Gulf of Maine Seabird Working Group
35th Annual Summer Meeting

Hog Island, Bremen, Maine
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Meeting minutes were compiled by Heather Major, UNB

Introduction

The Gulf of Maine Seabird Working Group (GOMSWG) is a collaborative effort among state and federal agencies, national and state Audubon 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 30 years. Despite this combined effort, many seabird populations still face significant threats and challenges from predators, declining availability of prey species, climate change, sea level rise, human disturbance, invasive species, and threats during migration. Many of the management agencies are also facing declining budgets that challenge our ability to manage the colonies. It is through our combined effort and sharing of knowledge that seabirds stand the best chance of overcoming the challenges they now face.

Meeting activities involved island reports from Canada to Massachusetts, followed by afternoon presentations. A table with 2019 GOMSWG census results will be distributed concurrently with this report.

ISLAND REPORTS

CANADA

Lobster Bay, Nova Scotia

The Brothers Islands Wildlife Management Area (North Brother Island)

Julie McKnight, Conservation Biologist – Canadian Wildlife Service, Environment and Climate Change Canada
Shawn Craik, Associate Professor of Biology – Université Sainte-Anne
Ted D'Eon, Island Steward

Tern Census

The tern census was conducted on North Brother Island on 18 June with five observers. We surveyed all suitable nesting habitat by making systematic sweeps through the nesting area and placed wooden craft sticks in each nest upon discovery to avoid counting individual nests more than once. We used survey flags to delineate areas previously surveyed. Since we followed at least most ROST and ARTE nests initiated during peak nesting, we estimated the number of COTE nests by obtaining the difference between the total number of nests counted on 18 June and the number of ROST + ARTE nests; see Table 1.

Table 1. Number of tern nests found on North Brother Island from 2012-2019

Year	COTE	ARTE	ROST
2014	694		37 (year end: 38)
2015	687		35 (year end: 42)
2016	619		42 (year end: 50)
2017	141*		24*
2018	74*		2*
2019	372	35	47 (year end: 52)

* colony was abandoned post-census due to heavy predation

Productivity

We assessed fledging success for each species using a mark-recapture approach involving two banding periods.

The first banding period (15-16 July) coincided with the week prior to the first fledging of chicks. On 15 July, we systematically searched the island for chicks and captured and banded all chicks that were estimated to be ≥15 days old. We assumed chicks reached 15 days old when wing chord length reached 80 mm, 90 mm, and 110 mm for ROST, COTE, and ARTE, respectively. Once wing chord reaches 60 mm, juvenile ARTE can be distinguished from young COTE by their shorter tarsus bone (<19 mm for ARTE). On 16 July, we performed a second sweep in which we recorded band numbers of chicks marked on 15 July and we marked all unbanded chicks that were ≥15 days. The estimated number of chicks present (N) for each species in this first cohort was derived using the following equation: (M * n)/r where, M is the number of chicks marked during the 1st sweep, n is the number of birds ≥15 days old encountered during the 2nd sweep, and r is the number of banded (i.e. recaptured) birds encountered during the 2nd sweep.

The second banding period occurred on 24 July. We systematically searched the island for tern chicks and captured and banded all chicks that were estimated to have been ≥15 days old. Later in the day, we performed a second sweep in which we recorded band numbers of chicks banded during the first sweep on that day (we did not include any chicks banded on 15 and 16 July) and we marked all unbanded chicks that were ≥15 days. Equation (1) above was used to calculate the estimated number of chicks present for each species in this second cohort.

We estimated the total number of chicks produced for each of the three tern species by summing the number of chicks present in the first cohort and the second cohort. Fledging success (# of young fledged/pair) was estimated for each species by dividing the estimated number of fledged chicks by the number of nests counted during the 18 June survey; see Table 2.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on North Brother Island in 2019. Numbers in parentheses indicate sample size.

Species	Clutch size	Hatching success	Estimated number of chicks fledged/pair*
COTE	2.53 (30)	63% (26)	0.89
ARTE	2.00 (35)	74% (34)	0.69
ROST	1.46 (52)	95% (48)	1.0

* Assuming chicks reaching 15 days are fledged

Predator Activities and Control Efforts

One Great Black-Backed Gull nest was removed from North Brother Island. The eggs were notably cold and we believe the tern response was effective at deterring the gulls from incubating this clutch.

