarah Morrow, Island Supervisor – National Audubon Society Seabird Institute
Katie Crandall, Research Assistant

Tern Census

The 2023 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on 11 June. 1,581 Common Tern nests were counted. The Lincoln Correction Index was calculated at 1.0504, and with the addition of 80 previously marked study nests, the total nest count was 1,741 nests. No Roseate Tern nests were discovered.

Table 1. GOMSWG annual census results on Outer Green Island, 2018-2023

Year	COTE	ROST	ARTE
2018	1553	0[2]	0
2019	1727	0	0
2020	1775	0	0
2021	1661	2[1]	0
2022	1994	0	0
2023	**1741**	**0**	**0**

[1]One ROST nest was laid after the census period
[2] Four ROST nests were laid after the census period

Tern Productivity

The average number of eggs per nest was 1.95 (n=80) of which an average of only 1.30 hatched per nest. The first recorded hatch was on 11 June, and peak hatch lasted from approximately June 20-25. The average number of chicks fledged per nest (productivity) was 0.44, this is the lowest productivity seen on Outer Green Island in the past 13 years of monitoring.

Table 2. Outer Green Island annual Common Tern productivity, 2018-2023

Year	Mean Clutch	Mean Hatch	Productivity	No. Monitored Nests
2018	2.18	1.92	1.19	83
2019	2.12	1.81	1.37	75
2020	2.12	1.93	0.74	76
2021	2.21	1.93	0.54	89
2022	2.33	1.99	1.27	81
2023	**1.95**	**1.30**	**0.44**	**80**

One significant factor affecting productivity this season was weather. During late egg-incubation and early chick-rearing periods, heavy storms lasting multiple days occurred creating unsustainable conditions for both eggs and newly hatched chicks to survive. Death by exposure was calculated at 28.9% of total chick deaths recorded this year (including chicks missing/presumed dead). A low hatch success rate and high chick mortality rate combined, resulted in a decrease in productivity by 65.4% from 2022.

Tern Provisioning

Chick provisioning was observed at Common Tern nests. In 2023, a total of 364 feedings were recorded over 114.2 observation hours, averaging 0.96 feedings per nest per hour. The most frequently observed prey item was sandlance which made up 36.69% of observations, followed by herring at 15.68%, and hake at 9.47%. Of note were several goosefish observed late in the season.

Predation

The greatest tern predation impact this season came from the frequent presence of a single and/or pair of Peregrine Falcons, most likely from a known nearby nest location north of Portland. One or both adult Peregrine Falcons were seen 17 days out of the season, with every sighting accompanied by persistent dreading and chasing from the terns. A total of 11 terns were confirmed as predated by the falcon(s) over the course of the season, 10 adults and 1 fledgling, none appearing to be banded.

Greater Black-backed and Herring Gulls were the most common gull species seen throughout the season. A total of three gulls were shot using a .22 rifle; all three gulls shot had obvious wing injuries leaving them incapable of flying. The carcass of one gull was made into an effigy, paraded around the island and then displayed on a pole on the southeast side of the island for gull deterrence. An almost immediate and drastic decrease in egg predation was seen after the effigy was placed. Later in the season, there was a higher number of gulls foraging and/or loafing in the intertidal surrounding OGI, with no visible evidence of fledgling predation.

Table 4. Outer Green Island predator control efforts, 2023

Species	No. of Nests Destroyed	No. of Gulls Shot
Herring Gull	0	3
Great Black-backed Gull	0	0
Laughing Gull	0	0

The last predatory species of note that visited Outer Green Island was the Common Raven. One to three ravens visited the island for a total of five days within the last two weeks of the season. These ravens were seen predating at least two discarded and rolled guillemot eggs. No evidence of fledgling or adult tern predation was observed or suspected.

Black Guillemots

This season, 26 Black Guillemot burrows were monitored for productivity. Five new burrows were found in 2023. The average clutch size was 1.89 and the average number of eggs hatched per nest was 1.07. Productivity was 0.88 chicks fledged per pair.

American Oystercatchers

A pair of American Oystercatchers nested on the southwest side of the island for the third consecutive year. The nest had one egg and one recently hatched chick present when found, and two chicks fledged.

Jenny Island, Maine

Margaret Jensen, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 8. A total of 1,739 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs. A Lincoln index mark/recapture correction of 1.072 was applied to the uncorrected count. The addition of 54 productivity nests and 48 marked feeding study, geolocator, and GPS tag nests brought the total to 1,857 nests (Table 1). This count is the third highest ever recorded on Jenny (Table 1). Twenty-two Roseate Tern nests were also active during the GOMSWG census window. One additional B-wave nest was laid after the census window.

Table 1. GOMSWG census results on Jenny Island, 2019-2023.

Year	COTE	ROST
2019	1,618	21
2020	1,433	21
2021	2,044	17
2022	1,899	17
2023	1,857	22

Tern Hatch and Fledging

Common Tern nests were already widespread across the island when researchers arrived for the 2023 season. The first Common Tern chick to hatch (June 7), was 3 days earlier than in 2021 and 2022 (June 10), and the first Common Tern chick to fledge (July 2), was similarly 4 days earlier than in 2020 and 2021 (July 6).

Tern Productivity

For Common Terns, five productivity plots containing 54 nests, three feeding study plots with 21 nests, and 4 nests of GPS tagged adults were monitored to determine productivity. 22 Roseate Tern nests were monitored for productivity. Common Tern productivity was 0.35 chicks fledged per nest, which was a decrease from both 2022 (1.25) and 2021 (0.55; Table 2). This decrease is likely due to the multiple severe rainstorms and days of heavy fog during much of June and early July. Roseate Tern productivity was calculated at 1.14 chicks fledged per nest.

Table 2. Tern productivity on Jenny Island, 2021-2023.

Species	Year	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2021	2.43	2.13	0.55	99
	2022	2.20	1.90	1.25	88
	2023	**2.01**	**1.51**	**0.35**	**79**
ROST	2021	1.94	1.71	1.27	17
	2022	2.00	1.82	1.10	17
	2023	**1.70**	**1.50**	**1.14**	**22**

Tern Provisioning

Common Tern chick provisioning was monitored at three feeding study plots with 21 nests. A total of 373 feedings were observed, across 117.43 hours of observation, with an average of 0.96 feedings per nest per hour. Atlantic herring constituted the highest percentage of observed feedings (38.1%; Table 3). Hake (including white hake and four-bearded rockling) made up another 17.7% of the feedings.

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2023.

Prey item	Number of Items	% of Diet
Herring	142	38.1
Hake	66	17.7
Sandlance	8	2.1

One feeding study plot with 6 Roseate Tern nests was monitored. A total of 169 feedings were observed over the course of 54.02 hours, with an average of 0.87 feeds per nest per hour. Herring constituted the highest percentage of observed feedings at 27.8% (Table 4). Sandlance was the second most common at 21.3%, having overtaken hake, which was the second most common in 2022. Hake (including white hake and four-bearded rockling) followed at 9.5%.

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2023.

Prey item	Number of Items	% of Diet
Herring	47	27.8
Sandlance	36	21.3
Hake	16	9.5

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2023 field season. They were not observed preying on tern chicks, or even landing above the intertidal on the island. Great Black-backed Gulls occasionally circled above the Common Eider flock, and were observed predating at least two eider chicks.

Peregrine Falcon predation was less intense during the 2023 season than during 2022. The predation of five adult terns was observed over the course of the season, and two partially-eaten kills were found on the rocks on the eastern side of the island.

Only one Black-crowned Night Heron was observed during the 2023 season. It landed on the north tip of the island for less than a minute before getting chased away by the terns. No evidence of egg predation was observed.

Other Birds
Nine Common Eider nests were observed during the 2023 GOMSWG census, compared to 6 in 2022. Well over 100 eider chicks were routinely being observed on the water by that date. Two Mallard nests were also observed during the census.

Avian Flu
No birds were seen exhibiting symptoms of avian flu during the 2023 season.

Pond Island National Wildlife Refuge

Theresa Rizza, Island Supervisor and Sarah Brennan, Research Assistant – National Audubon Society Seabird Institute

Tern Census
Tern census was conducted on June 16. The unadjusted count for Common Terns (COTE) was 1511 nests. An additional 90 COTE study nests were being followed at the time of census and the Lincoln Index was 1.026. The adjusted count of 1641 nests, which includes study nests, is the highest number of nests recorded on Pond Island since the restoration project began and is 61 more nests than last year (Table 1).

At the time of census, there were 4 active Arctic Tern (ARTE) nests and 9 active Roseate Tern (ROST) nests. We believe, however, that there was one additional ARTE nest in a different location on the island that was not found before it was abandoned. One additional B/C-wave ROST nest was found post-census, bringing the total number of ROST nests for the season to 10, the third highest number in the history of the restoration project, and the highest since 2018.

Table 1. Number of tern nests on Pond Island NWR from 2018-2023.

Year	COTE	ROST	ARTE
2018	1065	2	11
2019	1159	0	7
2020	1453	2	3
2021	706	0	0
2022	1580	5	5
2023	1641	9	4

Productivity
COTE productivity was determined by following 81 nests in fenced and unfenced study plots. These nests were followed from egg stage until fledging (fledging determined at 15 days, unless later found deceased). Mean clutch size for COTE was 2.20 with a mean hatch of 1.95 and 0.88 fledged per nest. Four ARTE nests were monitored. ARTE mean clutch size was 2.0, with a mean hatch of 0.5, and productivity of 0.25 chick fledged per nest (Table 2). Nine ROST nests were monitored throughout the season, followed from egg stage until fledging. ROST mean clutch size was 1.67, and mean hatch was 0.56. ROST averaged 0.11 fledged per nest (Table 2).

Table 2. Tern reproductive success on Pond Island, 2019-2023.

