Gulf of Maine Seabird Working Group (GOMSWG)
38th Annual Summer Meeting Report

Meeting held virtually via Zoom
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Visit the website: gomswg.org

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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.

Though the COVID-19 pandemic was still with us in 2022 the impacts to colony monitoring and management were much reduced compared to previous seasons. This year brought another challenge in the form of highly pathogenic avian influenza (HPAI). HPAI was documented in several colonies and caused mortality in many species including waterfowl, gulls, and terns. Colony managers implemented additional safety procedures to include greater personal protective equipment for staff and sanitizing equipment during banding procedures to reduce the spread of HPAI.

Once again, the 2022 GOMSWG meeting was held virtually, via Zoom due to the continued COVID-19 pandemic. Meeting activities included summaries of island activities, reported in geographical order from Canada south to Massachusetts. A table with 2022 GOMSWG census results will be distributed concurrently with this report and/or made available at the GOMSWG website (gomswg.org).

Island and Site Reports

Canada

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, Sophie Landry – Université Sainte-Anne; Alexis Saulnier – Acadia University; Nova Scotia Department of Natural Resources and Renewables

Tern Census

The tern census was conducted on North Brother Island on 12 June 2022 with three observers. We surveyed all suitable nesting habitat by making systematic sweeps through nesting habitat 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 1032 tern nests were counted during the nest census, representing the highest nest count recorded for The Brothers since nest monitoring began by Ted D'Eon in 1990.

The first COTE and ARTE eggs were laid during 19-22 May and the first ROST eggs were laid during 26-31 May.

Table 1. Number of tern nests found during survey on North Brother Island from 2015-2022. The survey is conducted during peak nesting.

Year	COTE	ARTE	ROST	LETE
2015	687		35 (year end: 42)	-
2016	619		42 (year end: 52)	-
2017	141[1]		24[1]	-
2018	74[1]		2[1]	-
2019	372	35	47 (year end: 52)	-
2020	664		49[2]	-
2021	771	65	46 (year end: 51)	-
2022	855	134	43 (year end: 50)	-

[1] Colony was abandoned post-census due to heavy predation

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

Productivity

Fledging success is not measured.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on North Brother Island 2022. Data for 2021 shown in parentheses.

Species	Mean clutch size	Hatching success	Fledging success	Nests monitored
COTE	2.40 (2.52)	0.79 (0.94)	-	30
ARTE	2.00 (2.00)	0.75 (0.78)	-	30
ROST	1.61 (1.67)	0.94 (0.92)	-	50

Tern Provisioning

Table 3 shows statistics from observations of chick provisioning undertaken from blinds as well as GoPro cameras (ROST only) on North Brother Island. Photographic data of chick provisions for all three tern species will be analyzed by students in the

coming weeks. A DNA barcoding study was initiated and involved obtaining fecal matter from 20 chicks (2021) and 25 chicks (2022) for each of COTE, ROST, and ARTE.

Table 3. Prey items (percent) in tern chick diet on North Brother Island in 2022.
***n* is the total number of prey items observed.**

Prey item	COTE	ROST	ARTE
Herring	44%; n = 93	26%; n = 24	14%; n = 1
Hake	7%; n = 15	8%; n = 7	86%; n = 6
Sand Lance	5%; n = 11	45%; n = 24	-
Atlantic Silverside	3%; n = 6	-	-
Fish Bits*	1%; n = 2	-	-
Pollock	0.5%; n = 1	9%; n = 8	-
Butterfish	0.5%; n = 1	-	-
Stickleback	0.5%; n = 1	-	-
Unidentified	36%; n = 75	12%; n = 11	-

*Fish Bits: Small pieces of discarded fish from a fish processing plant's effluent pipe where Common terns were observed dipping.

Predator Activities and Control Efforts
No gulls nested on North Brother Island. South Brother was not visited to check for nesting gulls. On many occasions late in the season, juvenile Herring gulls and mature Great Black-backed gulls circled the island or loafed on the edge of the colony. On two occasions, gulls were observed capturing chicks at the water's edge.

An adult male Northern Harrier was observed within the colony on two consecutive days (July 27th & 28th). On the 27th, the raptor captured an adult tern.

Common Eiders
Ten incubated eider nests were recorded on North Brother Island. Clutch sizes were 2, 5, 5, 7, 3, 5, 4, 5, 4, and 2.

Other Notes
We surveyed islands throughout Lobster Bay and the surrounding areas during peak tern nesting. Six ROST nests were confirmed on Cape Sable Island on June 18th.

We conducted at-sea surveys in suspected foraging areas to determine the location and foraging behavior of terns during breeding. We identified five Roseate tern foraging sites, and we obtained photographic evidence of Sand Lance and Herring being caught by Roseates across these sites.

41 chicks were swabbed for Avian Influenza; however, we have not yet received the results for the samples.

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 and DNA metabarcoding. 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.

Machias Seal Island

Tabatha Cormier, Island Supervisor –University of New Brunswick
Joana Romero and Emily Williams- field technicians

Tern Census
A formal census was not completed for the 2022 season; however, we estimate there were approximately 300 nests on the island. No ROST or COTE were observed breeding on the island this summer.

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

2015	2016	2017	2018	2019	2020	2021	2022
150	175	300	476	500	0	0	300

Productivity

Terns breeding on MSI had a very successful season given the last two years of complete failure.
116 ARTE nests with a total of 180 eggs were monitored this season. The first tern egg was encountered on June 3 and mean lay date was June 10. Egg predation was somewhat high this year with 61 of the 180 ARTE eggs (34%) having been depredated. Most of the depredation occurred in one particular plot, accounting for half of the depredated eggs. Mean hatch date was July 2; hatch success was 0.689 (82 of the remaining 119 eggs) for ARTE. A total of 42 ARTE chicks fledged (alive at day 15). The fledge success for monitored nests this season was 0.51 fledge/chick (to day 15). Out of the 82 monitored ARTE chicks, 20 were found dead over the course of the season.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Machias Seal Island in 2022.

Species	Clutch Size	Hatching Success	Fledging Success	Nests Monitored
COTE	NA	NA	NA	NA
ARTE	1.67	0.69	0.51	116
ROST	NA	NA	NA	NA

Tern Provisioning

We completed 15.75 hours of ARTE chick provisioning observation on a total of 4 nests in one plot. Given the spread of nest location, chick provisioning was difficult to monitor for ARTE this season as few nests were in close enough proximity to one another for efficient monitoring to occur. Prey availability remained consistent throughout the season, with hake and sandlance as the predominant prey items. No COTE chick provisioning observation was completed due to no breeding individuals.

Table 3. Principal prey items (percent) in tern chick diet on Machias Seal Island in 2022. *n* is the total number of prey items identified.

Prey Item	COTE	ARTE	ROST
n	NA	58	NA
Hake	NA	44.8	NA
Sandlance	NA	15.5	NA
Unknown	NA	15.5	NA
Butterfish	NA	8.6	NA
Fish Scrap	NA	8.6	NA
Stickleback	NA	3.4	NA
Herring	NA	3.4	NA

Predator Activities and Control Efforts

A total of 7 gull nests were found on MSI this season. Near the end of June, lethal gull control was performed on the island by CWS hired personnel. A total of 8 adult HERG were shot around the island- 4 of which were believed to be breeding on MSI as they were consistently observed near nests on the north region of the island. This appeared to have worked for deterrence for the majority of the season as numbers remained low within the colony. However, gull numbers began to rapidly rise again around puffin fledging time when they would most often be observed lined up on the outskirts of the rocks in numbers ranging 50-100 specifically in the mornings and evenings. As more puffins were leaving, HERG were observed actively hunting in the colony and poking around ATPU burrows.

An adjacent island with a persistent breeding colony of HERG and GBBG, was visited once during the season on May 31st. A total of 13 gull nests, all HERG, were found and destroyed by shaking and poking eggs. A total of 31 eggs were destroyed. Laughing Gulls, most often 4-5 individuals (max daily count- 14), were consistently present on island throughout the season; however, no active nests or nest sites were encountered on the island.

Common Eiders

Counts were conducted weekly with a high of 339 individuals (185 males, 154 females) on June May 25th. Ducklings were first seen in mid-June and were still present around the island in early August. Our highest count was on July 7th with 53 ducklings.

Alcids: Atlantic Puffin

A formal ATPU census was not conducted this year (2019 census estimate 6,300 breeding pairs).
From an initial 105 monitored productivity burrows, 85 were determined to be active and monitored for the season (80.9% occupancy). Mean lay was May 10th. The final check of all productivity burrows was completed on August 9th. 70 of the 85 active burrows (82%) had hatched; 10 (14%) were of known age. 18 eggs (21%) went missing (confirmed empty burrows), 2 eggs (0.02%) were confirmed dead, 7 chicks (0.1%) went missing, and 6 chicks (0.05%) were confirmed dead. 46 chicks from productivity burrows had been banded (age day 35) with 67% fledge success as of August 10th. Linear growth rate this season was 6.0 g/day. A total of 119.5 hours of ATPU chick provisioning stints were conducted. Food was relatively stable throughout the season with the diet consisting mainly of sandlance early in season and then switching to hake and herring mid-season. We banded a total of 155 fledglings captured on the lawn through the night between July 26-August 9.

Alcids: Razorbills

A formal RAZO census was not conducted this season (2019 census estimated 2,880 breeding pairs).
A total of 73 burrows were monitored for productivity this season. Linear growth rate was 4.97 g/day.
A total of 74.15 hours of RAZO chick provisioning stints were conducted.
From an initial 90 monitored burrows, 83 (81% occupancy) were determined to be active and monitored for the season. Mean lay was May 7th. Of the 73 eggs, 45 (62%) hatched and 28 (38%) went missing or were confirmed dead. Of the 45 chicks, 2 (0.04%) went missing and 6 (0.13%) were confirmed dead.

Alcids: Common Murre

COMU numbers remain high. From June 22 to 23 a minimum of 998 active nests were estimated.
A total of 236 chicks were banded this year. GPS tags were deployed on 9 adult COMU and 5 were recovered.
A total of 63.50 hours of COMU chick provisioning stints were conducted.

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

	n	Mean Lay	Mean Hatch	Burrow Occupancy	Hatching Success (hatch/ active nest)	Nest Success (fledge/chick)	Linear Growth Rate (mass)
ATPU	85	May 10	June 22	0.81	0.74	0.67	6.0
RAZO	73	May 7	June 9	0.81	0.62	0.77	4.97

Table 5. Principal prey items (percent) in Alcid chick diet on Machias Seal Island in 2022.
***n* is the total number of prey items identified.**

Prey Item	ATPU	COMU	RAZO
n	1765	651	365
Herring	13.5	40.7	56.7
Hake	41.8	2.0	23.0
Haddock	4.59	6.9	1.37
Sandlance	26.5	0.8	11.0
Pollock	0.45	0	1.37
Butterfish	4.8	12.9	0.5
Squid	2.21	6.45	0.27
Euphausiid	0.91	0.31	0.27
Larval fish	2.03	0.15	0.55
Rock Gunnel	0	14.6	0.27
Radiated Shanny	0	5.2	0
Other	3.21	9.99	4.7

Maine

Petit Manan Island

Hallie Daly: Island Supervisor – Maine Coastal Islands NWR, USFWS
Nick Giordano, Jehan Mody,and Kaiulani Sund - Island Technicians
Dr. Natasha Gownaris- Visiting Professor from Gettysburg College

Tern Census

During the Gulf of Maine Seabird Working Group (GOMSWG) census on June 11, 2022, a total of 1,175 active tern nests were counted. We applied a Lincoln Index correction factor of 1.018 to this value and added our 94 productivity plot nests for an estimated total of 1,201 pairs of terns on Petit Manan Island (PMI) in 2022. This season's estimate is lower than the 2021 estimate (1,333 pairs) by 9.9%, or 132 pairs of terns. During peak incubation prior to the census, 413 individual nests were identified to species to calculate species ratios of interior habitats, noting that common tern (COTE) dominated shorelines and mixed Arctic tern (ARTE)/COTE interior habitats were each uniquely calculated. Overall, 447 ARTE pairs and 752 COTE pairs were estimated to have nested with a colony-wide ratio of 37% ARTE and 63% COTE. Additionally, 24 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 successfully deterred from nesting on the island in large numbers before the census. This resulted in an incomplete count for the number of both COEI and LAGU nests on the island.