Other Notes

After abandoning North Brother Island in 2017 due to intense predation by American Crows and scattering to a handful of islands in 2017 and 2018, the terns retuned in force to North Brother Island in 2019. We surveyed islands throughout Lobster Bay during the peak nesting period but did not document breeding evidence for ROST elsewhere.

Machias Seal Island

Sarah Durham, Island Supervisor/PhD student - University of New Brunswick; Nola Sheets and Michel Vorasane field technicians

Tern Census

A formal census was not completed for the 2019 season; however we estimate there were approximately 500 nests on the island. The last tern census was completed on June 15-16, 2018 with an estimated total of 450 ARTE and 26 COTE nesting on MSI. No ROST or LETE were observed breeding on the island this summer.

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

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
175	75	50	90	187	150	175	300	476	500

Productivity

Terns breeding on MSI had a somewhat successful season, with 71 chicks dying from rain and exposure to the elements. 151 ARTE nests with a total of 245 eggs and 9 COTE nests with a total of 22 eggs were monitored this season. The first tern egg was encountered on May 27 for ARTE and June 1 for COTE, mean lay date was June 7 for ARTE and June 18 for COTE. The rate of egg predation was high this year, with 28 of the 245 ARTE eggs (0.114) and 7 of the 22 COTE eggs (0.318) having been depredated. Mean hatch date was June 27 for ARTE and July 3 for COTE; hatching success was 0.549 for ARTE and 0.545 for COTE.

A total of 48 ARTE chicks fledged (alive at day 15), with 47 monitored nests raising 1 chick to fledge and 1 monitored nests raising 2 chicks to fledge. The fledge success for monitored nests this season was 0.25 fledge/nest (to day 15). 71 of the 135 monitored ARTE chicks were found dead over the course of the season with no apparent injuries or weight loss, ultimately resulting in low fledging rates. A total of 2 COTE chicks fledged (alive day 15), with 2 monitored nests raising 1 chick to fledge and 0 monitored nests raising 2 chicks to fledge. The fledge success for monitored nests this season was 0.11 fledge/nest (to day 15).

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Machias Seal Island in 2019. Data for 2018 shown in parentheses.

Species	Clutch Size	Hatching Success	Fledging Success	Nests Monitored
COTE	2.44 (2.13)	0.55 (0.82)	0.11 (0.25)	9 (8)
ARTE	1.63 (1.64)	0.55 (0.76)	0.25 (0.65)	151 (132)
ROST	NA	NA	NA	NA

Tern Provisioning

We completed 55.32 hours of ARTE chick provisioning observation on a total of 23 nests in 3 separate plots. No COTE chick provisioning observation was completed due to low productivity. Prey availability remained consistent throughout the season, with larval fish (particularly larval sandlance), euphausiids, and hake as the predominant prey items.

Table 3. Principal prey items (percent) in tern chick diet on Machias Seal Island in 2019. *n* is the total number of prey items identified. Data for 2018 shown in parentheses.

Prey Item	COTE	ARTE	ROST
n	NA (91)	229 (851)	NA
Herring	NA (9.9)	1.7 (0)	NA
Hake	NA (27.5)	44.1 (15.6)	NA
Sandlance	NA (2.2)	0 (0.5)	NA
Butterfish	NA (0)	0.4 (0.4)	NA
Pollock	NA (0)	0 (0)	NA
Stickleback	NA (3.3)	7.9 (2.5)	NA
Euphausiid	NA (4.4)	7.4 (21.3)	NA
Larval fish	NA (49.5)	6.1 (54.2)	NA
Other	X (3.3)	32.3 (5.5)	NA