Species	Year	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	2019	1.97	1.63	1.41	73
	2020	2.03	1.71	0.79	62
	2021	1.76	0.85	0.27	62
	2022	2.24	1.94	1.56	68
	2023	**2.20**	**1.95**	**0.88**	**81**
ARTE	2019	1.58	1.25	1.25	12
	2020	1.56	0.56	0.45	9
	2021	1.00	0.33	0.33	3
	2022	2.00	1.80	1.00	5
	2023	**2.00**	**0.5**	**0.25**	**4**
ROST	2019	1.00	0.5	0.5	2
	2020	2.00	0.75	1.00	2
	2021	-	-	-	-
	2022	1.33	1.00	0.83	6
	2023	**1.67**	**0.56**	**0.11**	**9**

Tern Chick Provisioning

Chick provisioning studies were conducted by observing 18 COTE nests from hatching through fledging or failure. There were 853 total prey items observed being fed during 611 nest hours of observation, resulting in a feeding rate of 1.40 feedings per nest-hour. The principal prey species delivered was sandlance (37.16%). The diet was fairly diverse otherwise and the next two highest represented prey types were shrimp (12.66%) and herring (11.25%). (Table 3).

Table 3. Principal prey items in COTE chick diet on Pond Island in 2023.

Prey item	Number of Items	% of diet
Sandlance	317	37.16
Shrimp	108	12.66
Herring	96	11.25

Predator Activities and Control Efforts

Pond Island was subjected to severe predation events during the 2023 season, in stark contrast to the prior year. A mink was spotted on island on May 28 and was present until caught in a body-hold trap on June 2. Three adult tern carcasses were found stashed in the ruins of the lightkeeper's house on May 29. One carcass with injuries of mink predation was discovered the first night the mink was present on island, but disappeared before it could be removed by staff and is potentially included in the cached birds. No other carcasses indicating mink predation were found while the mink was still on island.

On June 12, staff found the carcasses of between 30 and 34 adult terns, based on the body parts found. Two of these carcasses were Arctic Terns, the rest were Common Terns. Based on the patterns of the injuries, a large number were attributed to a Great-horned Owl (GHOW) and many others to a mink. Staff set three owl traps and eight conibear traps were set in response that day. Between June 13 and 23, thirteen more adult tern carcasses, comprising one Arctic tern and the rest common terns, were found on the island, most bearing injuries indicative of predation by an owl. On June 14, a GHOW was spotted hunting on the island around 18:30 and pursued in attempts to trap the owl by hand to no success. The owl was observed hunting on island again on June 16, 21, and 22, all between 18:00 and 20:00. One adult female eider carcass was found predated on June 16 with injuries indicative of predation by either GHOW or Bald Eagle. The GHOW was eventually trapped on June 25 and staff stopped finding fresh carcasses on the island.

A sharp-shinned hawk was observed predating fledgling terns on July 29 and 30.

Peregrine falcons (PEFA) were observed hunting on the island throughout the season. Early season attempts were primarily made by a juvenile PEFA who was not observed taking a tern until July 16. Late season attempts were made by a mix of adult and juvenile PEFA and they were observed hunting on the island five or more times per day in the afternoon and were observed taking terns at least once per day, although higher actual predation numbers are suspected.

Predation of eggs by ruddy turnstones was observed in both in late and early season which coincided with their increased presence due to migration. Numbers of predated eggs were never high and observed almost exclusively on the edges of the colony.

Depredation from gulls was not detected and harassment of the colony by gulls was exceedingly rare. At the end of July, between seven and fifteen laughing gulls loafed in the intertidal around the landing and would frequently chase adult terns for fish, but no mortality occurred.

Highly Pathogenic Avian Influenza (HPAI)

Pond Island National Wildlife Refuge did not have confirmed cases of HPAI in the breeding colony during the 2023 season. HPAI was suspected as a possible cause of mortality in the case of a single dead adult COTE found on June 5 which had gray feces around the vent. The carcass was destroyed without being tested and no other birds, dead or alive, were seen with symptoms indicative of HPAI.

Eastern Egg Rock, Maine

Emma Lachance Linklater, Island Supervisor – National Audubon Society Seabird Institute

Census

GOMSWG census was conducted on June 9, 10, and 11 to accommodate the early laying observed this season. We found our first Common Tern eggs on May 19 and our first chicks on June 12. The raw count of Common Tern nests was 1386, which was then adjusted with a mark-recapture adjustment (Lincoln Index) of 1.055. Including the addition of 29 nests in unfenced feeding study plots and 60 nests in fenced productivity plots, our final Common Tern nest count was 1552. This represents a 14% increase in Common Tern nests since 2022. Unfortunately, Roseate Tern and Arctic Tern numbers decreased since 2022 with 69 Roseate Tern nests (12% decrease from 2022) and 53 Arctic Terns nests (37% decrease from 2022). Laughing Gull nesting numbers significantly increased from 2022 to 2023. During census, 1635 Laughing Gull nests were counted and poked to prevent hatching. This is a 37% increase since 2022, and continues the trend of increasing nesting on Eastern Egg Rock since 2018.

Table 1. Number of tern and Laughing Gull nests found on Eastern Egg Rock from 2018-2023.

Year	COTE	ROST	ARTE	LAGU
2018	1021	82	86	1
2019	1067	76	70	333-862
2020	1156	80	77	1174
2021	1359	85	74	251
2022	1358	78	84	1194
2023	1552	69	53	1635

Tern Productivity

Productivity was significantly lower for Common and Roseate Terns than has been observed in the last five years, and Arctic Tern hatch success was lower than four of the last five years. Clutch size for all three species was higher than or similar to previous years, but consistent cool and wet weather greatly impacted the hatch success and productivity of this year's terns. Many Common and Arctic Tern eggs were drowned early in the season. Roseate Tern nests seemed less susceptible to flooding overall, but for all three species, many chicks that did hatch died of exposure within their first couple days. Arctic Terns breeding at the south end of the island also experienced heavy predation by Herring Gulls and Great Black-backed Gulls.

Table 2. Reproductive Success for Common, Arctic, and Roseate Terns on Eastern Egg Rock from 2019-2023.

Species	Year	Clutch size	Mean Hatch	Productivity	Nests monitored
COTE	2019	2.01	1.57	1.16	69
	2020	2.28	1.81	0.27-0.56	79
	2021	2.30	2.00	0.51	78
	2022	2.47	2.24	1.26	68
	2023	**2.52**	**1.32**	**0.38**	**77**
ARTE	2019	1.75	0.98	0.40	53
	2020	1.67	0.60	-	42
	2021	1.84	1.08	-	73
	2022	2.00	1.51	-	53
	2023	**1.81**	**0.68**	**-**	**53**
ROST	2019	1.43	1.2	1.10	70
	2020	1.83	1.68	1.60	72
	2021	1.65	1.38	1.06	78
	2022	1.99	1.54	1.09	78
	2023	**2.00**	**1.54**	**0.99**	**69**

Tern Provisioning

High quality prey like sandlance, herring, and hake dominated the diets of monitored chicks this season, and low quality prey such as stickleback and butterfish were almost or completely absent. The highest percentage of fish consumed by Common Tern chicks was herring, by Roseate Tern chicks was sandlance, and by Arctic Tern chicks was hake. Tern chick provisioning stint hours were significantly impacted by the consistently wet weather this season. The Egg Rock crew spent 66.33 hours monitoring 17 Common Tern chick nests, 40.85 hours monitoring 8 Roseate Tern nests, and 35.17 hours monitoring 9 Arctic Tern nests.

Table 3. Principal prey items (percentage) in tern chick diet on Eastern Egg Rock in 2023.

Prey item	COTE	ROST	ARTE
Herring	28.4	24.8	2.4
Hake	12.4	9.9	25.2
Sandlance	21.6	33.7	18.7
Butterfish	1.5	1.0	0.8
Pollock	9.8	0	0
Stickleback	0	0	0

Predator Activities and Control Efforts

Laughing Gull deterrence began as soon as the team arrived on the island and consisted of shooting gull-deterrence flares, banging pots and pans, screaming, and carrying a Laughing Gull decoy around the island several times a day. This approach was initially very successful at eliminating Laughing Gull from the island, but decreased in efficacy as the gulls became desensitized to our efforts. We transitioned to searching for nests and we destroyed 709 Laughing Gull nests before census and an additional 1635 nests during census.

We observed predation of tern adults and fledglings by Herring Gulls, Great Black-backed Gulls, and Peregrine Falcons, and predation of tern eggs by Herring Gulls, Great Black-backed Gulls, Ruddy Turnstones, and Mallards. We attempted to shoot Herring Gulls and Great-Blacked Gulls but weren't successful, and rarely had clear windows with both good visibility and no boats in range when we could safely use the rifle. We also used gull-deterrence flares a few times when we observed a Herring Gull attempting to predate Common Terns.

Atlantic Puffin

We observed our first Atlantic Puffin with fish on June 7 and continued to record new active burrows right up to our last day. Egg Rock's active puffin burrow count was 154. We trapped and banded 23 adult Atlantic Puffins, and

grubbed and banded 12 pufflings. Stefanie Collar stayed on the island for 11 days and deployed 12 GPS tracking tags on adult puffins.

Other Notes
While conducting census, we counted 26 Common Eider nests. Ducklings were regularly observed in July and several groups of large ducklings were observed in August.

Three Razorbills were present on Eastern Egg Rock for the majority of the season, and were often seen loafing and billing. However, there was no indication that they bred on the island this year.

A single Tufted Puffin was observed on different 5 days in 2023. It occasionally loafed with the Atlantic Puffins which did not seem to enjoy its company, and otherwise joined rafts or circled the island.

Metinic Island

Ryan Potter, Island Supervisor - USFWS

Tern Census
On June 16, we counted 1,118 tern nests during the Gulf of Maine Seabird Working Group (GOMSWG) census. After applying a Lincoln Index Correction Factor of 1.027 to the raw count and adding 85 productivity plot nests, we estimated a corrected total of 1,231 pairs of terns nested on Metinic in 2023. This number was nearly the same as 2022 (1,226 pairs) and is the largest number of nesting terns on Metinic since restoration efforts began in 1998. We identified the species at 17% of the nests (n=211) and calculated a species ratio of 70% common terns (858 pairs) and 30% Arctic terns (373 pairs).