Table 1. Number of nests found on Petit Manan Island during the GOMSWG census window from 2018-2022.

Year	COTE	ARTE	LAGU	COEI
2018	906	371	766	47
2019	937	365	656	45
2020	949	352	589	36
2021	872	461	820	36
2022	752	447	3	24

Tern Productivity

At the egg-stage, nest predation by gulls was estimated to be 1.6% across the colony, much lower than previous years. This may have been due to the reduction in the number of LAGU nesting on the island. Within productivity plots, the hatch rate for COTE was 71.6% and 61.6% for ARTE. COTE productivity was recorded at 0.81 chicks per pair and ARTE productivity at 0.55 chicks per pair. Prey availability appeared to be consistent throughout much of the season, but an overall diverse array of prey species was documented, including higher than normal amounts of squid and fish-scraps being fed to chicks. We also observed a large-scale mortality event starting on July 19th where 70+ fledging-aged chicks were found dead throughout the colony over a 10-day period. All dead chicks tested for Avian Influenza (HPAI) came back negative, so these mortalities may be attributed to reductions in feeding frequencies, or recent weather events.

Table 2. Breeding parameters for Common and Arctic Terns on Petit Manan Island in 2022 (2021 in parenthesis).

Species	Clutch Size	Hatching success	Fledging success	Productivity	Nests monitored
COTE	1.86 (1.79)	71.6% (50.7%)	60.4% (13.2%)	0.81 (0.12)	36 (42)
ARTE	1.65 (1.72)	61.6% (74.3%)	54.1% (12.7%)	0.55 (0.16)	60 (43)

Arctic Tern Metapopulation Project

As part of the Arctic tern metapopulation project, 87 adult ARTE were re-sighted while 11 adults were recaptured during island-wide trapping efforts. A total of 123 new birds were banded, six adults and 117 chicks.

Tern Provisioning

Provisioning observations were conducted on 15 ARTE nests and 14 COTE nests for a total of 1,059 observation hours (533 ARTE/ 526 COTE) with 1,852 prey deliveries (710 ARTE/ 1,114 COTE). Overall, hake and herring were the dominate prey items for both species of tern, contributing to 71.7% of ARTE diet and 73.9% of COTE diet. These were split respectively into 32.3% hake, 29.9% herring, and 9.4% hake or herring for ARTE and 35.7% herring, 21.2% hake, and 16.7% hake or herring for COTE. Invertebrates made up a small proportion of prey brought in by both species, contributing to 2.6% of ARTE chick diet

and 4.13% COTE chick diet. On average, ARTE adults delivered 1.4 prey items per nest per hour while COTE delivered 2.1 items per nest per hour.

Table 3. Principal prey items (%) in tern chick diets on Petit Manan Island in 2022.

Species	ARTE	COTE
Hake	32.3%	21.2%
Herring	29.9%	35.8%
Hake or Herring	9.4%	16.9%
Invertebrates	2.6%	4.1%
Sandlance	2.7%	2.3%
Haddock	0.0%	0.0%
Pollock	0.3%	0.7%
Butterfish	2.2%	2.2%
Squid	0.1%	0.5%
Larval Fish	0.0%	0.1%
Silverside	0.1%	0.6%
Lumpfish	0.0%	0.2%
Unknown Fish	18.5%	9.7%
Unknown	1.4%	2.4%

Predator Control

Avian predators were discouraged from roosting or perching on the island throughout the season by using pyrotechnics, bird spikes, a high-powered laser, and human presence. Peregrine falcons (PEFA) were the most frequent avian predator observed. PEFA were first observed on May 4 and we observed throughout the season (67 times on 44 days). PEFA were directly observed predating 15 adult and/or fledgling terns but were presumed to have killed at least seven more adults/fledglings based on prey remains. In addition to terns, PEFA predated upon one adult razorbill and one adult black guillemot. It is believed that two different adult PEFA, and three different juvenile PEFA were observed on PMI this summer, one of which was banded.

After persistent effort this season, 99% of the historic LAGU nesting colony was deterred from nesting on the island. As a result, only three nests were found and destroyed during the GOMSWG census, and a further 42 nests were found and destroyed during the remainder of the season. We lethally removed 18 adult LAGU, 17 for predator control purposes and one individual that was exhibiting signs of HPAI. In addition, one herring and five great black-backed gulls were lethally controlled, all of which were suspected of having HPAI.

Alcids

Our individual high counts for alcids were: 239 Atlantic puffins (June 23), 370 black guillemots (May 21), 99 razorbills (June 3), and 23 common murre (June 20). We located 96 active Atlantic puffin (ATPU) burrows with 69 chicks and a total of 35 considered to have fledged. Later in the summer, many of the puffin chicks started to lose weight and were structurally smaller than normal. We suspect that some of the chicks considered "fledged" may not have survived once they left PMI. An overall linear growth rate recorded from 28 monitored ATPU chicks was 3.91 grams/day, slightly higher than last year's LGR. We also found six razorbill (RAZO) nests with a productivity rate of 0.33 chicks fledged/pair. We located and monitored 85 black guillemot (BLGU) nests around the perimeter of the island and along the wooden boardwalk. Overall productivity for BLGU was 1.18 chicks/pair. 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 2022.

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

Species	Burrows Monitored	Hatch Success	Productivity
ATPU	96	81%	0.36
RAZO	6	33%	0.33
BLGU	85	70%	1.18

In addition to daily counts and productivity monitoring, we tried to read ATPU bands and opportunistically capture adults during burrow checks. We were able to read bands on 167 ATPU and 24 ATPU were recaptured. We banded 65 ATPU (36

adults/29 chicks). We replaced the BBL and field readable bands on four of the 36 banded ATPU that had duplicate field readable bands with MSI birds. Additionally, we read bands on two adult RAZO and one of the two RAZO chicks that fledged was banded. We recaptured 12 adult BLGU during productivity checks and banded 111 new individuals (10 adults/101 chicks).

Petrels

Extra effort was put in this season to increase monitoring efforts for Leach's storm-petrel (LESP). We located and flagged burrows early in the season while vegetation was short. We returned to the burrows in late June and used burrow-scope cameras and an audio-playback to determine occupancy of incubating adults. We confirmed a minimum of 87 active burrows. We determined that 76 burrows were "observable" (could be scoped or grubbed). These burrows were permanently marked with metal tags for future monitoring. We determined that 63 of the 76 burrows had eggs, and we later found 46 chicks for an estimated hatching rate of 73%. We banded 23 LESP during burrow monitoring efforts (8 adults, 15 chicks), and one bird was recaptured.

In addition to monitoring burrows, we used mist nets to capture LESP at night from August 3-9. We deployed four mist-nets from 10pm-2am on suitable weather nights to capture adult petrels. We banded 85 petrels and eight adults were recaptured from previous years. In addition, seven regurgitate samples were collected for further analyses. Overall, this year we deployed 109 LESP bands (94 adults, 15 chicks) to further mark-recapture efforts.

Other Research

Stable Isotope/Fecal Sampling: A total of 60 fecal samples were collected from COTE, ARTE, ATPU, and BLGU 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 University), blood samples were collected from 220 individuals for stable isotope analysis; 11 adult ARTE, 6 adult COTE, 64 ARTE chicks, 45 COTE chicks, 1 adult BLGU, 64 BLGU chicks, and 29 ATPU chicks, resulting in over 450 samples. All samples were processed in-field where hematocrit was taken and plasma was extracted for further analysis of isotopic signatures. In addition, over 50 eggshell membranes were collected from ARTE, COTE, ATPU, and BLGU for further analyses. Lastly, dropped fish samples were collected from around the colony, including 153 fish samples across 21 different species of fish, 34 mussel samples at 4 different time periods, as well as amphipods, isopods, and terrestrial prey items (months, flies, dragonflies, beetles, etc.).

Seabird Tick Collection: A total of 121 seabird ticks were collected from 27 individuals (22 ATPU chicks, 2 BLGU chicks, 1 COTE chick, and 2 found on island staff). Ticks were collected as part of a University of Maine, Orono research study looking at tick-borne diseases on remote seabird islands.

Ship Island

Laura Wallace, Island Supervisor and Rachel Dudek, Island Intern - USFWS

Tern Census

We conducted the 2022 GOMSWG census on Ship Island on June 16th. The unadjusted count of common tern nests was 846, with a Lincoln Index of 1.038, and an adjusted count of 936 nests. This far exceeds the 2021 corrected count of 426 common tern nests and is the highest number of terns observed nesting on Ship Island. We observed and heard two Arctic terns throughout the season, leading us to believe there may be an ARTE/COTE hybrid pair nesting on Ship.

Table 1. Number of tern nests on Ship Island from 2018-2022

Year	COTE
2018	519
2019	427
2020	355
2021	426
2022	936

Tern Productivity

We monitored 60 nests in nine productivity plots. Average clutch size was 2.52 eggs per pair, hatch success was 79.3%, fledge success was 93.9%, and productivity was 1.80 chicks per pair. This was the highest reported productivity for common terns in the Gulf of Maine. We only found 12 dead chicks in our plots. Chicks grew at an average of 7.52 g/day.

Table 2. Reproductive success for common terns on Ship Island from 2018-2022.

Year	Nests monitored	Clutch size	Hatching success	Productivity
2018	51	2.10	-	-
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

Tern Provisioning

We included 22 nests in our provisioning study and observed for the nests for 621.9 hours. We observed 1,031 feedings for a rate of 1.66 average feeds/nest/hour. The majority of the tern chick diet was comprised of Atlantic herring (98.1%). No butterfish were delivered to chicks during watch hours and only one dried up butterfish carcass was observed in the sand during the GOMSWG nest survey.

Table 3. Principal prey items (percent) in tern chick diet on Ship Island in 2022 (n=1,031).

Prey item	COTE
Herring	98.1%
Hake	0.3%
Sand Lance	0.4%
Butterfish	0%
Pollock	0.3%
Stickleback	0%
Invertebrates	0.6%

Predator Activities and Control Efforts

We did not remove any gulls from Ship Island in 2022. Although, we continued to harass gulls throughout the season and displayed dead gulls along the beach. The terns also did a good job of driving gulls away from the island. We observed peregrine falcons 17 times this season, and they successfully predated five adult terns. In addition, three adult terns that were injured by the peregrine had to be euthanized.

We observed bald eagles flying over Ship Island, but never observed any eagles landing on the island. The eagles primarily preyed on gulls nesting on Trumpet Island, but also predated gulls on East and West Barge. Although we did not observe any mammalian predators, we proactively set 10 conibear traps in case any mink swam to Ship Island. Because of concerned for owl predation in recent years, we deployed 10 padded leg-hold and two Swedish goshawk traps for the entire season. We did not trap or observe any owls this year.

Other Species

We observed 52 species of birds on or around Ship Island in 2022. In addition to common terns, breeding was suspected or confirmed for three species of passerines, one species of waterfowl, and one shorebird. To reduce habitat for browntail moths, the Refuge cut all the trees and shrubs on the island in 2021. This management action reduced the foraging and nesting habitat for songbirds. We estimated 4-6 Song sparrow, 12-13 savannah sparrow, 1-2 mallard, 1-2 yellow warbler, and 5 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 July 2nd. We did not observe any ducklings beyond age class 1b. We did not observe any successful predation attempts on eiders, but gulls and bald eagles did attempt to predate ducklings.