Predator Activities and Control Efforts

Non-lethal gull control was continued this year, using paintball guns and hazing of loafing individuals. A laser pointer (Bird Control Group Handheld 200) continued to be used this season as a nonlethal gull control tool and proved to less effective than in 2018. Early in the season the target gull(s) would immediately flush and not return, but as the season progressed, they tended to circle back and re-land suggesting some amount of habituation. The laser did not seem to negatively impact any other bird species on the island, however. The laser pointer proved to be ineffective in very bright conditions and very foggy conditions. It was determined that a contracted predator control specialist was not necessary this season due to rain/exposure causing high rates of mortality among tern chicks.
An adjacent island with a persistent breeding colony of HERG and GBBG, was visited 4 times during the season: May 25th, June 9th, June 24th, July 7th. A total of 7 gull nests, all HERG, were found and destroyed by shaking and poking eggs. A total of 20 eggs were destroyed. A pair of bald eagles were observed at the gull colony from July 8th through August 8th during which time no gulls were observed there. Laughing Gulls were consistently heard on island between May 23rd and July 20th; however, no active nests or nest sites were encountered on the island. A high count of 7 individual LAGU was recorded on June 4th. No gull nests were found on MSI this year.

Common Eiders

Counts were conducted weekly with a high of 282 individuals (146 males, 136 females) on June 1st. Ducklings were first seen in mid-June and were still present around the island in early August. Our highest count was on July 9th with 63 ducklings.

Alcids: Atlantic Puffin

A formal ATPU census was conducted from June 18 through June 20 resulting an estimate of 8,635 breeding pairs. From an initial 101 monitored productivity burrows, 75 were determined to be active and monitored for the season (74.3% occupancy). Mean lay was May 12th The final check of all productivity burrows was completed on August 12th and 13th. 50 of the 75 active burrows (66.7%) had hatched; 19 (25.3%) were of known age. 11 eggs (14.7%) went missing (confirmed empty burrows), 9 eggs (12%) were confirmed dead, 8 chicks (10.7%) went missing, and 5 chicks (6.7%) were confirmed dead. 37 chicks from productivity burrows had been banded (age day 35) with 74% fledge success and 49% nest success as of August 13th. Linear growth rate this season was 9.0 g/day (3.6 g/day in 2018, 7.6 g/day in 2017). A total of 138.1 hours of ATPU chick provisioning stints were conducted. Food was relatively stable throughout the season with the diet consisting mainly of hake early in season and then switching to haddock mid-season.

Alcids: Razorbills

A formal RAZO census was conducted on June 23 and June 24 resulting an estimated 3,715 breeding pairs.
A total of 67 burrows were monitored for productivity this season. Linear growth rate was 1.89 g/day (5.2 g/day in 2018, 5.3 g/day in 2017). A total of 55.7 hours of RAZO chick provisioning stints were conducted.
From an initial 94 monitored burrows, 67 (71% occupancy) were determined to be active and monitored for the season. Mean lay was May 17th. Of the 67 eggs, 44 (65.7%) hatched and 23 (34.3%) went missing or were confirmed dead. Of the 44 chicks, 6 (13.6%) went missing and 5 (11.4%) were confirmed dead.

Alcids: Common Murre

COMU numbers remain high. From July 23rd to July 27th a minimum of 277 active nests were estimated. A total of 50 chicks were banded this year, 30 of which we obtained blood sample from for the purposes of stable isotope analysis. 32 adults were banded, 30 of which also had blood sample taken. GLS tags were recovered from 1 of the 10 adults tagged in 2017. A total of 47.12 hours of COMU chick provisioning stints were conducted.

Table 4. Breeding parameters for Atlantic Puffins and Razorbills on Machias Seal Island in 2019. Data for 2018 shown in parentheses.

	n	**Mean Lay**	**Mean Hatch**	**Burrow Occupancy**	**Hatching Success (hatch/ active nest)**	**Nest Success (fledge/ active nest)**	**Linear Growth Rate (mass)**
ATPU	75 (124)	May 12 (May 16)	June 21 (June 26)	0.74 (0.76)	0.67 (0.74)	0.49 (0.32)	9.0 (3.6)
RAZO	67 (73)	May 17 (May 18)	June 21 (June 22)	0.71 (0.78)	0.66 (0.71)	0.49 (0.52)	1.9 (5.2)

Table 5. Principal prey items (percent) in alcid chick diet on Machias Seal Island in 2019. *n* is the total number of prey items identified. Data for 2018 shown in parentheses.