Table 1. Estimated number of tern pairs counted during the GOMSWG census at Metinic Island, 2019-2023.

Year	COTE	ARTE
2019	515	316
2020	630	389
2021	690	421
2022	689	537
2023	858	373

Productivity
Overall productivity was lower than in 2022 but close to, or just above, the long-term average for both Arctic and common terns.

Table 2. Tern reproductive success at Metinic Island, 2019-2023.

	2019	2020	2021	2022	2023
Common Tern					
# of Nests	40	45	44	55	59
Mean Clutch Size	2.25	1.96	2.20	2.31	2.37
Mean Hatch Success	90%	81.8%	89.7%	89.0%	95.0%
Mean Fledge Success	46%	50.0%	19.6%	60.6%	47.4%
Chicks fledged/pair	0.93	0.80	0.43	1.40	1.07
Arctic Tern					
# of Nests	24	24	28	30	26
Mean Clutch Size	1.71	1.63	1.82	1.87	1.42
Mean Hatch Success	85.4%	92.3%	88.2%	91.1%	81.1%
Mean Fledge Success	91.4%	63.9%	35.3%	62.5%	73.3%
Chicks fledged/pair	1.33	0.96	0.64	1.17	0.85

Tern Provisioning

During chick provisioning observations, we watched 13 common tern nests for 321 hours and recorded 326 feedings (1.02 feedings/hour/per nest). We observed 19 Arctic tern nests for 515 hours and recorded 737 feedings (1.43 feedings/hour/per nest). Invertebrates (29%) and hake (28.4%) were the most common prey items delivered to Arctic tern nests followed by sand lance (13.7%) and herring (10.7%). For common terns, herring (32.8%) was the most common prey item, followed by hake (19.0%), sand lance (17.8%), and invertebrates (13.8%). Over the course of the season, sand lance was the dominate prey item brought in by both species during initial hatching and early chick rearing before there was a noticeable shift to small hake and then larger herring as chicks began to fledge.

Table 3. Principal prey items of tern chick diets on Metinic Island in 2023.

Prey Item	COTE	ARTE
Herring	32.8%	10.7%
Hake	19.0%	28.4%
Hake/herring	1.8%	0.4%
Invert	13.8%	29.0%
Sand Lance	17.8%	13.7%
Butterfish	0.9%	1.2%
Pollock	1.8%	1.4%
Atlantic Saury	-	0.3%
Silverside	0.3%	-
Fish Scrap/Chunk	-	0.3%
Haddock	1.5%	1.6
Unknown Fish	5.8%	4.9%
Unknown	1.2%	4.7%

Predator Activities and Control Efforts

We determined that 4.1% of the 100 tern nests we marked for our predation study had been predated prior to the GOMSWG census. This was roughly the same as in 2022 and lower than prior years. Herring and great black-backed gulls are allowed to nest on Metinic, away from the tern colony. We conducted a gull census on May 26 and 27 and counted 116 herring and four great black-backed gull nests. We coated all the gull eggs with vegetable oil to reduce hatching rates. Herring and great black-backed gulls were observed on several occasions preying upon common eider ducklings, and on two occasions, we observed a herring gull grabbing a small tern chick.

Merlin have previously bred in the forest on Metinic, but we do not believe they nested this season. We observed a merlin in the tern colony on 29 occasions. Additionally, we observed peregrine falcons within the tern colony on 31 occasions. The peregrines were most common later in the season as tern chicks began to fledge. They were successful in capturing at least six terns (one adult and five chicks).

We caught 51 garter snakes this season and all snakes were removed from the island. On one occasion, we observed a large snake trying to consume a small tern chick. Another snake had what appeared to be an egg in its' abdomen. We also observed feathers and bird skulls in several fecal samples from the snakes we had captured.

Black Guillemots

We located 84 active guillemot burrows on USFWS property and as of July 26 had confirmed a hatch rate of 58.2%. The first guillemot chicks were observed June 25 and as of the last burrow check, 64.7% (n=55) of chicks had fledged or were at least 10 days old. Guillemot chicks gained an average of 11.63 g/day. We believe that several eggs were predated by corvids or gulls, and other burrows were flooded by rain events of storm surge. We captured six adult guillemots (1 recap and 5 unbanded) and banded 36 chicks.

Leach's Storm-Petrels

We located 215 active petrel burrows on the northern half of the island using audio callback, a burrow scope, or grubbing. We only confirmed eggs in 50 burrows as we were not able to see inside or reach the nest chamber in

most burrows. As of the last burrow check at the end of July, at least 50% of eggs had hatched (i.e. 25 chicks) with another 14 eggs still being incubated.

Common Eiders
We counted common eider nests opportunistically while conducting our gull census at the end of May. We located 34 nests based on finding a nest, finding an incubating female, or flushing a female out of a patch of dense vegetation. This census did not include the forest interior where additional hens were observed throughout the season. We observed the first eider ducklings on May 28 and then we regularly observed ducklings throughout the season. We recorded a high count of 67 hens and 180 ducklings on June 15. On July 20, we observed 97 older ducklings around the northern half of the island.

Sheep
Sheep graze freely across Metinic from September through May but are restricted to the southern half of the island during the seabird breeding season. With the help of Refuge staff, an electric fence was set up across the middle of the island and sheep were herded to the south side of the fence on May 15. A small group of sheep evaded round up efforts, and by the end of May, 16 sheep remained on FWS property. Throughout the season, these sheep repeatedly tried to enter the tern colony and were confirmed to have trampled eggs in at least one common tern nest.

Research:
Moth Surveys: Field technician Adrianna Nelson conducted surveys on 13 nights to document the diversity and abundance of moth species on Metinic. She used a black light bucket trap at three different locations. She observed 687 individual moths representing 124 different species. Most notable of these is the slender clearwing moth, a globally vulnerable species according to NatureServe.

Matinicus Rock

Tracey Faber, Island Supervisor – National Audubon Society Seabird Institute

Tern and Laughing Gull Census
The GOMSWG census was conducted on 19-20 June. We estimated a total of 686 Arctic Tern nests after adjusting the raw count with a Lincoln Index correction factor. We directly counted 290 Common Tern nests, or 29.7% of the total colony. Common Tern nests increased from 278 in 2022, and 25-50 nests were laid or re-laid after the census window island-wide. Arctic Tern nests decreased by 179 from 2022. LAGU nesting was decreased and delayed by hazing efforts such that only 4 active nests were found during the census.

Table 1. GOMSWG census results on Matinicus Rock, 2018-2023

Year	ARTE	COTE	LAGU
2018	717	268	1
2019	790	327	4
2020	No census	No census	No census
2021	854	395	121
2022	865	278	135
2023	686	290	4

Tern Productivity
Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Arctic Terns fledged 0.77 young per nest with a mean clutch of 1.47. Common Terns fledged 0.81 young per nest and mean clutch was 1.67.

Table 2. Tern productivity on Matinicus Rock 2021-2023

Species	Year	Mean clutch size	Hatch Success	Productivity	Nests monitored
ARTE	2021	1.71	0.88	0.25	48
	2022	1.92	0.84	1.16	49
	2023	**1.47**	**0.78**	**0.77**	**47**
COTE	2021	1.88	0.88	0.28	32
	2022	2.15	0.91	1.41	27
	2023	**1.67**	**0.74**	**0.81**	**27**

Tern Chick Provisioning

We conducted both Arctic and Common Tern chick provisioning studies. The most common prey item for Common Terns was sandlance, at 30% of items, while hake comprised 24% of prey. Common Tern diet was 21% inverts and 79% fish. 51% of Arctic Tern chick diet was amphipods, larval lobster, or unknown inverts, 16% was hake, and 10% was sandlance. Arctic Tern diet was 60% inverts and 40% fish. The predominance of sandlance in June contributed to rapid growth rates and slower feeding rates through early July.

Predator Activities and Control Efforts

Peregrine Falcons and Merlins were observed throughout the season but were never seen taking any monitored species. Two Herring Gulls predated young chicks and fledglings from mid-July through early August, and one was shot. 35 Laughing Gulls were shot, one to four every few days between May 23 and June 30, and carcasses were displayed in typical nesting areas, which were also searched for nests. A pair of Ruddy Turnstones predated around 50 nests of both tern species over two days prior to census.

This was the third year that Common Ravens nested on the island, though the pair abandoned their nest after being fired upon in early spring. They continued to predate adult alcids, alcid eggs, and Leach's Storm-Petrels throughout the season.

Atlantic Puffins

Preliminary productivity of Atlantic Puffins is 0.49, with hatch success of 0.59 and estimated fledge success of 0.85. Puffin diet was mostly sandlance (41%), followed by haddock (29%), and hake (16%). Sandlance comprised the majority of diet from late June through mid-July, when it was replaced by haddock, redfish (*Sebastes*, sp.), goosefish, and hake.

Razorbills

Razorbill hatch success was 0.62 (n=42), and productivity was 0.55 chicks fledged per nest, with a fledge success of 0.88. Razorbill diet consisted primarily of herring (51%), sandlance (34%), and hake (6%).

Black Guillemots

Preliminary productivity of Black Guillemots is 0.64 (n=45), with a hatch success of 0.62 (n=74) and estimated fledge success of 0.63 (n=31). Mean clutch size was 1.71 eggs per pair.

Common Murres

We recorded a high count of 76 Common Murres on 6 June. At minimum 18 eggs were laid, and 13 chicks hatched, with 12 likely fledging in late June to mid-July. This was the 6th consecutive year that Common Murres have bred on Matinicus Rock. Incidental diet observations consisted primarily of sandlance, with some herring and haddock.

Leach's Storm Petrels

Overall burrow density was 0.9/m2, and the occupancy rate across three productivity plots was 0.74. Productivity checks are ongoing, but incubation and early chick-rearing nest failures have occurred at a higher rate than in the previous four years of monitoring.