Other Notes

Refuge staff repeatedly mowed the vegetation across Ship Island to reduce the abundance and distribution of invasive species, and to encourage terns to nest in the interior of the island.

We collected 100 fecal samples from common terns to identify the diet of chicks and adults: 25 adults during incubation, 25 adults during chick rearing, and 50 chicks. The Refuge is working with Cornell University to conduct the DNA analysis of fecal samples to determine diet composition.

Seal Island

Coco Faber, Island Supervisor – National Audubon Society Seabird Institute

Tern Census

The 2022 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on June 14 on Seal Island. 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 1.0286 was applied to the direct count, and an extrapolated total was derived from this number. We calculated a combined total of 1785 Arctic and Common Tern nests. This is the lowest combined census count since 1996. A species ratio was determined through identifying a sub-sample of nests to species, then used to calculate an estimated count of 1064 Common and 721 Arctic Tern nests.

Table 1. Adjusted number of tern nests found on Seal Island NWR from 2017-2022.

Year	COTE	ARTE
2017	1064	733
2018	1204	829
2019	1293	776
2020	No census	No census
2021	1422	659
2022	1064	721

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots (Table 2). Arctic Tern productivity, 0.83 chicks fledged per nest, was near the long-term average, while Common Tern productivity, 1.32 chicks fledged per nest, was higher than average. Productivity for both species was markedly higher than 2021, which had some of the lowest productivity values in the history of monitoring.

Table 2. Tern productivity on Seal Island NWR, 2021-2022.

Species	Year	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2021	1.74	0.72	0.32	69
	2022	**2.21**	**0.86**	**1.32**	**57**
ARTE	2021	1.71	0.62	0.22	49
	2022	**1.78**	**0.83**	**0.83**	**36**

Tern Provisioning

Arctic Tern nests were observed for 789.25 nest-hours, with an average feeding rate of 1.63 feedings per nest per hour. Common Tern nests were observed for 1,128.95 nest-hours, with an average feeding rate of 1.08 feedings per nest per hour. Hake was the most common prey item fed to Arctic Tern chicks, with Atlantic saury, amphipods, and euphausiids making up most of the rest of identified prey items. Hake and herring were the most common prey items for Common Tern chicks, with Atlantic Saury coming in a close third (Table 3). It should be noted that for both Arctic and Common Terns, Atlantic Saury made up an unusually high percentage of diet.

Table 4. Principal prey items (percent of diet by prey item) in tern chick diet on Seal Island NWR in 2022. Total number of prey items observed n= 1,285 for ARTE and n= 1,214 for COTE.

ARTE		COTE	
Prey item	**% of diet**	**Prey item**	**% of diet**
Hake	**56.6**	Hake	**41.1**
Amphipod	**8.7**	Herring	**19.0**
Atlantic Saury	**7.1**	Atlantic Saury	**13.6**
Euphausiid	**6.7**	Sandlance/Larval Sandlance	**4.5**

Predator Activities and Gull Control Efforts

Gull predation was observed regularly, often at the fringes of the colony, and occasionally in the center of the tern colony. 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 a nesting effort by at least 5 pairs was observed in late June. Nests were searched out and destroyed, with concurrent lethal and nonlethal hazing efforts that were successful in eventually pushing most pairs off the island. Late in the season, a single hatched chick was discovered, but was likely later predated by a Herring Gull.

Table 4. Gull control measures by species at Seal Island NWR in 2022.

Species	# Nests destroyed	# Killed
Herring Gull	302	9
Great Black-backed Gull	41	3
Laughing Gull	5	1

Peregrine Falcons made regular visits to the colony throughout the tern nesting period. They often made multiple passes through the colony in a single day, particularly at dawn and dusk, though were not observed successfully catching terns consistently. Their presence was less frequent than in the previous two years, but increased during the tern fledging period.

Atlantic Puffins

Atlantic Puffin productivity was monitored at 78 burrows. Hatching success was 0.94 chicks hatched per egg, the highest hatch success the island has seen since 2015. Productivity was estimated at 0.79 (Table 5).

Table 5. Atlantic Puffin hatch success and productivity at Seal Island NWR from 2017-2022.

	# Burrows monitored	Hatch Success	Productivity
2017	68	0.91	0.89
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	0.79

A total of 1,433 prey items were observed delivered to puffin chicks, comprising 20 identified species. Hake was the most frequently delivered prey item (64.2%), followed by sandlance (8.0%). Herring, butterfish, and Atlantic saury each made up less than 4% of diet. The surprise fish of the season was Northern sennet, which appeared in just 5 recorded bill loads, but has not been previously seen in puffin diet.

Black Guillemots

Black Guillemot productivity was monitored at 44 burrows. Average clutch size was 1.86, hatch success was 0.76, and productivity was 0.84.

Razorbills

A total of 82 active burrows were confirmed in 2022. A subset of 43 burrows were monitored for productivity. Productivity this season was 0.47 and hatch success was 0.63.

Cormorants
A minimum of 55 Great Cormorant nests and 34 Double-crested Cormorant nests were counted from photos taken on June 2. This is an increase of 8 nests for the Great Cormorants and a decrease of 2 nests for the Double-crested Cormorants from 2021. Counts of chicks of both species are still being conducted to determine an estimated productivity, but we estimate that this will be a record-breaking year for Great Cormorant fledgling numbers.

Avian Flu
In 2022, we observed potential signs of Avian Influenza (HPA1) among our breeding seabird populations. The gull populations on the island were most affected, with 8 adult Great Black-backed Gulls discovered dead or displaying symptoms, and 15 adult Herring Gulls and 2 chicks found dead or symptomatic. As Seal Island is large, and the gull colony is not monitored closely, the tally of dead gulls is likely higher than what was observed. Avian Flu had a smaller potential impact terns. Over the course of the season, we found 4 adult Common Tern carcasses with unknown cause of death (1 was tested and was negative for flu), with no live birds displaying obvious symptoms. We found 3 adult Arctic Tern carcasses (1 was tested and was negative for flu) and found 2 live adults displaying possible symptoms. In addition, we found 2 Arctic Tern chicks who were displaying possible symptoms. Finally, we found two female Common Eider carcasses.

Matinicus Rock

Tracey Faber, Island Supervisor – National Audubon Society Seabird Institute

Tern and Laughing Gull Census
The GOMSWG census was conducted on 15-16 June. We estimated a total of 865 Arctic Tern nests after adjusting the raw count with a Lincoln Index correction factor. We directly counted 278 Common Tern nests, or 24.3% of the total colony. Although there was a decline in Common Terns, around 10 late-arriving pairs nested further north than recorded in recent years. During the GOMSWG census we counted and destroyed 135 Laughing Gull nests.

Table 1. GOMSWG census results on Matinicus Rock, 2017-2022.

Year	ARTE	COTE	LAGU
2017	600	166	3
2018	717	268	1
2019	790	327	4
2020	No census	No census	No census
2021	854	395	121
2022	865	278	135

Tern Productivity
Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Arctic Terns fledged 1.16 young per nest and mean clutch was 1.92 for 49 nests. Common Terns fledged 1.41 young per nest and mean clutch was 2.15 for 27 nests.

Table 2. Tern productivity on Matinicus Rock 2021-2022.

Species	Year	Mean clutch size	Mean hatch	Productivity	Nests monitored
ARTE	2021	1.71	0.88	0.25	48
	2022	**1.92**	**0.84**	**1.16**	**49**
COTE	2021	1.88	0.88	0.28	32
	2022	**2.15**	**0.91**	**1.41**	**27**

Tern Chick Provisioning
We conducted Arctic and Common Tern provisioning studies. The most common prey item for Common Terns was hake, at 56% of items provisioned overall. 36% of Arctic Tern chick diet was hake, with amphipods at 37%. Other prey items of note in Arctic and Common tern diet were Atlantic saury, observed frequently throughout the season, a run of larval lobster, our first record of a John Dory, and late season incidental observations of mackerel.

Predator Activities and Control Efforts
Peregrine Falcons and Merlins were observed throughout the season, and a peregrine was observed taking an adult tern or fledgling on three occasions. A Herring Gull predated young chicks and fledglings from late June through mid-July, when it was shot. Laughing Gulls nested in areas of tall vegetation. We transected suitable Laughing Gull habitat every two weeks, destroying nests on the first three rounds, and poking eggs on the fourth. 468 nests were destroyed, the majority likely re-lays, and an estimated 20-30 chicks hatched. Attempted and successful kleptoparasitism of terns, guillemots, and puffins were observed at higher frequency than the previous two years.

An active Common Raven nest was discovered upon arrival to the island on 13 May, with five recently hatched chicks that were dispatched immediately. This was the second year that ravens nested on the island. In 2022, the pair heavily predated adults and eggs of Leach's Storm-Petrels, puffins, guillemots, Razorbills, and eiders. They also predated or fed off the carcasses of large gulls that had exhibited symptoms of avian influenza.

Atlantic Puffins
Productivity of Atlantic Puffins was 0.55 and hatch success was 0.74 (n=83). Puffin diet was majority hake (62.7%), followed by sandlance (15.3%), and Atlantic saury (3.8%). In a notable divergence from the previous few years, haddock comprised only 1.3% of diet. Of note was our first record of Northern sennet.

Razorbills
Razorbill hatch success was 0.76 (n=55), and productivity was 0.60 chicks fledged per nest. Razorbill diet consisted primarily of hake (39%), sandlance (21%), herring (18.3%), and Atlantic saury (16.3%).

Black Guillemots
Productivity of Black Guillemots was 0.83 (n=46). Preliminary observations from Black Guillemot diet studies indicate that adults were primarily provisioning rock gunnels, pollock, rosefish, and cunner.

Common Murres
In 2022, we surveyed loafing Common Murres on the island mid-day when visibility allowed between late May and mid-June, when the first chicks hatched. We recorded a record high count of 170 loafing birds on 5 June. While egg and chick fates can be difficult to determine with limited monitoring, at minimum 17 eggs were laid, including three found predated or rolled, and a minimum of 9 chicks hatched, with 8 likely fledging in mid to late July. This was the fifth consecutive year that Common Murres successfully bred on Matinicus Rock.

Leach's Storm Petrels
Overall burrow density was 0.87/m2, and the occupancy rate across three productivity plots was 0.83. Productivity is still being monitored. Mist-netting was conducted in 2022 to collect diet samples for Keenan Yakola's graduate study of storm-petrel foraging ecology.

Manx Shearwaters
Six active Manx Shearwater burrows were confirmed in 2022. Unfortunately, we found two Manx Shearwater skulls in areas where Common Ravens had cached carcasses, and we believe this was the pair that previously nested in a shallow rock burrow that was inactive this year. We used a combination of call playback, burrow latticing, and grubbing to assess activity throughout the season. As of the last check, four chicks had hatched and a final egg was still being incubated, though it is likely dead.

Other Breeding Birds
In 2022, we confirmed breeding of Common Ravens, American Black Ducks, Common Eiders, Savannah Sparrows, Song Sparrows, and Herring Gulls, in addition to the above-mentioned species.

Metinic Island

Caitlin Walker, Island Supervisor - USFWS

Tern Census
On June 15, we counted 1,115 tern nests during the Gulf of Maine Seabird Working Group (GOMSWG) census. After applying a Lincoln Index Correction Factor of 1.026 to the raw count and adding 82 productivity plot nests, we estimated a corrected

total of 1,226 pairs of terns on Metinic in 2022. This is the largest population of terns nesting on Metinic since restoration efforts began in 1998. We identified the species at 24% of the nests (n=299) and calculated a species ratio of 56% common terns (689 pairs) and 44% Arctic terns (537 pairs).

Table 1. Estimated number of tern pairs counted during the GOMSWG census at Metinic Island, 2018-2022.