Prey Item	**ATPU**	**COMU**	**RAZO**
n	4979 (5074)	400 (267)	314 (1422)
Herring	1.2 (2.2)	8.3 (28.1)	36.9 (16.7)
Hake	31.9 (15.9)	1.8 (1.1)	32.8 (9.6)
Haddock	13.4 (9.1)	10.0 (11.6)	1.0 (0.2)
Sandlance	4.2 (1.5)	1.8 (3.7)	7.0 (3.4)
Butterfish	0.6 (0.7)	2.5 (7.1)	0.0 (0.1)
Squid	2.0 (2.9)	7.3 (5.2)	1.0 (0.4)
Euphausiid	0.7 (3.3)	0.3 (0)	0.6 (0.1)
Larval fish	12.2 (60.2)	1.3 (2.6)	5.7 (67.9)
Rock Gunnel	0 (0)	17.0 (21.3)	0 (0)
Other	33.9 (16.3)	26.3 (5.5)	14.6 (0.1)

MAINE

Petit Manan Island

Jimmy Welch: Island Supervisor - USFWS
Hallie Daly, Devin Jobe, Brandon Meisner: Island Technicians – USFWS

Census

During the GOMSWG census on June 18 and 19, 2019, we counted 1,246 active tern nests, including 70 nests in productivity plots. After applying the Lincoln correction index of 1.047 on all nests outside of productivity plots, we estimate 1,302 pairs of terns nested on PMI in 2019. This was 2% higher than last season's results (1,277 pairs). We identified 460 nests to species (32%), and used a new species ratio method first tried in 2018 where COTE dominated shoreline nests and mixed interior habitats were uniquely calculated. The interior species ratio at PMI in 2019 was 42% ARTE and 58% COTE, while shorelines were 100% COTE. By calculating unique ratios for designated zone, we estimate 363 ARTE pairs and 939 COTE pairs nested in 2019. The overall colony-wide ratio was 28% ARTE and 72% COTE. Additionally, we counted 45 common eider nests and 656 laughing gull nests during the census.

Table 1. Estimated number of terns, laughing gulls, and common eiders counted during the GOMSWG census at Petit Manan, 2015-2019.

Year	COTE	ARTE	LAGU	COEI
2015	706	481	620	62
2016	574	384	543	60
2017	657	431	605	46
2018	925*	352*	766	47
2019	939*	363*	656	45
*new species ratio method used				

Tern Productivity

COTE productivity was 0.85 chicks fledged per nest and ARTE productivity was 0.77 chicks fledged per nest. Prey availability appeared to be consistent throughout the season. Weather also appeared to be favorable, with the exception of a large storm on June 27th. We found six dead chicks in plots the next day.

Arctic Tern Metapopulation Project

As part of the Arctic tern metapopulation project, we re-sighted 148 adult Arctic terns, recaptured 18 adults, and banded 155 new birds (35 adults and 120 chicks).

Table 2. Tern reproductive success at Petit Manan Island, 2015-2019.

	2015	2016	2017	2018	2019
COTE					
N	32	27	34	34	33
Mean Clutch Size	2.09	2.04	2.29	2.03	2.03
Mean Hatch Success	85.1%	92.7%	92.4%	71%	76.1%
Mean Fledge Success	68.4%	54.9%	66.2%	61.2%	54.9%
Mean Chicks Fledged/Nest	1.22	1.04	1.38	0.88	0.85
ARTE					
N	38	41	40	39	44
Mean Clutch Size	1.87	1.54	1.68	1.79	1.71
Mean Hatch Success	81.7%	71.4%	82.1%	65.7%	79.2%
Mean Fledge Success	62.1%	64.4%	56.4%	58.7%	55.7%
Mean Chicks Fledged/Nest	0.95	0.71	0.78	0.69	0.77

Tern and Puffin Provisioning

We conducted provisioning observations for 24 common tern nests and 10 Arctic tern nests for a total of 456.73 observation hours (137.88 Arctic tern and 318.85 common tern) and observed 700 prey deliveries (141 Arctic tern and 559 common tern). Herring was the primary prey for common terns this field season, contributing to 26.52% of the diet and hake was the primary prey for Arctic terns contributing to 31.21% of the diet. On average, common tern adults delivered 1.75 prey items per nest per hour while Arctic terns delivered 1.02 items per nest per hour.