Manx Shearwaters

We used a combination of call playbacks, burrow latticing, and grubbing to assess Manx Shearwater activity throughout the season. Two burrows were dug out by ravens and remained empty throughout the season, though appeared to be partially re-dug in early August. Of the remaining four burrows, two hatched chicks.

Other Breeding Birds

In 2023, we confirmed breeding of Common Ravens, Common Eiders, Savannah Sparrows, and Herring Gulls, in addition to the above-mentioned species.

Seal Island National Wildlife Refuge

Coco Faber, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The 2023 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on June 16. As not all areas of the tern colony are cleared to walk through, a partial direct count of the colony was conducted across 14 grid squares within Area 1. A Lincoln Index of 1.046 was applied to the direct count, and an extrapolated total was derived from this number. We calculated a combined total of 1,659 Arctic and Common Tern nests. This is a decrease of 126 nests 2022, and the lowest combined census count since 1995. A species ratio was determined by identifying a sub-sample of nests to species, then used to calculate an estimated count of 1,604 Common and550 Arctic Tern nests. The number of Common Tern nests increased slightly from a 5-year low in 2022. In contrast, the number of Arctic Tern nests dropped significantly, to hit the lowest count since 1995 (Table 1).

Table 1. Adjusted number of tern nests found on Seal Island NWR from 2018-2023.

Year	COTE	ARTE
2018	1,204	829
2019	1,293	776
2020	No Census	No Census
2021	1,422	659
2022	1,064	721
2023	1,109	550

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots (Table 2). Mean clutch, mean hatch, and productivity were lower for both species this year compared to 2022. The low hatch success and productivity values are a result of multiple storms, gull predation in the fog, and a drop in provisioning late in the season that caused some fledglings to return to die.

Table 2. Tern productivity on Seal Island NWR, 2021-2023.

Species	Year	Mean clutch size	Hatch Success	Productivity	Nests monitored
COTE	2021	1.74	0.72	0.32	69
	2022	2.21	0.86	1.32	57
	2023	**1.93**	**0.84**	**0.51**	**59**
ARTE	2021	1.71	0.62	0.22	49
	2022	1.78	0.83	0.83	36
	2023	**1.50**	**0.73**	**0.60**	**30**

Tern Provisioning

Arctic Tern nests were observed for 636 cumulative nest-hours, with an average feeding rate of 1.60 feedings per nest per hour. Common Tern nests were observed for 648 cumulative nest-hours, with an average feeding rate of 0.82 feedings per nest per hour. Arctic Tern diet was 36.5% amphipods, 21.3% sandlance, and 16.7% hake, while Common Tern diet was 56.5% sandlance, 10.9% hake, and 10.7% herring (Table 3).

Table 4. Principal prey items (percent of diet by prey item) in tern chick diet on Seal Island NWR in 2023. Total number of prey items observed n= 1,016 for ARTE and n=533 for COTE.

Prey item	ARTE %	Prey item	COTE %
Amphipod	**36.5**	Sandlance	**56.5**
Sandlance	**21.3**	Hake	**10.9**
Hake	**16.7**	Herring	**10.7**
Euphausiid	**3.2**	Amphipod	**6.0**

Predator Activities and Gull Control Efforts

Gull predation was observed regularly, often at the fringes of the colony in the Area 1 meadows, and occasionally in the center of the tern colony. In late June and early July, there was an intense period of predation by several Herring Gulls and a Great Black-backed Gull that occurred in the dense fog. This included many missing eggs and chicks from productivity plots. One of the suspected Herring Gulls was shot, and little predation was observed subsequently. Gull control efforts included poking eggs in all gull nests found during a gull census conducted at the end of May and mid-June, as well as the culling of individual predatory gulls (Table 4). Low numbers of Laughing Gulls were observed daily, and one nest was found and destroyed in late July.

Table 4. Gull control measures by species at Seal Island NWR in 2023.

Species	# Nests destroyed	# Killed
Herring Gull	292	3
Great Black-backed Gull	35	0
Laughing Gull	1	0

Peregrine Falcons were rarely seen in 2023, after several years of regular Peregrine Falcon activity on the island. A Peregrine was only observed taking a single tern this season, though it is likely that more were predated.

Atlantic Puffins

Atlantic Puffin productivity is being monitored at 65 burrows. Hatch success was 0.77 chicks hatched per egg. This is the lowest recorded hatch success in the past five years. Productivity monitoring is ongoing, but the projected number of chicks fledged per pair is 0.59. This decline in productivity from 2022 is partially a result of soaking storms that contributed to low hatch success and the deaths of young chicks early on in the season (Table 5).

Table 5. Atlantic Puffin hatch success and productivity at Seal Island NWR from 2018-2023.

	# Burrows monitored	Hatch Success	Productivity
2018	63	0.92	0.60
2019	71	0.89	0.85
2020	73	0.88	0.76
2021	77	0.79	0.53
2022	78	0.94	0.81
2023	**65**	**0.77**	**0.59**

A total of 1,629 prey items were observed delivered to puffin chicks, comprising 19 identified species. Haddock and sandlance made up the majority of diet, at 36.2% and 34.5% respectively, followed by hake at 19.6% of prey items (Table 6). sandlance was observed nearly exclusively in bill loads mid-June until late July. It was replaced first by haddock and then by small hake and a low number of redfish and goosefish.

Black Guillemots

Black Guillemot productivity was monitored at 45 burrows. Average clutch size was 1.82 eggs laid per pair and average hatch success was 0.62 chicks hatched per egg. Productivity monitoring is ongoing, but the projected productivity is 0.62 chicks fledged per pair. This is the lowest productivity for Black Guillemots since 2014, largely driven by low hatch success.

Razorbills
A total of 95 active burrows were confirmed in 2023, an increase of 14 burrows from 2022. A subset of 45 burrows were monitored for productivity. Productivity this season was 0.62 chicks fledged per pair and hatch success was 0.80 chicks hatched per egg.

Cormorants
A minimum of 43 Great Cormorant and 34 Double-crested Cormorant nests were counted from photos taken on May 24. Compared to 2022, this is a decrease of 12 Great Cormorant nests and the same number of Double-crested Cormorant nests. Counts of chicks of both species are still being conducted to estimate productivity.

Ship Island

Aidan Colligan, Island Supervisor and Owen Beaupre, Island Intern - USFWS

Tern Census

We conducted the 2023 GOMSWG census on Ship Island on June 12th. The unadjusted count of common tern nests was 1,354, with a Lincoln Index of 1.031, and an adjusted count of 1,392 nests. This exceeds the 2022 count of 936 common tern nests and is the highest number of terns observed nesting on Ship Island.

Table 1. Number of tern nests on Ship Island from 2019-2023

Year	COTE
2019	427
2020	355
2021	426
2022	936
2023	1392

Tern Productivity

We monitored 64 nests in eight productivity plots. Average clutch size was 2.63 eggs per nest, hatch success was 86.3%, fledge success was 66.21%, and productivity was 1.50 chicks per pair. Chicks gained an average of 6.72 g/day. We found 43 dead chicks from our plots. The majority of chick deaths occurred from 7/25-7/31 during a period of low provisioning and significant weight loss.

Table 2. Reproductive success for common terns on Ship Island from 2019-2023.

Year	Nests monitored	Clutch size	Hatching success	Productivity
2019	36	2.05	77.0%	-
2020	33	2.27	78.8%	0.97
2021	45	1.61	66.2%	0.94
2022	60	2.52	79.3%	1.80
2023	64	2.63	86.3%	1.50

Tern Provisioning

We included 24 nests in our provisioning study and observed the nests for 564.5 hours. We observed 907 feedings with a rate of 1.61 average feeds/nest/hour. Most of the tern chick diet was comprised of Atlantic herring (85.96%) followed by Sand Lance (6.25%).

Table 3. Principal prey items (percent) in tern chick diet on Ship Island in 2023 (n=907).

Prey item	
Herring	85.96%
Hake	0.22%
Sand Lance	6.25%
Butterfish	0%
Pollock	1.43%
Stickleback	0%
Invertebrates	2.08%

Predator Activities and Control Efforts

We removed one great black-backed gull from Ship Island this season. Predation by two or more great black-backed gulls started June 30th and continued sporadically for the remainder of the season. We continued to harass gulls throughout the season and displayed multiple dead gulls along the beach. The terns aggressively mobbed any predator that entered the colony. We observed peregrine falcons 28 times this season, and they predated at least five adult terns. Additionally, merlin predated one fledgling tern. Northern harriers attempted to predate adults and chicks on two occasions.

We observed bald eagles flying over Ship Island, but never observed them attempting to land. The eagles primarily preyed on gulls nesting on Trumpet Island and cormorants on West Barge. Although we did not observe any mammalian predators, we proactively set five conibear traps in case any mink swam to Ship Island. Because of the history of owl visitation in recent years, we deployed five padded leg-hold and two Swedish goshawk traps for part of the season. We did not trap or observe any evidence of owls this year.

Other Species

We observed 57 species of birds on or around Ship Island in 2023. In addition to common terns, breeding was confirmed for three species of passerines, one species of waterfowl, and one shorebird. The vegetation on Ship Island is also managed with mowing and controlled burns. These management actions reduced the foraging and nesting habitat for songbirds. We estimated 5-6 song sparrow, 10-12 savannah sparrow, 4-5 mallard, 1 yellow warbler, and 6 spotted sandpiper pairs nested on Ship Island this year.

Common eiders were frequently observed on Trumpet Island, East Barge, and the waters surrounding Ship Island. We observed our first eider crèche on June 5th and the last crèche was observed on Aug 8th. We observed ducklings in age classes 1a and 1b with a single duckling seen at 1c and 11a. We did not observe any successful predation attempts on eiders, but gulls did attempt to predate ducklings.

Other Notes

Refuge staff partially mowed the vegetation on Ship Island to reduce the abundance and distribution of invasive species, and to encourage terns to nest in the interior of the island. Vegetation growth proved a significant issue this season causing nest abandonment and chick entanglement. We tested the efficacy of Vinegar (30% concentrated) and Avenger Weed Killer (55% d-limonene) on vegetation plots this season.