Year	COTE	ARTE
2018	522	320
2019	515	316
2020	630	389
2021	690	421
2022	689	537

Productivity

Productivity was higher than in recent years for both Arctic and common terns.

Table 2. Tern reproductive success at Metinic Island, 2018-2022.

	2018	2019	2020	2021	2022
Common Tern					
# of Nests	41	40	45	44	55
Mean Clutch Size	2.24	2.25	1.96	2.20	2.31
Mean Hatch Success	88%	90%	81.8%	89.7%	89.0%
Mean Fledge Success	42%	46%	50.0%	19.6%	60.6%
Chicks fledged/pair	0.83	0.93	0.80	0.43	1.4
Arctic Tern					
# of Nests	26	24	24	28	30
Mean Clutch Size	1.69	1.71	1.63	1.82	1.87
Mean Hatch Success	93.2%	85.4%	92.3%	88.2%	91.1%
Mean Fledge Success	61%	91.4%	63.9%	35.3%	62.5%
Chicks fledged/pair	0.96	1.33	0.96	0.64	1.17

Tern Provisioning

During chick provisioning observations, we watched 14 common tern nests for 468 hours and recorded 600 feedings (1.28 feedings/hour/per nest). We observed eight Arctic tern nests for 333 hours and observed 293 feedings (0.88 feedings/hour/per nest). Hake were they most common prey item delivered to Arctic tern chicks (43.7%) followed by inverts (19.8%) and herring (13.3%). Compared to 2021, feeding rates for Arctic terns almost doubled, but the average size of prey items decreased for all species except hake, pollock, unknown, and other. Common tern feeding rates also increased slightly from 2021 but overall average prey size decreased, except for butterfish and inverts. Common tern diet averaged 89% fish and Arctic tern diet averaged 76% fish. We observed a higher percentage of butterfish delivered to chicks in the beginning of July. Linear growth rates were similar to previous years (5.75g/day) for Arctic terns and (5.67g/day) for common terns. The average linear growth from 2018-2022 was 5.52g/day for Arctic terns and 5.52g/day for common terns.

Table 3. Principal prey items (percent) of tern chick diets on Metinic Island in 2022.

Prey Item	COTE	ARTE
Herring	36.2%	13.3%
Hake	28.3%	43.7%
Hake/herring	10.7%	0.7%
Invert	4.5%	19.8%
Sand Lance	4.5%	3.4%
Butterfish	2.0%	0.3%
Pollock	0.2%	1.0%
Bluefish	0.2%	-
Atlantic Saury	2.0%	1.0%
Silverside	0.3%	-
Fish Scrap/Chunk	2.7%	3.4%
Haddock	0.2%	-
Unknown Fish	4.5%	12.6%
Unknown	3.8%	1.7%

Predator Activities and Control Efforts

We determined that 4.2% of 99 tern nests monitored were predated prior to the GOMSWG census. This was slightly lower than 2021 and lower than previous years. A peregrine falcon visited the colony four times and was successful twice. A merlin was removed in mid-May and a second adult was observed hunting in and around the tern colony throughout the season. The merlin visited the colony throughout the season, but most visits occurred at the end of July. It was observed successfully hunting on multiple occasions and signs of merlin predation were found in the intertidal area. We confirmed that the merlin killed at least three tern chicks. Laughing gulls do not breed on Metinic, but small groups of gulls were observed throughout the season. We observed laughing gulls kleptoparasiting terns in July. We lethally controlled three herring gulls in 2022. We oiled six great black-backed and 121 herring gull nests. A great horned owl was removed from the forest in early May. We removed 52 eastern garter snakes from the tern colony this season.

Black Guillemots

We located 74 active guillemot burrows on USFWS property and by July 26th had confirmed a 64% hatch rate. We routinely monitored productivity and growth rates in 24 burrows. We determined that five burrows completely failed due to predation or chick mortality. We found the first guillemot chick on July 1st. We determined that chicks had an average linear growth rate of 11.92 grams/day with a productivity rate of 0.92 chicks fledged/pair. As of the last burrow check on July 26th, 63% of chicks from monitored burrows (n=22 chicks) were at least 10 days old. We captured 12 adult BLGU while checking burrows after eggs hatched. We banded 61 new guillemots this season (10 adults / 51 chicks).

Leach's Storm-Petrels

We located 102 active burrows using a callback or a burrow scope and we confirmed eggs in 30 burrows. As of our last burrow check, 83% of eggs had hatched (n=25 chicks). We suspect that hundreds of petrels nest on Metinic, but we can not access the burrows located in the stone walls that are scattered across the north end of the island,

Common Eiders

We conducted a common eider census while searching for gull nests on the north end of Metinic Island on May 24th and 25th. We identified 27 nests during the census by finding a nest, finding an incubating female, or flushing a female out of a patch of dense vegetation. The census did not include the forest interior, but we observed several hens frequenting this area throughout the season. We observed the first eider ducklings on May 28th, and we continued to see ducklings throughout the season as they approached the fledging stage. The largest crèches were observed in the South Cove on June 10th (50 duckling with 15 hens) and 25th (45 ducklings with 20 hens).

Sheep

Sheep graze Metinic from September through May, and are kept on the south side of the island during the breeding season. We assisted the Refuge in moving the sheep to the south side of the electric fence on May 19th. By early July, at least 11 sheep were on FWS property. We suspect that they were able to get around the edge of the fence at low tide. Although the sheep made several attempts to enter the tern colony, we did not find crushed eggs or chicks, but we suspect that a minimal amount of damage is likely. The energy expenditure of adults attempting to dive at the sheep may have also affected productivity.

Research:
GPS Loggers: On June 21st, Refuge staff and a graduate student from Oregon State deployed nine GPS loggers on nesting terns. They tagged five Arctic and four common terns, and these tern nests were included in our provisioning study. Unfortunately, all tags stop transmitting data by the end of July.

Eastern Egg Rock

Keara Nelson, Island Supervisor – National Audubon Society Seabird Institute

Census
An island-wide Common Tern and Laughing Gull nest count was conducted on June 11. During the census, 1271 Common Tern nests were counted. The addition of productivity nests, feeding study nests, and a Lincoln index of 1.0155 brought the total to 1358 nests. During the census, 1194 laughing gull nests were found. 78 Roseate Tern nests and 84 Arctic Tern nests were identified by June 20. One additional B-wave Roseate Tern nest was identified after the census.

Table 1. GOMSWG census results on Eastern Egg Rock, 2017-2022.

Year	COTE	ARTE	ROST	LAGU
2017	886	76	104	1729
2018	1021	86	82	1
2019	1067	70	73	333
2020	1156	77	80	1174
2021	1359	74	85	251
2022	1358	84	78	1194

Tern Productivity
A total of 68 Common Tern nests were monitored in fenced productivity plots and unfenced feeding study plots. Productivity of 1.26 chicks fledged per nest, which is much higher than the productivity estimate of 0.51 in 2021. Roseate Tern productivity was calculated from a sample of 75 unfenced nests. Roseate terns fledged 1.09 chicks per nest. Arctic tern hatching success was monitored at 53 nests, with 5 breeding adults having GPS and 10 having geolocator tags. Arctic tern hatch success was 1.51 chicks hatched per nest.

Table 2. Tern productivity on Eastern Egg Rock, 2021-2022.

Species	Year	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2021	2.30	2.00	0.51	77
	2022	**2.47**	**2.24**	**1.26**	**68**
ARTE	2021	1.84	1.08	-	73
	2022	**2.00**	**1.51**	**-**	**53**
ROST	2021	1.65	1.38	1.06	78
	2022	**1.99**	**1.54**	**1.09**	**78**

Tern Provisioning
Twelve Common Tern nests were observed over a total of 382 nest-hours. Hake was the most frequently fed prey item, comprising 54.3% of feedings, followed by herring at 13.2%. Six Arctic Tern nests were observed for 182 nest-hours. Hake comprised most of the diet at 41.6%, followed by unknown at 26.8%. These were mostly from fish too small to identify. Five Roseate Tern nests were observed over 217 nest-hours. Hake was the most frequently observed prey item at 65.0%, followed by sandlance at 17.8%.

Table 3. Principal prey items in tern chick diet on Eastern Egg Rock in 2022.

COTE		ROST		ARTE	
Prey Item	**%**	**Prey Item**	**%**	**Prey Item**	**%**
Hake	54.3	Hake	65.0	Hake	41.6
Herring	13.2	Sandlance	17.8	Unknown Fish	26.8

Courtship feedings for Common Terns were also monitored during pre-laying and incubation. Common Terns were observed for a total of 39 observer hours. Courtship feedings were comprised primarily of sandlance 67.5%, and hake at 14.6%.

Predator Activities and Control Efforts

Herring Gulls continued to predate the tern colony this season, however no Herring Gulls were lethally removed. Other avian predators, including Peregrine Falcons and Bald Eagles, were observed flying by the colony on multiple occasions. A Peregrine Falcon was seen taking a tern chick and a juvenile Bald Eagle was seen taking a Laughing Gull chick.

To manage Laughing Gulls, the team used behavioral harassment, including playing bongo drums, clapping hands, using a siren, banging on pots, and using a laser. Laughing Gull effigies were strung up around the island and one adult was shot prior the crew's arrival on May 12. As Laughing Gull numbers started to spike in June, another adult was taken to help deter newly arriving breeders looking to nest. All Laughing Gull eggs found during census were oiled. Hazing efforts were greatly reduced compared to last year.

Although Mallard broods were not seen predating Common Tern nests as they have in previous years, they were seen eating tern egg membranes. Future attempts to dissuade Mallard nesting should be considered.

Table 5. Gull control measures at Eastern Egg Rock in 2022.

	GBBG	HERG	LAGU
Gulls Shot	0	0	2
Nests Destroyed	0	0	1194

Atlantic Puffins

There were at least 171 active puffin burrows on the island. Hake comprised most of the puffin diet at 66.1%. Sandlance was the second most prevalent prey species observed at 10.5%, followed by herring at 7.9%. The first chick feeding was observed on June 8 from Tower Blind.

Black Guillemots

Productivity was monitored for Black Guillemots at 37 nests. Mean clutch size was 1.92 and productivity was 0.64 chicks fledged per nest.

Leach's Storm-petrels

Leach's Storm-Petrels productivity was monitored at 26 nests across two plots. Hatching success was 0.81, which is higher than the 0.67 hatching success reported in 2021, and productivity is still being monitored.

Avian Flu

One Great Black-Backed Gull was seen dying with neurological issues. Approximately 8 Common Tern adults, 1 Roseate Tern adult, and 2 immature Laughing Gulls were found dead with unknown causes. The dead Roseate Tern was tested for avian flu and results came back negative.

Rare Birds

In 2022, a pair of American Oystercatchers, a pair of Black Skimmers, and a single Tufted Puffin were seen on the island.

Visitors

There were 12 visitor groups who spent the day on Eastern Egg Rock in 2022. This includes Hog Island Adult and Teen camps, National Audubon CEOs and board members, Project Puffin donors, The Boston Globe, NBC's Today Show, NBC Maine, NBC Boston, Imax documentary crew, Canon documentary crew, and UMaine Native American Program. Additionally,

program founder Steve Kress, photographer and writer Derrick Jackson, photographer Jean Hall, PhD student Keenan Yakola, Assistant Sanctuary Manager Seabird Sue, Seabird Sanctuary Manager Paula Shannon, Development and Communications Associate Kim Keller, and Education Assistant Arden Kelly were able to spend a various number of nights on the island.

Pond Island

Dallas Jordan and Rebecca Howell, Island Supervisor and Research Assistant – National Audubon Society Seabird Institute

Tern Census

Tern census was conducted on June 14. The unadjusted count for Common Terns (COTE) was 1487 nests. An additional 66 COTE study nests were being followed at the time of census and the Lincoln Index was 1.018. The adjusted count of 1580 nests, which includes study nests, is the highest number of nests recorded on Pond Island since 2015 and 874 more nests than last year (Table 1).