We documented puffin diet composition with photos of adults entering the burrows, and later identified the fish in the images. We found this method of provisioning difficult due to the speed in which puffins return to their burrows with prey, and spent 19.83 hours in blinds, conducting feeding stints. We also found it productive to identify puffin prey opportunistically during trapping stints. In total, we observed 57 feedings and were able to identify 200 prey items. Haddock made up the majority (48.70%) of prey items identified. We also identified several other prey species including squid, lumpfish and euphausiids.

Table 3. Principal prey items (%) in tern and puffin chick diets on Petit Manan Island in 2019.

2019	ARTE	COTE	ATPU
Hake	31.21%	10.75%	22.80%
Larval Fish	0%	0%	0
Invertebrate	0.71%	12.72%	0
Pollock	2.84%	3.76%	0
Squid	0.71%	0%	0.52
Herring	26.24%	26.52%	5.18%
Sandlance	1.42%	7.35%	1.04%
Butterfish	1.42%	0.18%	9.33%
Haddock	3.55%	4.66%	48.70%
Unknown	2.13%	0.90%	0
Unknown Fish	24.82%	29.21%	3.11%

Predator Control

We discouraged avian predators from perching on the island throughout the season using bird deterrents. Peregrine falcons were a reoccurring predator starting in early June, and observed several times per week until the end of the season. We found the remains of two adult puffins and three terns and observed 13 adults and one fledgling predated by the peregrine, though peregrine falcon predation is assumed to be slightly higher. Bald eagles were also a regular visitor to the island, but mainly preyed on the laughing gull colony. Merlin's and Northern Harrier's were also frequently observed in the on the island in May. Merlin made successful predation attempts on three occasions and a Northern Harrier was observed making one successful predation attempt, all on songbirds. During the census, we oiled the eggs in 406 laughing gull nests and destroyed 191 laughing gull nests. Lethal removal of avian predators thought to be tern or kelptoparasitism specialists also occurred and included: five adult laughing gulls and two herring gulls which both had broken wings. We also had several heron species visit Petit Manan including a green heron (June 18th-20th) which was believed to have predated several tern and laughing gull eggs. We also had several other potential egg predator species including a juvenile yellow-crowned night heron (July 16th-18th) and a least bittern (May 21st). We used human presence to deter herons from predating eggs.

Alcids

The highest alcid counts for the season were 176 Atlantic puffins (June 30th), 83 razorbills (June 16th), 12 common murres (June 24th) and 240 Black Guillemots (May 19th). The 2019 puffin population was slightly higher than 2018 (62 pairs) but lower than 2015 (77 pairs). Of the 5 razorbill pairs, only 1 fledged a chick. Guillemots increased from 68 pairs in 2018 to 82 pairs in 2019. Many guillemot chicks had not fledged yet when the crew left the island, but is a minimum of 1.31 pairs. Although common murres were observed loafing on the island, there was no evidence of any breeding attempts in 2019.

Table 4. Active alcid nests and reproductive success at PMI, 2019.

2019	Active Nests	Hatch Success	Productivity
ATPU	69	81.4%	0.75
RAZO	5	20%	0.20
BLGU	82	84%	1.31 min

In addition to daily counts and productivity monitoring, we re-sighted alcid bands and captured adult alcids by grubbing and setting box traps. This season, we re-sighted 140 Atlantic puffins, recaptured 14 adults, and banded 43 new puffins (33 adults and 18 chicks). Puffin chick banding will continue throughout August. We re-sighted three adult razorbills and banded our one razorbill chick before fledging. Finally, we banded 62 black guillemots (3 adults and 59 chicks).

Petrels

We conducted three sweeps of the island to look for petrel burrows. The first sweep occurred during the first week of May to mark possible burrows, the second occurred during the first week of June to determine occupancy, and the last check was during the first week of August to assess hatching. We were able to confirm occupancy by either grubbing burrows or using a playback of their chatter call. If we were able to grub the burrow and found an adult, egg, or chick we considered it occupied. Additionally if playbacks elicited a response, we also considered the burrow occupied. We banded 11 Leach's storm-petrel adults during this effort.

Other Research

Petrel GPS tagging: In 2019 we worked with a graduate student to deploy GPS tags on Leach's Storm-Petrels. The goal of the project is to better understand offshore feeding locations and activity for adult storm-petrels during the breeding season. We deployed eight tags on PMI on adults during the incubation period or early in the chick rearing period. We candlelit eggs to determine stage of development and estimate hatch date. We were able to successfully retrieve four of the eight tags deployed thus far.