We deployed eight GPS tags on common terns to monitor spatial movements relative to chick provisioning. Data was transmitted to a base station and uploaded from Jun 12th to Aug 8th.

We collected 80 fecal samples from common terns to identify the diet of chicks and adults: 20 adults during incubation, 20 adults during chick rearing, and 40 chicks. The Refuge is working with Cornell University to conduct the DNA analysis of fecal samples to determine diet composition.

Petit Manan Island

Amanda McFarland: Island Supervisor – Maine Coastal Islands NWR, USFWS
Devin Leal, Jocelyn Little,and Logan Becker - Island Technicians
Dr. Natasha Gownaris- Visiting Professor from Gettysburg College

Tern Census

During the Gulf of Maine Seabird Working Group (GOMSWG) census on June 14, 2023, we counted 852 tern nests. We applied a Lincoln Index correction factor of 1.053 to this value and added our 64 productivity plot nests for an estimated total of 944 pairs of terns on Petit Manan Island (PMI). This represents a 21% reduction in the colony size as compared to 2022 (1,201 pairs). During peak incubation prior to the census, we identified 252 nests to species to calculate species ratios of interior habitats. We estimate 307 pairs of ARTE and 637 pairs of COTE nested on PMI, with a colony-wide ratio of 33% ARTE and 67% COTE. Additionally, seven Common eider (COEI) and three Laughing gull (LAGU) nests were documented during the census. The historic nesting area for LAGU was not surveyed as the LAGUs were generally deterred from nesting on the island. This resulted in an incomplete count for both COEI and LAGU nests on the island.

Table 1. Number of nests found on Petit Manan Island during the GOMSWG census window from 2019-2023.

Year	COTE	ARTE	LAGU	COEI
2019	937	365	656	45
2020	949	352	589	36
2021	872	461	820	36
2022	752	447	3	24
2023	637	307	3	7

Tern Productivity

At the egg-stage, nest predation was estimated to be 2.4% across the colony. This was slightly higher than the previous season (1.1%). This could have been due to poor weather and visibility (i.e. excessive fog) preventing immediate predator management. Within productivity plots, hatch success for COTE was 68.3% and ARTE was 36.1%. For ARTE, this was the lowest recorded hatch success in the past five years. We attributed this to low attendance during the incubation period. COTE productivity was recorded at 0.56 chicks per pair and ARTE productivity at 0.34 chicks per pair. Notably, fledge success for ARTE was the highest for the past five years, and body condition of fledglings was favorable. Arctic tern chicks gained an average of 7.34 g/day, while common tern chicks gained 7.17 g/day.

Table 2. Tern productivity summary for Petit Manan Island from 2019-2023.

YEAR	2019	2020	2021	2022	2023
COTE					
# of Nests	33	23	42	36	36
Mean Clutch Size	2.03	1.96	1.79	1.86	1.89
Hatch Success	76.1%	84.4%	50.7%	71.6%	64.1%
Fledge Success	54.9%	47.4%	13.2%	60.4%	45.4%
Productivity	0.85	0.78	0.12	0.81	0.56
ARTE					
# of Nests	44	36	43	60	56
Clutch Size	1.71	1.67	1.72	1.65	1.48
Hatch Success	79.2%	71.7%	74.3%	61.6%	36.1%
Fledge Success	55.7%	55.8%	12.7%	54.1%	63.3%
Productivity	0.77	0.67	0.16	0.55	0.34

Tern Provisioning

Provisioning observations were conducted on 9 ARTE nests and 11 COTE nests for a total of 452.3 observation hours (181 ARTE/ 271 COTE) with 396 prey deliveries (182 ARTE/ 271 COTE). Overall, chick diet differed between ARTE and COTE. COTE diet was primarily Herring and Sandlance, forming 71.5% of overall diet. ARTE chick diet was far more diverse, with the dominant prey items being Inverts, Sandlance, and Hake (Table 3). This was the lowest observed percentage of Hake within both species diet in the past decade. On average, ARTE adults delivered 1.00 prey items per nest per hour while COTE delivered 0.79 items per nest per hour.

Table 3. Principal prey items (%) in tern chick diets on Petit Manan Island in 2023.

Species	ARTE	COTE
Herring	12.60%	50.00%
Sandlance	18.10%	21.50%
Invertebrates	18.10%	3.70%
Hake	14.20%	4.70%
Unknown Fish	11.00%	6.10%
Larval Fish	7.70%	2.30%
Unknown	7.10%	2.30%
Butterfish	6.00%	1.40%
Hake or Herring	1.10%	3.30%
Pollock	0.60%	3.70%
Stickleback	1.10%	0.50%

Alcids

Our individual high counts for alcids were: 207 Atlantic puffins (June 13), 339 black guillemots (May 16), 43 razorbills (May 12), and 9 common murre (May 12).

We located 91 active Atlantic puffin (ATPU) burrows. We confirmed the fate for 86 of those burrows and found 59 chicks and considered 54 chicks to have fledged. Due to weather conditions in June, six burrows were flooded. ATPU egg laying and hatching was a week earlier than average. Early chick diet was 100% Sandlance, and chick condition was average until the third week of July, when we observed a sudden decline in chick weights. Chicks lost an average of 33 grams during this period. By the last week of July, we observed a diversity of diet items being fed to chicks, and they once again began gaining weight. Productivity was similar to that observed during the past decade. “Micro-puffins” were observed in some monitored burrows, but other chicks experienced typical weight gain this season. These smaller chicks were mostly observed in late hatched burrows. We located five active razorbill (RAZO) burrows. RAZO productivity was 0.2 chicks/pair.

We located 87 Black guillemot (BLGU) burrows. We monitored 56 burrows around the perimeter of the island and along the wooden boardwalk. BLGU productivity was 1.05 chicks/pair. Guillemot chicks gained an average of 11.8 g/day. Common murre were regularly observed on the rocky point beneath the lighthouse and on occasion we observed prospecting and performing courtship behavior. However, there was no evidence of any known breeding attempts in 2023.

Table 4. Active alcid nests and reproductive success at PMI, 2022.

Species	Burrows Monitored	Hatch Success	Productivity
ATPU	86	68.6%	0.63
RAZO	5	20.0%	0.20
BLGU	56	63.1%	1.05

Petrels

We located and flagged petrel burrows early in the season while vegetation was short. We returned to the burrows in late June and used burrow-scopes and an audio-playback to determine occupancy of incubating adults. We monitored a subset of 31 burrows that were easily grubbed or scoped. These burrows were permanently marked with metal tags for future monitoring. We determined that 24 of the 31 burrows had eggs, and we later found 17 chicks for an estimated hatching rate of 70.8%.

Due to poor weather, no mist-netting was attempted this season for LESP.

Predator Control

Avian predators were discouraged from roosting or perching on the island throughout the season by using pyrotechnics, bird spikes, an Agri-laser, and human presence. Peregrine falcons (PEFA) were the most frequent avian predator observed. PEFA were first observed on May 12th and we observed a minimum of 53 predation attempts. Due to high amounts of fog this season, we were unable to confirm most predation events for the month of June. We directly observed the predation of 17 terns. We also observed six additional tern feather piles. PEFA also predated one adult ATPU. We never observed more than one PEFA at the colony, therefore we do not know how many individuals frequented the colony this season. A Common Raven (CORA) was suspected of predating two adult Black Guillemots in July. Both events were within five days of each other, and no other events were observed afterward.

We continued the LAGU control from the previous season to prevent reestablishment. We focused our efforts on harassment, mostly through human presence on the western side of the island. In addition, we lethally removed five LAGU which attempted to nest. We found and removed eight more nests after the GOMSWG census. We lethally removed two Herring and one Great black-backed gull, two of which were injury related.

Other Research

Stable Isotope/Fecal Sampling: A total of 36 fecal samples were collected from COTE, ARTE, and ATPU to be used to compare diets of chicks to adults and among species. The Refuge is working with Cornell University to conduct the DNA analysis of tern and alcid fecal samples to determine diet composition.

Stable Isotope/Blood Sampling: In partnership with Dr. Natasha Gownaris (Gettysburg College), blood samples were collected from 50 individual chicks for stable isotope analysis. Both alcids (11 BLGU/ 10 ATPU) and terns (16 ARTE/ 13 COTE) were sampled throughout the season. We sampled 28 individuals a second time, totaling 78 samples collected among all species. Additionally, 45 eggshell samples were collected from ARTE, COTE, ATPU, BLGU, RAZO, and LESP for further analysis.

Tern GPS Tagging: In partnership with Dr. Natasha Gownaris (Gettysburg College) we deployed 12 GPS tags on four ARTE and eight COTE. Due to low attendance within the colony, high abandonment was observed among tagged birds. Productivity for tagged birds was similar to the colony wide productivity for ARTE (0.33), but lower for COTE (0.38).

Leach's Storm-petrel GPS Tagging: In partnership with Keenan Yakola (Oregon State University) we deployed 12 GPS tags on LESP. Tags were deployed during the incubation period and removed after five days. We successfully retrieved 10 tags. We determined that three of the burrows were abandoned after the tags were deployed. Hatch success for tagged nests was 50%.

2023 Maine State Synopsis of Nesting Least Terns

From June 15 - 28 two coordinated walking nest census counts documented a minimum of 193 nesting pairs of Least Terns in Maine. This was 84 pairs fewer than last year's 277 pairs and was the second lowest pair count in the past ten years. During the census window, 9 nests were on Laudholm, 77 nests on Crescent Surf, 76 nests on Stratton Island, 8 nests on Goose Rocks, 20 nests on Higgins, and 3 nests on Seawall. After the census window passed, high counts of 10 nests on Goose Rocks, 11 nests on Seawall, and 3 nests on Reid State Park were recorded. The Least Terns on Laudholm fledged a minimum of 1 chick, Crescent Surf a minimum of 8 chicks, and Stratton Island fledged a minimum of 4 chicks. Goose Rocks, Higgins, Seawall, and Reid did not fledge any chicks which left the state with a minimum total of 13 fledglings and an estimated productivity of 0.07 fledglings per pair. This was the lowest number of fledglings and lowest productivity recorded since monitoring and management of Least Terns began in 2003.