At the time of census, there were 5 Arctic Tern (ARTE) nests and 5 Roseate Tern (ROST) nests. Over the course of the season there were a total of 5 ARTE nests. One additional B-wave ROST nest was found post-census, bringing the total number of ROST nests for the season to 6, the highest number since 2015.

Table 1. Number of tern nests on Pond Island NWR from 2017-2022.

Year	COTE	ROST	ARTE
2017	942	0	8
2018	1065	2	11
2019	1159	0	7
2020	1453	2	3
2021	706	0	0
2022	1580	5	5

Productivity

COTE productivity was determined by following 66 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 2.23 with a mean hatch of 1.94 and 1.55 fledged per nest. Five ARTE nests were monitored. ARTE mean clutch size was 2.0, with a mean hatch of 1.8, and productivity of 1.0 chick fledged per nest (Table 2). Six ROST nests were monitored throughout the season, followed from egg stage until fledging (95% of A-chicks are assumed to have survived; B-chick survival determined by day 2 weights >16.7 grams). ROST mean clutch size was 1.33, and mean hatch was 1.00. ROST averaged 0.83 fledged per nest (Table 2).

Table 2. Tern reproductive success on Pond Island, 2021-2022.

Species	Year	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	2021	1.76	0.85	0.27	62
	2022	**2.24**	**1.94**	**1.56**	**68**
ARTE	2021	1.00	0.33	0.33	3
	2022	**2.00**	**1.80**	**1.00**	**5**
ROST	2021	-	-	-	-
	2022	**1.33**	**1.00**	**0.83**	**6**

Tern Chick Provisioning

Chick provisioning studies were conducted by observing 18 COTE nests from hatching through fledging or failure. There were 871 total feedings observed during 535.5 nest hours of observation, resulting in a feeding rate of 1.63 feedings per nest-hour. The principal prey species delivered were sandlance (37.31%) and herring (32.38%). Hake was the third most abundant prey species compromising 2.64% of diet (Table 3).

Table 3. Principal prey items in COTE chick diet on Pond Island in 2022.

Prey item	Number of Items	% of diet
Sandlance	325	37.31
Herring	282	32.38
Hake	24	2.64

Predator Activities and Control Efforts

Pond Island was subjected to limited predation events during the 2022 season, in stark contrast to the prior year. Most notably, a Peregrine Falcon (PEFA) started visiting the island on occasion (approximately once every few days) beginning in early June through the end of July. One adult tern carcass, indicative of PEFA predation, was found in late May. The PEFA was only observed taking an adult tern once, on June 18.

Five owl traps were preemptively placed on posts in anticipation of owl predation, though no owl was detected at any point during the season. Remains of a gosling were found on top of one of the owl posts before traps were placed.

In early May, three American Crows were frequently seen in the morning on the south side of the island predating eider eggs. No deterrence was enacted, as they were not detected in the tern colony at any point, and they would leave after disturbance by island staff.

Depredation from gulls was not detected and harassment of the colony by gulls was exceedingly rare. At the end of July, approximately seven Laughing Gulls loafed on the landing and would occasionally chase adult terns for fish, but no mortality occurred.

Highly Pathogenic Avian Influenza (HPAI)

Pond Island National Wildlife Refuge confirmed cases of HPAI in the breeding colony during the 2022 season. HPAI became suspect as a cause of mortality on June 12, when island staff discovered two dead common eiders, one dead COTE adult, and one living COTE adult that was exhibiting HPAI symptoms (e.g. erratic neurological behavior, shaking head). One dead COTE adult was found prior to this incident on June 8 with no signs of predation, though at this point HPAI was not suspected. The living individual died shortly after being removed from the colony, and was sampled to test for HPAI, with results confirming its presence. Over the course of the season, we encountered 27 COTE adults and 7 common eiders suspect of mortality from HPAI, finding approximately 1-2 dead birds a day. There were additionally approximately 20 large dead fledgling COTE discovered, though it remains unclear if deaths were HPAI-related or higher numbers of dead fledgling birds were discovered due to high productivity and census counts on the island. While the colony did not suffer widespread outbreak and devastation, the presence of HPAI was cause for concern.

Jenny Island

Ben Becker, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 11. A total of 1,740 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs, and one nest numbering 5. A Lincoln index mark/recapture correction of 1.040 was applied to the uncorrected count. The addition of 62 productivity nests and 24 marked feeding study nests brought the total to 1899 nests (Table 1). This count is the second highest ever recorded on Jenny (Table 1). Seventeen Roseate Tern nests were also active during the GOMSWG census window. No additional B-wave nests were laid after the census window. One Arctic Tern adult was present all season; however no mate or nest was ever identified.

Table 1. GOMSWG census results on Jenny Island, 2018-2022.

Year	COTE	ROST
2018	1,426	24
2019	1,618	21
2020	1,433	21
2021	2,044	17
2022	1,899	17

Tern Hatch and Fledging

In 2022, while researchers were not present on the island to witness the first Common Tern egg laid, nest presence was notably more robust, earlier than previous years. The first Common Tern chick to hatch (June 10), was 5 days earlier than in 2020 (June 15), but the same as 2021 (June 10) and the first Common Tern chick to fledge (July 6), was similarly 5 days earlier than in 2020 (July 11), and the same as 2021.

Tern Productivity

For Common Terns, five productivity plots containing 68 nests and three feeding study plots with 20 nests were monitored to determine productivity. 17 Roseate Tern nests were monitored for productivity. Common Tern productivity was 1.25 chicks fledged per nest, which was an increase from 2021, when it was 0.55 (Table 2). This increase is likely attributed to an increase in size and abundance of high-quality food throughout the breeding season and lack of severe weather events, although overcrowding or high chick density may have had a detrimental impact. Roseate Tern productivity was calculated at 1.10 chicks fledged per nest.

Table 2. Tern productivity on Jenny Island, 2021-2022.

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**
ROST	2021	1.94	1.71	1.27	17
	2022	**2.00**	**1.82**	**1.10**	**17**

Tern Provisioning

Common Tern chick provisioning was monitored at three feeding study plots with 18 nests. A total of 1021 feedings were observed. Atlantic herring constituted the majority of observed feedings (56.7%; Table 3). Hake (including white hake and four-bearded rockling) made up another 12.0% of the feedings.

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2022.

Prey item	Number of Items	% of Diet
Herring	579	56.7
Hake	123	12.0
Butterfish	23	2.3

One feeding study plot with 4 Roseate Tern nests was monitored. A total of 247 feedings were observed. Herring constituted the majority of observed feedings at 39.7% (Table 4), which overtook sandlance from 2021, when it was the majority. Hake (including white hake and four-bearded rockling) was the second most common item at 20.2%. Sandlance followed at 17.8%

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2022.

Prey item	Number of Items	% of Diet
Herring	98	39.7
Hake	50	20.2
Sandlance	44	17.8

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2022 field season. No tern or eider chicks were observed to be preyed upon. However, on 9 June, a water-logged Herring Gull was stuck on the island for two days during a storm, and could not regain flight. During this time, it was seen moving amongst the colony, causing disturbances, and was euthanized. One abandoned Herring Gull nest was seen at the beginning of the season.

Peregrine Falcon predation was very apparent during the 2022 season. Two individuals were identified based on plumage, an adult and a juvenile or immature that made appearances towards the end of the season. Throughout the incubation and chick-rearing parts of the season, adults and chicks would be caught and carried away, while multiple disembodied wings and heads of fledged and unfledged chicks, characteristics of falcon kills, were discovered regularly.

Black-crowned Night-Herons were a significant nuisance during the 2022 season. One individual visited the island on most nights, for varying amounts of time, throughout the month of July. Although no predation was directly witnessed, several small chicks went missing from productivity plots on nights when it was seen in the area. Further evidence of empty nests and areas devoid of chicks also suggested successful predation. Night-stints were conducted to study the night-heron's behavior and test methods of non-lethal discouragement. Use of a camera-trap and night-vision binoculars were instrumental in detecting its presence. Non-lethal attempts to discourage the night-heron included playback of Black-crowned Night-Heron distress-calls, use of a high-powered bird-deterrent laser, and flushing by researchers. Unfortunately, while having some short-term effect, none of these methods showed long-term success. The distress calls had no noticeable effect on the night-heron, but increased disturbance among the terns. The laser caused the night-heron to flush, but it always returned, with shorter times to return after repeated use. The night-heron also returned after flushing by humans. Ultimately, due to the state-endangered status of Black-crowned Night-Herons, and the fact that it was late in the season and the late-hatching chicks of a size targeted by the night-heron had a small chance of survival anyway, lethal control was not attempted.

Other Birds

Six Common Eider nests were found during the 2022 GOMSWG census, compared to four in 2021. One American Black Duck nest was also discovered.

Avian Flu

Only one bird suspected of having avian flu was observed on Jenny Island; on June 21, a Common Tern adult was seen exhibiting neurological issues in the intertidal zone, and soon expired.

Outer Green Island

Juliana Ramirez, Island Supervisor – National Audubon Society Seabird Institute
Abigail Muscat, Research Assistant

Tern Census

The 2022 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on June 12-13. 1,915 Common Tern nests were counted. The Lincoln Correction Index was calculated at 1.0438829787, bringing the total to 1,994 nests. No Roseate Terns nested.

Table 1. GOMSWG annual census results on Outer Green Island, 2017-2022

Year	COTE	ROST	ARTE
2017	1434	0	0
2018	1553	0 [2]	0
2019	1727	0	0
2020	1775	0	0
2021	1661	2[1]	0
2022	1994	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 2.33 (n=81) of which an average of 1.99 hatched per nest. The first recorded hatch was on June 14, and peak hatch lasted from approximately June 20-25. The average number of chicks fledged per nest (productivity) was 1.27. This is a significant increase from last year and the highest productivity since 2017.

Table 2. Outer Green Island annual Common Tern productivity, 2017-2022

Year	Mean Clutch	Mean Hatch	Productivity	Nests monitored
2017	2.13	1.93	1.45	69
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

Tern Provisioning
Chick provisioning was observed at Common Tern nests. A total 1312 feedings were recorded. The most frequently observed prey item was herring which made up 32.6% of observations, followed by hake, which made up 19.1%. Additional observed prey included pollock (9.6%), butterfish (4.6%), fish scrap/bait (2.6%), insect (2.2%), and sandlance (2.3%). Of note were several goosefish observed late in the season.

Predation
Greatest predation impact this season was the frequent presence of a Peregrine Falcon, most likely from a known nearby nest north of Portland. An adult Peregrine Falcon (potentially more than one, but only one individual seen at a time) was seen 28 days out of the season, with every sighting accompanied by persistent dreading and chasing. There were numerous sightings of the peregrine carrying an adult or fledgling Common Tern, and occasionally one or more dismembered carcasses were found the following day.

Greater Black-backed and Herring Gulls were the most common gull species seen throughout the season. A total of 3 gulls were shot using a .22 rifle, two of which had injured wings. One of these individuals walked through the southern portion of the colony, predating a few eggs in the process. One gull carcass was laid out on the rocks at the southern end of the island, and one was strung up on the north side to prevent loafing and predation. Throughout the season we noticed a number of missing eggs and small chicks, particularly on the northwest side of the island. 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. Loud noises such as clapping, yelling, air-horn, and screamer sirens were used towards the end of the season as negative re-enforcement techniques to scare off all these gulls. The only other sighting of potential predators throughout the season was a single occurrence of 6 Black-Crowned Night Herons on June 22, with no evidence of predation.