Estimate of Least Tern Pairs

	WELLS	LAUDHOLM FARM	CRESCENT SURF	GOOSE ROCKS	WESTERN BEACH	STRATTON ISLAND	HIGGINS	RAM ISLAND	SEAWALL	POPHAM	REID STATE PARK	TOTAL
2003	0	20 (0)	57 (8)	8 (0)	0	-	38 (53)	0	0	0	33(5)	156 (66)
2004	15(10)	1 (0)	[50] (3)	0	0	-	45 (54)	0	0	0	50(2)	146 (69)
2005	0	4 (1)	[52] (7)	0	[40](3)	18 (9)	[22] (0)	0	[17] (0)	0	0	114 (20)
2006	[1] (0)	0	30 (10)	[25] (1)	0	103 (15)		0	0	0	[1](0)	134 (26)
2007	1 (1)	0	[37] (1)	[45] (2)	0	113(10)8	0	0	0	0	0	150*(112)
2008	0	0	92 (52)	2 (0)	[2]	72 (33)	0	0	0	0	0	166* (89)
2009	0	0	102**(62)	[6]**(0)	0	72 (16)	[16] (0)	0	0	0	0	170 (78)
2010	0	[1]**	136**(45)	[18]**	0	76** (5)	0	0	0	0	0	211* (50)
2011	0	0	123* (73)	23* (12)	0	59* (28)	0	0	0	0	0	205*(113)
2012	0	0	99* (78)	0	0	86-92* (72)	0	5 (1)	0	2	0	185-191* (155)
2013	0	0	129* (93)	0	0	92* (79)	0	0	0	3* (0)	0	224*(172)
2014	0	4** (4)	164* (29)	0	0	79* (36)	4* (0)	0	0	2* (?)	0	249* (72)
2015	0	6** (0)	138*(144)	0	0	69* (0)	25* (6)	0	0	14* (3)	0	233*(153)
2016	0	2**(0)	169*(15)	10**(7)	4(0)**	69*(14)	0	0	1(0)**	22(0)**	0	238*(36)
2017	0	1*(0)	115*(13)	4*(0)	48*(5)	87*(1)	0	0	0	0	0	255*(19)
2018	0	21*(0)	43*(19)	2**(0)	4**(0)	122*(50)	10**	0	0	0	0	186*(69)
2019	0	0	156*(31)	0	35*0)	84*(14)	21*+(16)	0	0	0	0	296*(61)
2020	0	0	130*(65)	0	0	0	128*(50)	0	7(1)	0	0	258*(116)
2021	0	18*(41) ***	116*(40) ***	[10]**(0)	0	[63]*(0)	71*(17)	0	13*(39)	0	0	281*(137)
2022	0	23*(18)	102*(0)	5**(1)	0	91*(14)	51*(5)	0	10*(2)	0	0	277* (40)
2023	0	9*(1)	77*(8)	8*(0)	0	76*(4)	20*(0)	0	3*(0)	0	0	193*(13)

( ) number of fledglings
[ ] colony deserted

***** simultaneous count at all occupied nesting sites during window count, not a site specific high nest count, only these numbers used in total. In 2017, after window count, colonies moved around substantially due to predation issues, in 2018 a synchronized count was not possible as the CS colony was disrupted and colonies never really synched up.

**** nesting outside of the window count and not included in state total**

*** Productivity at Crescent Surf and Laudholm Farm should be calculated by combining number of nests and fledglings from the two beaches and be considered one "Little River colony" as LETE were moving back and forth between beaches after fledging making it impossible to know which birds fledged from which beach.

Laudholm Farm Beach, Wells

Helen Manning, Kate O'Brien, and Katelyn Shelton - Rachel Carson NWR

Population Estimate: 9 Least Tern pairs were nesting during the walking nest count census conducted on June 27. One fledgling count was conducted on July 18 where a minimum of 1 fledgling was observed. All terns left the beach before a second count was conducted. Laudholm experienced week-long 11+ft tidal over wash events once a month which contributed to nest and chick loss and eroded the beach. This summer experienced long periods of rain and fog which lead to some chick loss. There was also suspected but unconfirmed red fox predation after the electric net fence dropped below an effective voltage and a fox got inside.

Comparison: 21 pairs nested at Laudholm in 2018 but all nests were predated by a fox after the electric net fence failed. There were no pairs nesting at Laudholm in 2019 or 2020. In 2021 there were 18 pairs nesting which combined with Crescent Surf's 116 pairs produced at least 81 fledglings. In 2022, 23 pairs produced 18 fledglings.

Predator Management: Predator management was not conducted at Laudholm Farm Beach. An electric net fence was set up around the colony but temporarily removed during the 11ft tide cycles then replaced after they passed.

Crescent Surf Beach, Kennebunk

Helen Manning, Kate O'Brien, and Katelyn Shelton - Rachel Carson NWR

Population Estimate: 77 Least Tern pairs were nesting during the walking nest count census conducted on June 27. One fledgling count was conducted on July 18 where a minimum of 8 fledglings were recorded. All terns had left the beach by the time a second fledgling count would have been conducted. Crescent Surf experienced week-long 11+ft tidal over wash events once a month which caused major nest loss and beach erosion. The long periods of rain and fog this summer contributed to chick loss along with a Cooper's Hawk that was actively hunting tern fledglings. There was also suspected but unconfirmed red fox predation after the electric net fence dropped below an effective voltage and a fox got inside.

Comparison: Crescent Surf Beach saw its most successful years in 2015, 2013, and 2012 with productivity of 1.04, 0.76, and 0.79 respectively. 2021, 2020, 2011, 2009, and 2008 were decent years with productivities between 0.5-0.6. Productivity was poor in 2017, 2016, and 2014, and was also poor from 2003-2007. In 2022, 102 pairs nested and did not fledge any chicks.

Predator Management: USDA Wildlife Services removed specialist predators from the Crescent Surf Beach area throughout the breeding season. An electric net fence was set up around the majority of the colony but temporarily removed during the 11ft tide cycles then replaced after they passed.

Goose Rocks Beach, Kennebunkport

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: A colony of roughly 35 Least Terns attempted to nest on Goose Rocks. During census there were a total of 8 nests and a seasonal high count of 10. No chicks hatched or fledged. There was constant heavy nest predation from skunks, fox, and crow throughout the entire nesting season.

Comparison: In 2022, five nest attempts hatched two chicks and fledged one. A small colony of Least Terns attempted to nest in 2021. There were ten nesting attempts but no chicks survived until fledging and the colony abandoned in late July. No nesting attempts were made in 2020 or 2019, although courtship was observed. Two nesting attempts were made in 2018 but no chicks hatched. At least seven pairs attempted to nest in 2017 but all were unsuccessful. Ten pairs of Least Terns made nest attempts on Goose Rocks in 2016 fledging at least seven chicks. No nesting attempts were made at Goose Rocks between 2012-2015. In 2011 a season high of 46 birds were documented and produced a minimum of 12 fledglings. In 2010, a small colony set up after failures at Crescent Surf and Stratton Island, however no chicks survived.

Predator Management: None.

Stratton Island

National Audubon Society

Population Estimate: 76 nests were counted during the nest census conducted on June 15 and a total of 91 nest attempts were recorded throughout the season. In late June, Black-crowned Night Herons predated the majority of the island's chicks and the colony never really recovered. Some Least Terns attempted to re-nest but faced challenges with heavy encroachment by nesting Common Terns who were observed kleptoparasitizing food-carrying Least Terns and were witnessed attacking Least Tern chicks out of aggression. Gulls may have impacted the nesting as well. A minimum of 4 fledglings were produced from the Least Tern colony this year.

Comparison: In 2022, at least 14 fledglings were produced from 91 pairs. Black-crowned Night Heron predation was the biggest struggle in 2022. In 2021 at least 63 pairs nested on the island but abandoned after two nights of Black-crowned Night-Heron predation and tropical storm Elsa, no chicks fledged. In 2020 least terns did not attempt to nest on the island. 84 pairs produced 14 fledglings in 2019 and 122 pairs produced 50 fledglings in 2018. In 2017 only one chick fledged from 87 nesting pairs. Stratton Island has historically hosted the second largest least tern colony in the state.

Predator Management: Predator management was conducted on Stratton Island. Specialist predators targeting the colony were removed.

Higgins Beach, Scarborough

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: A total of 20 nests were counted during the census with an estimated flock size of 55. There appeared to be a second wave of nesting but a fox made it into the electric fence and predated the entire colony before another nest count could be completed. The Least Terns remained around for a couple of weeks after the predation event but never successfully re-nested. One chick was seen during one visit but no chicks fledged. The electric fence was a struggle throughout the season, starting with battery issues, then low voltage, and eventually a fox getting into the colony.

Comparison: A colony with at least 51 nesting pairs fledged a minimum of five chicks in 2022. In 2021, at least 71 pairs nested and fledged a minimum of 17 chicks. A colony of at least 128 nesting pairs of Least Terns on Higgins Beach fledged at least 50 chicks in 2020. A smaller colony of 55 pairs fledged 16 chicks in 2019. A small colony was unsuccessful in 2018 and no terns nested in 2017. In 2016, a colony had begun to form at the end of May, but a storm tide in early June washed over the area, and no nests were laid. In 2015 and 2014, small colonies formed at Higgins Beach, fledging 13 chicks in 2015 and none in 2014. No Least Terns nested on Higgins between 2010-2013.

Predator Management: An electric net fence was set up surrounding most of the colony but had continual problems of low voltage and fox tracks were seen inside the fenced area.

Seawall Beach, Phippsburg

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: In 2023, there was a small colony of about ten adults with three nests during the census count. The colony grew to 50 adults with a high count of 11 nests. Predators were a constant problem, twice weekly visits would yield new nests and the following visits egg shells and predators tracks throughout. No chicks hatched or fledged.

Comparison: Last year a high count of 27 nests were counted and a total of two chicks fledged. In 2021, 39 chicks fledged from a minimum of 60 nesting pairs, although only 13 nests were recorded during the window count. In 2020, a small colony of Least Terns nested on Seawall beach. Of the seven nests, at least one chick fledged. A single Least Tern nest was found in 2016 on Seawall, but otherwise terns have not attempted to nest at Seawall Beach since 2005. That year a 17 nest colony was decimated by a fox or coyote.

Predator Management: None.

Reid State Park, Georgetown

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: A small colony of six arrived and nested late in the season on Half Mile Beach at Reid State Park. Three nests were counted and one chick hatched. The chick did not survive until fledge.

Comparison: Least Terns have not nested at Reid State Park since 2006. A single nesting pair was documented in 2006, but no fledglings produced.

Predator Management: None.

Canada

Machias Seal Island

April Kowalchuk-Reid, Island Co-Supervisor; Aditya Gandhi, Island Co-supervisor; Tristan Sanford, field technician, MSc Candidate – UNBSJ; and Katie Danyk, field technician.

Tern Census

No formal tern census was conducted in 2023.

Table 1. Estimated Number of Tern Nests on MSI (formal census in 2014 and 2018).

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
175	75	50	90	187	150	175	300	476	500	0
2021	**2022**	**2023**								
-	116	97								

Productivity

Fledging success was down this year compared to last. We had 16 chicks considered fledged. Upon the crew's arrival on May 11th, very few terns were present and no nests were found. It took about three more weeks for the Terns to begin landing. The first nest was found on June 2nd, mean lay date was June 13.

We monitored 67 nests for productivity (all ARTE) for a total of 87 eggs. The average clutch size was 1.29 (SD 0.52). Of the 87 eggs, 12 did not hatch, 44 went missing and were presumably depredated, and 31 hatched for an

overall hatch success of 0.41. First hatch was June 25th with a mean hatch of July 5th. Of the 31 chicks that hatched, 9 (29.0%) were found dead, 16 fledged (51.6%), and 6 chicks could not be found (19.4%).

Table 2. Breeding parameters as means ±SD for Common, Arctic, and Roseate terns on Machias Seal Island in 2023.

Species	Clutch Size	Hatching Success	Fledging Success	Nests Monitored
COTE	NA	NA	NA	NA
ARTE	1.3	0.41	0.52	97
ROST	NA	NA	NA	NA

Tern Provisioning

We completed 9 hours of ARTE chick provisioning observations on a total of 2 nests. We were unable to complete more due to a lack of nest density, visible chicks, and chick survival. These observations were first made on July 9th and continued until July 22nd when no feeding observations were made in the first hour of observations. A total of one individual prey item was observed to be fed to the monitored chicks. Based upon observations of adults arriving with prey outside of feeding watches, sandlance was the primary prey fed to chicks early in the season, this shifted to stickleback and pollack in the later season.

Predator Activities and Control Efforts

Non-lethal gull control included disturbing gulls observed in the colony using arm waving. The paintball device was non-functional this year, it will be repaired for the 2024 season. Lethal gull control continued and a total of 7 HERG were killed by our nuisance wildlife control officer during July 2-5. We did not find any active gull nests on MSI in 2023. Laughing Gulls were consistently seen flying around the island but we did not observe any nesting behaviours. A high count of 17 individual LAGU was recorded on June 12th, very few were seen in July and August. A HERG with a broken wing feasted in the colony until it was shot on July 4th. It was observed eating Tern eggs in the colony on many occasions and is the likely reason for most of our missing ARTE eggs.

Gull Rock, an adjacent island with a persistent breeding colony of HERG and GBBG, was visited once on June 22nd. A total of 17 gull nests (17 HERG and 0 GBBG), were found and destroyed by shaking and poking eggs. A total of 41 eggs were destroyed. Due to the timing of our visit to Gull Rock, some of the gull eggs had hatched or were in the process of hatching. We found 7 gull chicks during our search of the island.

Common Eiders

Counts were conducted weekly starting May 14th. Our highest count was a total of 388 individuals (222 males, 166 females, and 0 ducklings) on June 7th. We were unable to conduct Eider count for three straight weeks (June 25-July 9) due to thick fog, thus likely missed the peak duckling period. Our highest count of ducklings occurred on July 16th with 64 ducklings counted.

Alcids: Atlantic Puffin

No formal ATPU census was conducted in 2023.

We spent a considerable amount of time early in the season grubbing every marked burrow on the island, pulling stakes of burrows that are collapsed or too deep to monitor, and re-painting the remaining stakes. We added a total of 10 new burrows in two locations (5 burrows at Goofa, and 5 near Sunset blind) bringing our total number of marked burrows to 104. Occupancy for the 94 marked burrows from previous years was 81%. We were able to estimate hatch success from a total of 82 burrows, 30 eggs went missing, 4 were found dead, and 48 hatched (hatch success = 59%). First hatch occurred on June 9th and mean hatch was June 21 (SD = 7.50). We had a high number of chicks that were too small to band before we departed the island and were unable to include those individuals in our final estimates of fledge success and reproductive success. Out of a total of 42 burrows, 25 chicks fledged, 19 went missing, and 4 were found dead (fledge success = 0.60). Overall reproductive success was 33%, lower than our long-term average. We banded a total of 220 fledgling puffins (132 from burrows, including our productivity burrows, and 88 “lighthouse fledgers”).

A total of 102 hours of ATPU chick provisioning stints were conducted. Food comprised mostly of Sandlance and hake in the early part of chick-rearing and then switched to mainly squid, unknown larval fish, and pollack. At that point many of our productivity chicks began growing very slowly.

Alcids: Razorbills
No formal RAZO census was conducted in 2023.

Upon our arrival in mid-May, a total of 97 of our 108 marked burrows were active (occupancy = 90%). Of the 97 active burrows, 0 were dropped, 30 eggs were found dead or went missing and 67 hatched (hatch success = 0.69, first hatch = May 17th, mean hatch = June 9th, hatch SD = 8.25). Of the 67 chicks, 6 went missing, 6 were found dead, and 55 were considered fledged (fledge success = 0.82).

A total of 35 productivity chicks were banded. An additional 11 chicks were banded from non-productivity burrows.

A total of 58 hours of RAZO chick provisioning stints were conducted. Food seemed to be very good for RAZO this year and comprised mostly of herring, sandlance, and hake.

Alcids: Common Murre
COMU numbers remain high this year. From June 30- July 2, a minimum of 843 active nests were estimated (311 eggs, 532 chicks), lower than 2022. A total of 128 chicks and 10 adults were banded this year. A total of 61 hours of COMU chick provisioning stints were conducted with diet consisting mainly of herring, butterfish, and rock eel.

Table 4. Breeding parameters for Atlantic Puffins and Razorbills on Machias Seal Island in 2023. Data for 2022 shown in parentheses.

	n	**Mean Lay**	**Mean Hatch**	**Burrow Occupancy**	**Hatching Success (hatch/ active nest)**	**Nest Success (fledge/ active nest)**	**Linear Growth Rate (mass)**
ATPU	55 (95)	10-May (10-May)	21-June (22-June)	0.81 (0.79)	0.59 (0.74)	0.33 (0.49)	10.5 (6.0)
RAZO	97 (73)	4-May (7-May)	9-June (9-June)	0.90 (0.81)	0.69 (0.62)	0.57 (0.37)	3.01 (4.97)

Table 5. Principal prey items (percent) in alcid chick diet on Machias Seal Island in 2023; *n* is the total number of prey items identified.

Prey Item	**ATPU**	**COMU**	**RAZO**
n	1134	450	207
Euphausid	0.53	0.00	0.00
Fish Scrap	1.78	4.00	1.45
Hake	11.20	9.33	20.29
Hake or Herring	3.09	0.67	4.35
Haddock	0.97	0.22	0.48
Pollock	3.79	2.89	1.45
Larval hake	0.97	0.00	0.00
Larval sandlance	0.88	0.00	0.97
Larval unknown fish	4.41	0.00	0.48
Sculpin	0.00	0.00	0.00
Rock eel	0.09	10.67	0.00
Polychaete	0.09	0.00	0.00
Squid	3.62	3.11	0.00

Herring	6.61	19.78	35.27
Radiated shanny	0.00	0.00	0.00
Red fish	0.35	4.22	0.97
Red hake	0.00	0.00	0.00
Sandlance	53.35	8.00	23.19
Shrimp	0.00	0.00	0.00
Butterfish	0.62	12.44	0.00
Unknown	0.00	0.00	0.00
Unknown fish	6.79	10.67	10.63
Unknown gadoid	0.00	0.00	0.00
Silverside	0.00	0.00	0.00
Isopod	0.00	0.00	0.00
Atlantic Saury	0.00	0.00	0.00
Lumpfish	0.00	0.00	0.00
Mackerel	0.00	0.00	0.00

North Brother Island - Lobster Bay, Nova Scotia

Ted D'Eon, Alix d'Entremont, Kathleen MacAulay – Island stewards; Julie McKnight – ECCC-CWS; Luc Bilodeau, Shawn Craik, Macy d'Eon – Université Sainte-Anne; Alexis Saulnier, Mark Mallory – Acadia University; Nova Scotia Department of Natural Resources and Renewables

Tern Census

The annual tern nest census was conducted on 9 June 2023 with six observers. We surveyed all suitable nesting habitat by making systematic sweeps through the colony and placed wooden craft sticks in each nest upon discovery to avoid counting individual nests more than once. We report in Table 1 nest total for ROST (census + year-end) and the number of COTE and ARTE nests counted during the census. A total of 676 tern nests were counted during the nest census. The number of tern nests counted during this year's count was lower compared to last year's count of 1032; however, last year was the highest nest count recorded for North Brother Island since tern nest monitoring began in the 1990s.

The first COTE eggs were laid during 15-19 May and the first ARTE and ROST eggs were laid during 20-23 May, and which seem to represent slightly earlier first egg dates compared to 2022.

Table 1. Number of tern nests found during nest surveys on North Brother Island from 2019-2023. The survey is conducted during peak tern nesting.