Table 3. Outer Green Island predator control efforts, 2022

Species	No. of Nests Destroyed	No. of Gulls Shot
Herring Gull	1	1
Great Black-backed Gull	0	2
Laughing Gull	0	0

Avian flu
A total of 7 Common Tern adults, 1 Common Tern chick, 6 Common Eider chicks, 1 Common Eider adult (female), and 1 Herring Gull adult were found dead with no clear cause or appeared to be suffering from neurological symptoms. The 1 Common Tern chick was observed with neurological symptoms on July 6 and the chick was found dead on July 8. The 6 Common Eider chicks were found along with a dead Common Tern Adult all within a couple feet of each other on the southwest portion of the island. Other dead Common Tern adults were found in locations across the island. The adult Common Eider was seen on a visit to Junk of Pork. The adult seemed unbalanced in the water and did not fly when startled by us landing. Finally, the 1 Herring Gull was first spotted on June 22 floating towards the north tip, unfazed by the terns targeting it. On June 23, we found likely the same gull being targeted by terns on the cliff edge. It appeared to have mild neurological conditions and exhibited delayed responses to the terns pecking at it. Once we approached it flew off towards Junk of Pork, unbalanced. Samples were not collected, thus these occurrences cannot be confirmed to have been caused by avian flu.

Black Guillemots
24 burrows were monitored for productivity. 6 new active burrows were discovered throughout the season, 2 of which were washed out by exceptional high tides mid-July. The average clutch size was 1.75 and the average number of eggs hatched per nest was 1.00. Productivity was 0.87 chicks fledged per pair.

Stratton Island

Michael Rickershauser, Island Supervisor – National Audubon Society Seabird Institute

Tern Census
An island-wide Common Tern nest count was conducted on June 10. Arctic and Roseate Tern nests were found and counted throughout the season. 138 Roseate Tern nests were found during the GOMSWG census. Arctic Terns had 8 active nests during

the GOMSWG census, with 1 additional nest found late in the season, very likely re-laid from an earlier washed out nest, bringing the total number of Arctic Tern nests on Stratton in 2022 to 9 nests. The Common Tern nest count of 1216 nests was corrected with a Lincoln index of 1.06 to 1,287 nests, and the addition of 82 marked study nests brought the total count to1,369 nests. The Least Tern census was performed on June 7, with 91 nests found. Over the course of the season, many nests were lost to tides and abandonment, making distinguishing between later new nests and re-lays unfeasible. 152 LETE nest starts were recorded throughout the season, though many were likely re-lays.

Table 1. GOMSWG census results on Stratton Island, 2017-2022.

Year	COTE	ARTE	ROST	LETE
2017	1129	2	119	87
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

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 65 nests in the Common Tern plots fledged 1.31 chicks per nest. Roseate Tern productivity was 1.25 chicks fledged per nest for the 92 nests followed. From the 8 Arctic Tern nests followed, 6 chicks were seen successfully fledged, giving a minimum productivity of 0.75. Least Terns hatched chicks from 67 nests, and July 10 had the highest Least Tern fledgling count with 14 fledglings and 3 pre-fledglings seen, suggesting a minimum productivity of 0.19.

Table 2. Tern productivity on Stratton Island, 2021-2022.

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**
ROST	2021	1.83	1.47	1.02	95
	2022	**1.82**	**1.52**	**1.25**	**92**
ARTE	2021	1.69	0.55	-	13
	2022	**2.00**	**1.63**	**0.75**	**8**

Tern chick provisioning

12 Common Tern nests were observed with a total of 471 feedings. Chick diet primarily consisted of herring, sandlance, and hake, comprising 31%, 20%, and 16% of deliveries, respectively. 16% of prey items were not identified to species. 12 Roseate Tern nests were observed with a total of 717 feedings. Diet primarily consisted of sandlance, at 76% of deliveries. 15% 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. 79 Herring Gull nests totaling 222 eggs and 31 Great Black-backed Gull nests totaling 86 eggs were poked on Bluff Island. These nest counts are a small decline from 2021's significant increase. 1 Herring Gull and 2 Great Black-backed Gull nests were found Little Stratton. All nests were removed.

Wading Birds

The 2022 wading bird census was conducted on May 20 and 23. Researchers use mirror poles to view nest contents and egg templates to identify nests to species. 136 Glossy Ibis, 62 Snowy Egret and 67 Great Egret were identified. No Black-crowned Night-heron nests were identified on Stratton during census, although at least 2 night-heron nests were found on Bluff Island after the breeding season, following-up on observations of night-herons seen there in May.

Common Eiders

No Common Eider census was conducted in 2022.

American Oystercatchers

In May, a search of Little Stratton found no nests but several scrapes were observed. On June 15, 1 3-egg nest was found on Little Stratton. The nest was gone when checked at a later date and it is believed it succumbed to gull predation as Little Stratton is frequently occupied by both Great Black-backed and Herring Gulls. No juvenile oystercatchers were seen in 2022.

Black Guillemots

5 Black Guillemot burrows were confirmed in 2022, with 4 on Stratton Island and 1 on Bluff Island. Of the 4 nests on Stratton, 2 were found washed out and the 2 others were later abandoned prior to chicks hatching. Prey was observed being brought back to Bluff, and 1 juvenile guillemot was seen between the islands in August. A high count of 95 adult Black Guillemots was recorded on July 30.

Double-crested Cormorants

Double-crested Cormorant nest census was conducted on June 11. An average was determined from three observers counting all nests seen via boat. An estimate of 179 DCCO nests was found on Bluff Island.

Visitors

2022 marked the first in 3 years Stratton Island was open for visitation. York Co. Audubon had out 14 guests for their teen birding tour on July 9. On July 27, PNYC brought out 55 visitors. On July 30, the Prout's Neck Conservancy brought out Doug Tallamy, Nancy Olmstead, and 8 PNC members. 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.

Notable Birds

- Eastern Towhee seen on May 18
- Black Skimmer seen on June 8
- Yellow-crowned night-heron occasionally in July
- Killdeer seen on July 29

Least Terns

On June 6 and 7 coordinated walking nest census count documented a minimum of 277 nesting pairs of least terns in Maine. This was the third highest number of nesting pairs recorded in the state since monitoring began. During the census window, 23 nests were on Laudholm, 102 nests on Crescent Surf, 91 nests on Stratton Island, 51 nests on Higgins, and 10 nests on Seawall. After the census window passed, 5 nests were established on Goose Rocks and more nests appeared at Higgins and Seawall. The Least Terns on Laudholm fledged a minimum of 18 chicks, Crescent Surf did not fledge any chicks, Goose Rocks fledged 1 chick, Stratton Island fledged 14 chicks, Higgins fledged 5 chicks, and Seawall fledged 2 chicks for a minimum state total of 40 fledglings. Despite the high number of nesting pairs, 2022 saw the second lowest productivity rate recorded since monitoring began with an estimated 0.14 fledglings per pair.

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)

( ) 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 Garrett Erickson-Harris - Rachel Carson NWR

Population Estimate: 23 Least Tern pairs were nesting during the walking nest count census conducted on June 6. Four fledgling counts were conducted on July 15, July 28, August 10 and August 15 where a minimum of 18 fledglings were observed. Laudholm experienced week-long 11+ft tidal over wash events once a month which contributed to nest and chick loss. There was also suspected but unconfirmed red fox and raptor predation.

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.

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 Garrett Erickson-Harris - Rachel Carson NWR

Population Estimate: 102 Least Tern pairs were nesting during the walking nest count census conducted on June 6. No chicks were observed throughout the entire season, so only one fledgling count was conducted on July 21 where there were no fledglings recorded. Crescent Surf experienced week-long 11+ft tidal over wash events once a month which caused major nest loss. There was also partial colony abandonment in June due to an unknown cause and some nests were lost to red fox predation. The beach was particularly narrow this year providing less space for the terns than in the past.

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.

Predator Management: USDA Wildlife Services removed specialist predators from the Crescent Surf Beach area throughout the breeding season. The electric net fence was not put on the beach this year due to the beach being too narrow to accommodate the fence.

Goose Rocks Beach, Kennebunkport
Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns appeared on Goose Rocks after the window count was conducted. A high count of five nests were observed on June 21. The predator load was extremely high and it is likely additional nests were lost between visits. Predators were skunk, raccoon, and fox. At least one nest successfully hatched two chicks and one survived until fledging.

Comparison: 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.

Western/Ferry Beach, Scarborough
Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns did not attempt to nest on Western Beach for the third consecutive year in a row.

Comparison: In 2019, 35 Least Tern nests were observed on Western, but after a predation event, none survived, and no chicks remained. There were a minimum of five Least Tern nests in 2018 that fledged no chicks. There were 48 Least Tern nest attempts on Western in 2017, fledging five birds. In 2016, there were at least four nest attempts on Western, with no fledglings produced. Before this, terns had not nested on Western Beach since 2008, and the site had not fledged chicks since 2005, when

there was a total of 40 active nests. Prior to 2005, Least Terns had not nested at the site since 1981.

Predator Management: None.

Stratton Island
National Audubon Society

Population Estimate: 91 Least Tern pairs were nesting during the walking nest census count conducted on June 7. The highest fledgling count was on July 10 where 14 fledglings and 3 pre-fledgling chicks were recorded. The biggest struggle of the season was managing predation, largely if not exclusively, from Black-crowned Night-Heron.

Comparison: 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: The colony was guarded every night, from around 1930 to 2300, what was presumably the more active hours for Black-crowned Night-Heron. Numerous visitations were discouraged. A mannequin was left in the blind overnight in hopes the human shape would be enough to discourage the Black-crowned Night-Heron but it's very likely a lack of harassment led to it becoming acclimated. Staff limitations made full dusk-to-dawn watches unfeasible.

Higgins Beach, Scarborough
Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: A total of 51 pairs were nesting during the walking nest count census on June 6. More nests were initiated throughout the season with a high count of 67 being recorded. A minimum of five chicks fledged from Higgins Beach. An electric fence surrounded most of the colony, but fox tracks were frequently seen outside and within the fencing. The electric fence was not working for a period of two weeks, when fox tracks increased, and egg predations were high. Higgins Beach is a popular tourist beach with many beach-walkers wandering near the colony, disrupting roosting birds and making it a challenging place for fledgling birds. We believe that many fledglings leave earlier than the standard 2-week residency period, and as a result our fledgling estimates are particularly low for this site.

Comparison: 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.

Seawall Beach, Phippsburg
Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: In 2022, 10 Least Terns nests were counted during the window count on June 7. A high count of 27 nests was recorded on June 13. Fox tracks were consistently seen throughout the colony along with many predated nest attempts. The colony moved around the large sand spit area with many suspected re-nest attempts. The flock estimate was roughly 60 pairs. Two chicks fledged successfully.

Comparison: Last year 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.

Popham Beach State Park, Phippsburg
Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns were observed flying and foraging above the Morse River between Popham Beach and Seawall Beach, but no nests were laid on Popham Beach in 2022.

Comparison: Least Terns have not nested on Popham Beach since 2016. In 2016, there were at least 22 nesting attempts; some hatched but all were unsuccessful due to predation. In 2015, there were 40 nesting attempts, fledging four chicks. Three pairs nested in 2013 but produced no fledglings. Two pairs nested in 2012 and fledged three chicks. Prior to that, no Least Terns have attempted to nest on Popham Beach since 1997, when a 15 pair colony failed to produce any fledglings.

Predator Management: None.

New Hampshire

Isles of Shoals

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White and Seavey islands

Tern Census
Common Terns

- COTE census was conducted on June 11th through 17th, 2022
- Unadjusted census:
  - 682 nests on White Island
  - 2,261 nests on Seavey Island
  - Lincoln Indices were calculated for White Island and Seavey Island (divided into sections with indices ranging from 1.02 to 1.06 on White and 1.00 to 1.07 on Seavey)
- Adjusted census:
  - 710 nests on White Island
  - 2355 nests on Seavey Island
  - **Total estimated population was 3,066.** Down from census count last year (3,412, which was the highest census count for COTE since program began in 1997).