Year	COTE	ARTE	ROST	LETE
2019	372	35	47 (year end: 52)	-
2020	664		49[1]	-
2021	771	65	46 (year end: 51)	-
2022	855	134	43 (year end: 50)	-
2023	587	38	51 (year end: 61[2])	-

[1] The count of 49 nests includes a nest attended by a hybrid COTE x ROST pair
[2] The count of 61 nests includes a nest attended by a hybrid COTE x ROST pair

Productivity

Fledging success was not measured.

Table 2. Reproductive parameters for Common, Arctic, and Roseate terns on North Brother Island from 2019-2023.

Species	Year	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2019	2.53	0.63	-	30
	2020	-	-	-	-
	2021	2.52	0.94	-	25
	2022	2.40	0.79	-	30
	2023	**2.47**	**0.46**	**-**	**30**
ARTE	2019	2.00	0.74	-	36
	2020	-	-	-	-
	2021	2.00	0.78	-	23
	2022	2.00	0.75	-	30
	2023	**1.76**	**0.08**	**-**	**37**
ROST	2019	1.46	0.95	-	52
	2020	1.30	0.86	-	49
	2021	1.67	0.92	-	51
	2022	1.61	0.94	-	50
	2023	**1.43**	**0.63**	**-**	**61**

Tern Provisioning

Table 3. Chick provisioning data collected on North Brother Island via blind observations, GoPro footage, and photography, 2023.

Prey item	COTE	ROST	ARTE
Herring	51%; n = 100	53%; n = 69	-
Sand Lance	3%; n = 6	38%; n = 49	-
Hake	5%; n = 9	3%; n = 4	-
Mummichog	5%; n = 10	1%; n = 1	-
Stickleback	3%; n = 6	-	-
Ant	17%; n = 33	1%; n = 1	60%; n = 3
Butterfish	-	-	20%; n = 1
Marine Invertebrate	3%; n = 5	-	20%; n = 1
Shrimp	1%; n = 4	-	-
Other Prey (Pollock, fish scraps, Atlantic silverside, or smelt)	1%; n = 4	2%; n = 2	-
Unidentified	10%; n = 19	2%; n = 3	-

Table 4. Tern provisioning data (mate and chick feeding) collected on North Brother Island via blind observations, GoPro footage, and photographs, 2023.

Prey item	COTE	ROST	ARTE
Herring	27%; n = 269	47%; n = 120	15%; n = 9
Sand Lance	22%; n = 218	43%; n = 108	43%; n = 26
Mummichog	10%; n = 100	0.4%; n = 1	-
Atlantic Silverside	4.6%; n = 46	0.4%; n = 1	-
Hake	4.6%; n = 46	3.2%; n = 8	17%; n = 10
Shrimp	3.7%; n = 37	-	-
Lumpfish	1.4%; n = 14	-	-
Stickleback	1.4%; n = 14	-	-
Fish Scraps	1.1%; n = 11	-	-
Flying Ant	4.5%; n = 45	1.2%; n = 3	8.3%; n = 5
Pollock	0.1%; n = 1	1.2%; n = 3	-
Marine Invertebrate	1.3%; n = 13	-	1.7%; n = 1
Spider	-	-	5%; n = 3
June Bug	0.9%; n = 9	-	3.3%; n = 2
Other Prey (Butterfish, Eel, Smelt, Squid, Pipefish or Moth)	1.6%; n =16	-	-
Unidentified Prey	17%; n = 166	3.6%; n = 9	6.7%; n = 4

*A large percent of the unidentified prey was likely hake or herring.

Predator Activities and Control Efforts

No gulls nested on North Brother Island and South Brother Island was not visited. Evidence of predation was observed at most Arctic tern nests, and which contributed to zero productivity for the species. Many Common tern nests also showed signs of predation. Trail camera photos will be analyzed by students in the coming weeks to try to identify predators on the island.

On two consecutive days, an adult male Northern Harrier entered the colony and successfully captured a chick (June 21st & 22nd). Evidence of predation of an adult Common tern by a Great Horned Owl was recorded on June 25th.

The predator pressure on terns from gulls increased as the season progressed, reaching its peak during tern hatching and rearing. From their loafing grounds on the edge of the island, gulls were observed to occasionally enter the colony in an attempt to capture chicks; indeed, one Herring gull captured a chick on July 6th and one Great Black-backed gull captured a fledged ROST chick on July 9th.

Common Eiders

Six eider nests were recorded on North Brother Island with clutch sizes of 3, 3, 4, 4, 6, and 7. All nests were abandoned.

Other Notes

Islands in the Lobster Bay and surrounding area were surveyed around the time of peak tern nesting, however no Roseate nests were found in any of the nearby colonies.

Three adult tern carcasses were collected for laboratory analysis; one of which was a Roseate tern (June 7th) and the other two were Common terns (June 9th). The Roseate tern was thin and food was not found in its stomach during the necropsy. One of the two Common terns seemed to have been attacked by a predator, while the other was found dead on its nest with wings open. The latter tested positive for HPAI (presumed positive). No other evidence nor behaviour consistent with Avian Influenza was observed for adult terns for the remainder of the season.

There was a high rate of mortality among chicks across all three tern species soon after hatching (0 to 6 days). The exact mortality rate was not calculated. We suspect that following the large die-off of young tern chicks and

accompanying decrease in adult tern population size (i.e., terns abandoning colony after nest loss), most of the remaining chicks were predated by gulls. To minimize disturbance to the colony and remaining chicks, young terns were not banded or swabbed for Avian Influenza (HPAI). However, deceased Common (7) and Roseate (4) tern chicks were collected on June 22nd and 25th and sent for HPAI testing; all tests were negative. As of yet, no cause of death has been identified for the chicks.

A MSc study is underway (Alexis Saulnier) and focuses on a comparison of the diet, foraging routes, and foraging habitat use by ROST, COTE, and ARTE breeding on North Brother Island. Specifically, the number and frequency of prey species consumed by chicks of each species from year to year are being interpreted with data collected from chick provisions (2021/22/23) and DNA metabarcoding (2021/22). A comparison of foraging habitat use between the specialist forager – ROST – and the more generalist forager – COTE – is helping identify important prey and foraging locations for the terns of North Brother Island.

An undergraduate honours thesis has also begun (Macy d'Eon) evaluating whether the prey provided by ROST differs between the (i) pre-hatch and (ii) post-hatch periods. Using data collected on North Brother Island during the 2022 and 2023 breeding seasons, this study will assess the quality and efficacy of two data collection methods: GoPros video footage and photographic data of prey.

Afternoon Session

Using Seabird Data to Inform Offshore Wind Development in the Gulf of Maine

Julia Gulka – Biodiversity Research Institute

Roseate Tern Nest Depredation Mitigation through Nestbox Configuration and Audio Deterrents

Mark Baran – Mass Wildlife

Mapping aggression: research updates 2023

Kay Garlick-Ott – UC-Davis

Seabird Tracking in the Gulf of Maine 2023

Keenan Yakola – Oregon State University

GOMSWG 2023 Attendees

Name	Affiliation
Aidan Colligan	USFWS-Maine Coastal Islands NWR
Alexis Saulnier	Acadia University
Ali Ballard	National Audubon Society
Amanda McFarland	USFWS-Maine Coastal Islands NWR
Amy Simmons	National Audubon Society
April Kowalchuk-Reid	UNB
Art Borror	
Ayla Liss	National Audubon Society
Ben Becker	National Audubon Society
Betsy Cadbury	
Brad Zitske	Maine Department of Inland Fisheries & Wildlife
Brian Benedict	USFWS-Maine Coastal Islands NWR
Coco Deng	National Audubon Society
Coco Faber	National Audubon Society
Danielle D'Auria	MDIFW
Derrick Jackson	Project Puffin Co-Author
Devin Leal	USFWS-Maine Coastal Islands NWR
Don Lyons	National Audubon Society
Eddy Edwards	USFWS-Maine Coastal Islands NWR
Emma Lachance Linklater	National Audubon Society
Heather Major	UNB
Heather Williams	USFWS - Monomoy NWR
Helen Manning	USFWS - Rachel Carson NWR
Jacob Ligorria	National Audubon Society
Jean Hall	Volunteer Project Puffin
Jeff Spendelow	
Jess Golumbeski	
Jill Tengeres	USFWS-Maine Coastal Islands NWR
Julia Gulka	Biodiversity Research Institute
Juliana Ramirez	National Audubon Society
Kate Williams	Biodiversity Research Institute
Kay Garlick-Ott	National Audubon Society/UC Davis
Keenan Yakola	National Audubon Society/Oregon State University
Kelly Bell-Brown	National Audubon Society
Kelsey Sullivan	MDIFW
Kim Keller	National Audubon Society
Laura Williams	Maine Audubon Society
Linda Welch	USFWS-Maine Coastal Islands NWR
Lindsy Buckland	National Audubon Society
Liv Ridley	National Audubon Society
Mael Glon	USFWS

Margaret (Meg) Harrington	USFWS New England Field Office
Margaret Jensen	National Audubon Society
Mark Baran	Mass Fish and Wildlife
Meg Getzinger	National Audubon Society
Michael Langlois	USFWS-Maine Coastal Islands NWR
Orena Wong	UNH - White and Seavey
Pam Loring	USFWS
Paula Shannon	National Audubon Society
Peggy Friar	UNE retired
Peyton Caylor	National Audubon Society
Peyton Priestman	National Audubon Society
Quinn Carvey	UNB
Richard Podolsky	
Roxanna Sadaatzedeh	National Audubon Society
Ryan Potter	USFWS-Maine Coastal Islands NWR
Sarah Morrow	National Audubon Society
Shawn Craik	Université Sainte-Anne
Silas Hernandez	National Audubon Society
Steve Kress	National Audubon Society retired
Susan Schubel	National Audubon Society
Tasha Gownaris	Gettysburg College
Theresa Rizza	National Audubon Society
Tracey Faber	National Audubon Society
Zeke Smith	National Audubon Society