Roseate Terns

- 124 ROST nests were established on Seavey Island within the census window (before 19 June 2022; up from 112 in 2021)
- B-wave ROST nests brought season total to 147 (up from 115 in 2021).

Arctic Terns

- 1 ARTE nest was established by 19 June 2022 on White Island.

Table 1. Number of tern nests found on White and Seavey islands from 2016-2022.

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

Productivity

Common Terns

- 8 fenced plots (~10x12 ft) containing 72 nests
- Nests were monitored until chicks reached "fledge" age (15 days)
- Productivity was high in comparison to previous years likely due to abundance of high quality prey, fewer extreme storms, and relatively low predation pressure.

Roseate and Arctic terns

- ROST and ARTE nests were monitored individually until chicks reached "fledge" age (5 days for ROST and 15 for ARTE)

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on White and Seavey islands from 2016-2022. 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
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	1.29	88
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

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 20 June 2022. COTE observations concluded 28 July 2022, ROST observations will continue into early August.

Complementary provisioning data were collected by observers in blinds to compare to camera observations. Data from camera recordings will be collected in fall 2022.
- Diet items included herring, hake, sand lance, butterfish, cunner, mummichog, lumpfish, goosefish, gadid, pufferfish, pipefish, smelt, larval fish, squid, crab, euphausiid, praying mantis, 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: 40 pyrotechnics were used between 11 May and 31 July (down from 173 in 2021)
- Lethal control: removed 1 GBBG (injured and trying to haul up on White near Outhouse) and 1 immature LAGU
- Found remains of approximately 9 COTE chicks on Little Seavey that had been predated by gulls.

PEFA:
- Infrequent visits in May and June, with visits increasing in late July/August

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 near their den on Seavey using conibear traps. Six muskrats trapped (1 trapped in 2021).

Other Mammalian:
- No other mammalian predators were observed on White or Seavey islands between 11 May and 31 July 2022.

Other Nesting Species
- Common Eider: at least 36 nests (1 on White and 35 on Seavey; up from 35 in 2021)
- Spotted Sandpipers: at least 12 nests (3 on White and 9 on Seavey; up from 10 in 2021)
- Song Sparrow
- Used eBird for daily bird list to share bird diversity data from White and Seavey.

Other Isles of Shoals islands

Alcids
2022 was the first year of concerted monitoring efforts for Black Guillemots on the Isles of Shoals with two dedicated interns, Willow Dalehite and Yuna Park. As of August 7, 44 BLGU nests had been discovered across 4 neighborhoods on Appledore Island (22 nests) and another 4 neighborhoods on Smuttynose Island (22 nests). 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. 2022 nest counts will be conducted at the end of the breeding season when chicks have fledged. A combination of nest ID, adult counts, and drone imagery will be used to estimate breeding colony size and relative species abundance. Species include Snowy Egret, Great Egret, Glossy Ibis, and Black-crowned Night-Heron. Preliminary results suggest at least 46 Snowy Egret pairs, 5 Great Egret pairs, 8 Glossy Ibis pairs, and 1 Black-crowned Night-Heron pair.

American Oystercatchers
Shiloh Schulte of Manomet conducted kayak-based surveys of the Isles of Shoals on May 20 and July 22. Two nesting pairs were confirmed on Duck Island (1 with 1 chick and 1 with 2 chicks), 1 nesting pair on Smuttynose Island (with at least 1 chick), and 1 nesting pair on Lunging Island (with 3 chicks). Shiloh banded the 3 chicks on Lunging Island using yellow PFRs with black codes N31, N32, and N34.

Gulls
Gulls continue to be monitored on Appledore Island by the Gulls of Appledore team led by Sarah Courchesne and Mary Elizabeth Everett with 2022 interns Ry Andruk and Kayla Cannon. This year Great Black-backed Gulls appeared to experience higher levels of mortality related to HPAI in comparison to other seabirds. Monitoring efforts were curtailed in 2022 to prevent additional stress to breeding birds. 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.

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.
- Tern fecal collection (for DNA metabarcoding) and visual diet observations conducted to determine diet with Gemma Clucas.
- 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 in review by Olivia Smith).
- Deployed 10 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.
- Nest site selection by BLGU by SML intern Yuna Park
- Parental attendance behavior and reproductive success in BLGU by SML intern Willow Dalehite
- Drone-based exploration of gulls and long-legged wading bird distribution on Appledore Island with Gemma Clucas.
- Natal philopatry in Roseate Terns by SML intern Chloe Fugle.
- Body burden of Hg in breeding seabirds and transfer to terrestrial nesting environments by SML intern Lenny Laird.
- Patterns in GBBG aggression and divorce rates by SML interns Ry Andruk and Kayla Cannon

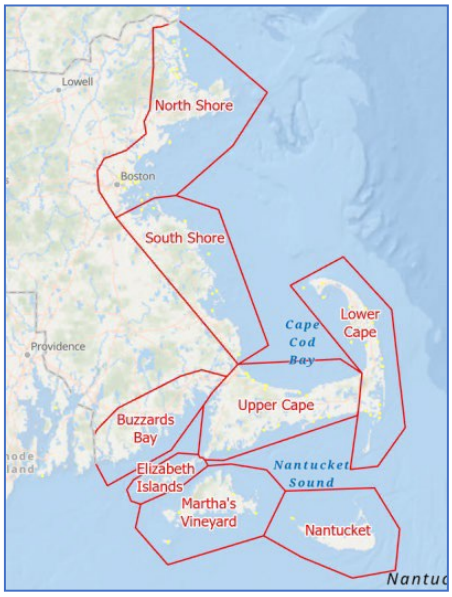
Massachusetts

Massachusetts Seabird Islands

Carolyn Mostello – Coastal Waterbird Biologist, MA Division of Fisheries and Wildlife

Census
Cooperators in Massachusetts surveyed 298 coastal sites in 2022 for the presence of breeding Roseate Terns (Sterna dougallii), Common Terns (Sterna hirundo), Arctic Terns (Sterna paradisaea), Least Terns (Sternula antillarum), Black Skimmers (Rhynchops niger), and Laughing Gulls (Larus atricilla). Approximately 100 sites were occupied by nesting birds. All Common Tern and Laughing Gull colonies were surveyed in entirety for the first time since 2019 and both species showed substantial increases over that time period, reaching record highs: Common Terns increased 33% to 27,000 pairs and Laughing Gulls 42% to 5,200 pairs. Compared to 2021, Roseate Terns increased 2% to 3,170 pairs (a record high), Least Terns decreased 23% to 4,131 pairs, Arctic Terns decreased from 1.5 pairs to 0.5 pairs, and Black Skimmers increased from 19 pairs to 23 pairs (a record high). Earliest and median first egg dates across sites were 20 May/ 20 May for Roseate Terns, 10 May/ 31 May for Common Terns, 21 May/ 31 May for Least Terns, 30 May/ 3 Jul for Black Skimmers, and 24 May/ (n/a) for Laughing Gull. No chronology data were available for Arctic Tern.

Seabirds were distributed among MA's regions in roughly the following distributions. (These numbers were based on preliminary data and differ from the final numbers discussed above.) The Gulf of Maine would include North Shore, South Shore, Lower Cape, and some of the Upper Cape region



(*Sketch of Regions by Bob Houston, based on schematic from Carolyn Mostello*)

Table 1. Seabird distribution in Massachusetts based on preliminary data.

2022	ROST	COTE	ARTE	LETE	BLSK	LAGU
North Shore	0	44	0	416	0	0
South Shore	0	3	0	406	0	0
Upper Cape	0	30	0	540	0	0
Lower Cape	15	17,674	0	1,166	0	5,201
Buzzards Bay	2,965	5,878	0	200	0	0
Elizabeth Is.	37	1,621	0.5	64	0	0
Martha's Vineyard	0	369	0	569	22	0
Nantucket	144	462	0	330	0	0
2022 Total	3,161	26,081	0.5	3,691	22	5,201

Species- and site-specific data for the largest colonies follow.

Table 2. Abundance and productivity of Roseate Terns at nesting sites in Massachusetts, 2022.

	No. pairs, A-period (2022)	Productivity (2022)	No. pairs, A-period (2021)	Notes 2022
Bird Island, Marion	2,031	0.82 fledg./nest	1,773	
Ram Island, Mattapoisett	934	0.6 fledg./nest	1,318	
Muskeget Island, Nantucket	149	0	12	Abundance estimate is rough: difficult to distinguish between nesting & non-nesting birds. Behavior was strongly suggestive of eggs & chicks but not confirmed.
Penikese Island, Gosnold	38	1.36 fledg./nest	3	
South Monomoy Island, Chatham	18	0.73 fledg./pair	4	

Table 3. Abundance and productivity of Common Terns at the 10 largest nesting sites in Massachusetts, 2022.

Site	No. pairs, A-period (2022)	Productivity (2022)	No. pairs, A-period (2021)	Notes (2022)
South Monomoy Island, Chatham	18,026	0.83 fledg./ pair	No data	
Ram Is., Mattapoisett	3,097	1.12 fledg./nest	4,080	
Bird Island, Marion	2,754	0.84 fledg./nest	3,148	
Penikese Island, Gosnold	1,621	1.46 fledg./nest	1,507	
Muskeget Island, Nantucket	480	0, poor	102	Abundance estimate is rough: difficult to distinguish between nesting & non-nesting birds.
Minimoy Island, Chatham	334	no data	80	
Little Beach/ Eel Pd., Edgartown	285	0	520	
General Edwards Bridge, Rte 1A, Revere-Lynn	102	no data	81	
Haystack Island, Edgartown	48	Poor	18	
Central Square, East Boston	42	no data	120	

Table 4. Abundance and productivity of Arctic Terns in Massachusetts, 2022.

Site	No. pairs, A-period (2022)	No. additional pairs, B-period (2022)	Productivity (2022)	No. pairs, A-period (2021)	Notes (2022)
Penikese Island, Gosnold	0.5	0	0	1.5	1 unpaired ARTE, presumably male, giving advertising calls 5/28-6/19; no nest detected.

Table 5. Abundance and productivity of Least Terns ata the 10 largest A- or B-period nesting sites in Massachusetts, 2022. Multiple productivity estimates for a site may represent values for multiple colonies or the upper and lower bounds of a range in estimates.

Site	No. pairs, A-period (2022)	No. pairs, B-period (2022)	Productivity (2022)	No. pairs, A-period (2021)
South Monomoy Island, Chatham	595	-	poor, good	619
Little Beach/Eel Pd., Edgartown	417	52	0, poor	30
Muskeget Island, Nantucket	320	360	0	8
Duxbury Beach, Duxbury	316	236	poor, fair, good	475
Crane Beach, Ipswich	293	-	fair	294
Barney's Joy/Little Beach, Dartmouth	192	298	poor	287
Norton Point Beach, Edgartown	0	228	0, good	0
South Beach (South of Break), Chatham	192	-	no data	no data
Dead Neck Sampsons Island, Barnstable	160	-	poor, fair	220
North Spit, Orleans	105	45	poor, fair	283

Table 6. Abundance and productivity of Black Skimmers in Massachusetts, 2022.

Site	No. pairs, A-period (2022)	No. additional pairs, B-period (2022)	Productivity (2022)	No. pairs, A-period (2021)
Little Beach/Eel Pd., Edgartown	22	0	0.59 fledg./pair	19
Norton Point Beach, Edgartown	0	4	fair	0
Ram Is., Mattapoisett	1	0	0	0
Minimoy Island, Chatham	0	1	0	0

Table 7. Abundance and productivity of Laughing Gulls in Massachusetts, 2022.

Site	No. pairs, A-period (2022)	No. pairs, B-period (2022)	Productivity (2022)	No. pairs, A-period (2021)	Notes
South Monomoy Island, Chatham	5,200	-	good	no data	
Muskeget Island, Nantucket	0	28	0	0	Courted but did not lay eggs

Monomoy National Wildlife Refuge

Eileen McGourty, Fish and Wildlife Biologist - USFWS
Heather Williams, Jason Talbott, Sydney Jones, Sejal Prachand, Biological Interns – Northwoods Stewardship Center and ACE for USFWS

Minimoy Island

Tern Census

In 2022, fourteen visits were made to the island. The first visit on April 18th prior to the arrival of terns. The last visit was on July 21st. A census was completed on June 21 and a total of 334 nests with eggs were counted. This is a significant increase in nesting pairs compared to 2021. The island was visited 5 times after the census and no signs of productivity were noted. No productivity data was collected for terns on Minimoy. One laughing gull nest was counted during census on the southeast end of the island by the flats to South Monomoy Island and several herring and black-backed gulls nests were noted on the west end of the island during the census.

Table 1. Number of tern nests found during census window on Minimoy from 2018-2022. Numbers in parentheses reflect nests found outside of the census window.

Year	COTE	ROST	LETE
2018	0 (1)	0	0
2019	1	0	0
2020	2	0	0
2021	80*	0	0
2022	334	0	0

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

Black Skimmer

One pair of black skimmer were observed attempting to nest on Minimoy Island in 2022. The pair was first seen on July 6th. A one egg nest was found on July 7th and it had three eggs by July 10th. The nest was likely over washed a few days later during a high tide event. The pair did not attempt to renest.

North Monomoy Island

Tern Census

In 2022, North Monomoy Island was visited 7 times between April 5th and August 12th. No official census was done during the June 5-20th window but a visit on June 22 confirmed no breeding terns where on the island. No nesting skimmers were noted either.

Table 2. Number of tern nests found during census window on North Monomoy from 2017-2021. Numbers in parentheses reflect nests found outside the census window.

Year	COTE	ROST	LETE
2018	0	0	0
2019	No census	No census	No census
2020	No census*	No census*	No census*
2021	0	0	0
2022**	0	0	0

*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 2022, 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 conducted every five years and the most recent census was completed in 2018. The next gull census is anticipated to be in 2023.

Wading Bird Census

In 2022 a wading bird census was conducted on May 13, 2022. No nesting wading birds were noted on the island. Four black-crowned night herons and two great egrets were observed. Many gull nests were found in areas where wading birds nested previously, with many of the gull nests empty. Most of the shrub layer appeared dead and what looked alive was very low to the ground. Old heron nests were still intact but most low to the ground. Unsure what caused the herons to move from the site but there were sign of several coyotes on the island throughout the season. Coyote control was conducted from April 26 through July 9and 6 adult coyotes were removed during four visits.

Table 3. Number of wading bird nests found on North Monomoy from 2018-2022 during census window.

Year	BCNH	GREG	SNEG	GLIB
2018	225	27	94	1
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

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

South Monomoy Island

Tern Census

Common Terns

In 2022 we were once again able to conduct a complete census of terns on South Monomoy Island. This is the first census since 2019. Refuge staff and volunteers conducted the survey on June 6, 7, 13-16, 18, and 19. Due to the limited number of people conducting the census, weather, and the increased number of terns, this year's census took 8 days to complete. The nesting area is delineated into 60m^2 grids, and all nests were tallied by grid number. The total raw nest count was 17,337. We used a Lincoln Index of 1.02 to adjust our raw count to 17,684. The Lincoln index was an average from 4 of the 8 days and matches our 5-year average. We were unable to conduct the Lincoln Index daily due to staffing and time constraints. An additional adjustment to compensate for late nesting and early counting derived from productivity plots was not applied in 2022 due to the number of nests that hatched or were depredated within the productivity plots. The raw count of 342 nests from the productivity plots counted during census was added to the Lincoln Index adjusted total for a final adjusted estimate of 18,026 nests on South Monomoy Island. This represents an increase of 26% over the past 3 years with the last census done in 2019 totaling 14,343 nests. 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 3,991 nests in the colony during the B-period.

Roseate Terns

Eighteen pairs of nesting roseate terns were counted during the A-census window and four during the B-period on South Monomoy Island. Of the 22 pairs monitored ten were found with chicks, twelve had eggs or a combination of eggs and chicks. Of the 18 eggs observed, 15 hatched. All but one nest hatched at least one chick, the one that failed to hatch was a B-period nest. A total of 26 chicks fledged according to GOMSWG standards. Additional pairs were noted but nests or chicks were not found for these pairs due to limited staff and time.

Least Terns

In 2022, a least tern census was completed by plover monitors over several days. A total of 595 nesting least terns were counted in 4 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 counted on June 12th. This number represents a minimum number of nesting least terns in the connection as it was noted that additional pairs were nesting behind a dune and could not be counted. The next largest colony was found on the south tip of the island at 60 incubating adults counted on June 16th. Two additional colonies were counted on June 16th, one just north of Powder Hole with 10 incubating adults and one just south of the Lighthouse Landing with 25 incubating adults. Productivity of least terns was not monitored but qualitative observations show good productivity in the connection area but poor productivity at the other three sites. Predation and over wash from storm events continue to significantly impact these colonies. No B-period census was conducted.

Table 4. Number of tern nests and laughing gull nests found on South Monomoy from 2018-2022. Numbers in parentheses reflect nests found outside the census window.

Year	COTE *	ROST	LETE	LAGU
2018	13472	30	499	3272
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

*Adjusted estimate based on Lincoln Index.
**It is estimated that there were 268-285 pairs of 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.

Productivity

Common terns had below average productivity in 2022, fledging an average 0.83 chicks per nest attempt. This number is below the long-term average of 1.24 chicks fledged per nest and can mostly be attributed to the low fledge success rate of 52% and in part to the slightly lower hatch success rate of 70%. Productivity success was based on 405 A-count nests that were monitored in 26 fenced productivity plots.

Roseate terns had above average productivity in 2022, fledging an average 1.44 chicks per pair for A-period nesters. Average clutch size was 1.83 eggs per nest attempt with an average of 1.5 eggs hatched per nest attempt.

Table 5. Breeding parameters for common and roseate terns on South Monomoy Island in 2022 during the A-period.

Species	Clutch size	Hatching success	Fledging success	Productivity (fledglings/nest)	Nests monitored
COTE	2.4	69.5%	51.5%	0.83	405
ROST	1.83	81.82%	88.89%	1.44	18

Tern Provisioning

Staff conducted 25 1-hour long common tern feeding stints from June 26th to August 3rd. Prey item, length, and recipient were recorded throughout each stint. Refuge staff recorded 148 total feedings during 25 hours of stints. The average recorded length of prey items was 1.32 culmen lengths which was down from 2.2 in 2019. Sandlance was the most common prey item, constituting 35.8% of the items observed. Even though sandlance made up most of the diet in 2022 this was significantly down from 89% in 2019. Other delivered prey items included herring (14.9%), hake (8.1%), bluefish (4.1%), and pollock (2.0%) were up from previous years. Butterfish remained low at 1.4% of delivered prey items. The other 33.79% of prey was attributed to unknown fish and other unknown items.

Table 6. Principal prey items (percent) in common tern chick diet on South Monomoy Island in 2022.

Prey Item	# of Feedings	Percentage
Sandlance	53	35.8
Herring	22	14.9
Hake	12	8.1
Butterfish	2	1.4
Bluefish	6	4.1
Pollock	3	2.0
Unknown	50	33.8

Laughing Gull Kleptoparasitism

Stints were continued this year to monitor the number of kleptoparasitism attempts made by laughing gulls on common terns. Twenty-nine kleptoparasitism stints were conducted throughout the colony this year, totaling 28.68 observational hours. Events of kleptoparasitism were recorded during 27 of the 29 stints. A total of 227 kleptoparasitism attempts were observed, with an average of 7.9 attempts per hour. Results show that laughing gulls were successful 32.7% of the time, common terns were successful 23.4% of the time, items were dropped 9.4% of the time, and the outcome was unknown 34.5 % of the time.

Predator Activities and Control Efforts

Predators that were present during the 2022 field season included coyote, northern harrier, greater black-backed gull, laughing gull, herring gull, grackle, red-winged blackbird, black-crowned night heron, bald eagle, peregrine falcon, cooper's hawk, and great horned owl. Two black-crowned night heron and two snowy egret nests with eggs were found within the colony. The large wading bird colony that used to be on North Monomoy Island moved to South Monomoy Island between 2020 and 2021 with most wading birds nesting south of the tern colony. Empty heron nests within the tern colony were destroyed to deter herons from nesting within the colony. Several sets of coyote tracks were continually seen throughout the season along the beach near the tern colony. Coyote tracks were also seen within the tern colony. Several coyotes were on island throughout the season with at least one denning pair. Early season removal of coyotes was completed between April 4th and April 26th with one den removed and 3 adults. Four additional predator control visits were conducted to remove coyotes during the nesting season between May 26th and July 9th. One additional adult coyote was removed from South Monomoy Island. Additional predator control activities were conducted during the nesting season by APHIS June 15th through June 17th and then again on July 27th through July 29th. A total of three common grackles, 2 red-winged blackbirds, 21 herring gulls, 18 laughing gulls, and 6 greater black-backed gulls were removed from the island. Most gulls were removed from within the tern colony, all other predator removal occurred outside the colony. Common tern fledge success was low this year at 52% with predation suspected as the main cause.

In 2022 staff placed game cameras within the colony to assist with identifying predators within the colony. This was done as staff time allowed and did not follow a standardized protocol for deployment location or timeframe, though camera settings were identical. Cameras were deployed staring on June 29th and the final camera was retrieved on August 8th for a total of 156 trap nights. The most common predator caught on camera was black-crowned night heron with 46 hits, followed by coyote and laughing gull with 4 hits, greater black-backed gull and mouse with 3 each, and herring gull and northern harrier each with one. We will continue to deploy cameras in the colony in 2023 to see if we can focus our predator control efforts on the species or individuals that are having the most impact.

Avian Influenza

Mortality of adult terns and laughing gulls was observed in the colony from the time we arrived on island in mid-May through the summer, with the highest numbers reported in May and June. Over the course of the season, 229 birds were found dead with the highest numbers occurring in laughing gulls, common eiders, and common terns. We also found several dead loon, greater black-backed gulls, and greater shearwater. A few common terns were observed with abnormal neurological behavior. Three common terns were sent into the National Health Center in Madison, Wisconsin. All three were sampled for avian influenza and tested negative. Two of the carcasses went through additional analysis to determine cause of death, both came back as undetermined. We also tested fresh dead birds including common terns, laughing gulls, herring gulls, greater black-backed gulls, and double-crested cormorants for avian influenza through cloacal and oral swabbing. A total of 27 birds were tested. Results of those samples are pending but at least one sample came back positive.

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 common tern. In total 26 adult samples were collected during the incubation period and another 25 during the chick-rearing period. Forty-three samples were collected from common tern chicks.

Morning Session

Overview of HPAI in wild birds in the Northeast
Kaitlin Sawatzki, Cummings School of Veterinary Medicine at Tufts University

Afternoon Session

Atlantic Puffin Research on Matinucs Rock
Will Kennerley – Oregon State University/National Audubon Society

Piloting Methods for a Spatial Model of Common Tern Aggression
Kay Garlick-Ott – University of California, Davis

Tern and Storm-petrel Taggin in the Gulf of Maine
Keenan Yakola, Oregon State University/National Audubon Society

Views from Kent Island
Liam Taylor, Yale University

A Critical Assessment of Microplastic Contamination in Seabirds Nesting on Northeaster US Islands
Charles Rolsky, Shaw Institute

Why are Puffins bringing in less herring for their chicks than other alcids from the Gulf of Maine?
Joana Romera, University of New Brunswick

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