Tern GPS tagging: In 2017, five common terns were equipped with solar satellite transmitters. Two of the transmitters continued to transmit during the 2018 nesting season, while the other three tags stopped transmitting over the fall and winter. We were able to re-sight one of the tagged terns this summer and were able to remove the non-functioning transmitter.

Laughing Gull Hormone Study & Stable Isotope/Fecal Sampling: In 2019 we continued the efforts to collect laughing gull eggs for a graduate student comparing hormone levels in eggs. We conducted two collections of 30 eggs from single egg LAGU nests (early and late season collections). The graduate student from North Dakota State studied the nesting phenology of the laughing gull colony. She compared eggs laid during the early, middle, and late seasons. Her goal was to compare hormone levels found in the eggs to try to determine the effect of the timing of nesting on the egg itself. Working with researchers from UMASS and the Northeast Climate Adaption Science Center, we were able to collect 24 COTE, 11 ARTE, 29 BLGU, 14 ATPU, 1 RAZO, 9 LAGU, 7 LHSP, and 1 COEI eggs for stable isotope analysis. We also collected fecal samples from common and Arctic terns, puffins and guillemots which were used to compare the diet of chicks to adults, and to compare diet among the species. The Refuge is working with University of New England and Cornell University to conduct the DNA analysis of tern and alcid fecal samples to determine diet composition.

Ship Island

Bobby Brittingham – Island Technician
Collin Kelly – Island Technician

Tern Behavior and Productivity

Ship Island was monitored by a two-person crew from May 21-July 26, 2019, with additional coverage from August 2-15 due to a wave of late nesting attempts. Common terns initially began nesting in late May, with a high count of 300 terns on May 27. By June 2, numbers decreased dramatically and only 4 terns were seen on June 4. We were unable to determine the cause of this decline. Only 9 active nests (and 14 abandoned nests) were counted during the GOMSWG census on June 19, and no correction factor was applied. The active nest clutch size was 1.56 eggs/nest. Mink and owl were deployed all season and partial night stints were conducted nearly every night, though no owl, mink, or raccoon were observed. The crew found small traces of scat that smelled like it a mustelid, from June 13-14 on the trails throughout the island. Refuge staff hypothesize an otter visited the island for a short period, which was enough disturbance to cause the terns to abandon.

Table 1. Estimated number of breeding common terns at Ship Island, 2015-2019.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
# of Active Nests during GOMSWG	105	251	438	405	680	684	620	519	9
Peak Nests	149	251	500	445	715	710	620	519	427

A sound system and tern decoys were deployed on June 14, which seemed to encourage birds to stay on the island. The second wave of nesting began on June 25, starting with 55 terns at the colony and gradually increasing to 200 terns by July 5. During this period, new nests were found every day, with a peak of 427 nests by July 26. Small numbers of new nests continued to be found daily in August.

Due to the late establishment of the colony, fledging data was selected from 16 productivity plot nests that had a chick hatch by July 18. We were not able to calculate fledging rates for the majority of the nests on Ship Island due to their late hatching dates. Any chick that was at least 12 days old by July 26 (date of last productivity plot check), was considered to have fledged.

Table 2. Common tern reproductive success at Ship Island, 2011-2019.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
N	104	41	56	41	44	58	68	51	16-36
Mean Clutch Size	2.34	2.32	2.43	2.44	2.30	2.28	1.96	2.10	2.05
Mean Hatch Success	67.9%	63.2%	71.3%	80%	72.3%	85.6%	27.1%	--	77%
Mean Fledge Success	25.5%	73.3%	45.4%	73.8%	89%	65.5%	72.%	--	57.1%
Chicks Fledged/Nest	0.40	1.07	0.79	1.44	1.48	1.28	0.39	--	1.00

Tern Provisioning

Provisioning data was collected from July 18-July 26 due to late nesting. We observed 271 feedings at eight different nests. The majority of the diet items fed to chicks were Atlantic herring, hake, and sandlance. During opportunistic observations of feeding from August 2-August 10; herring, hake, stickleback, invertebrates, pollock, and a couple instances of invertebrates were observed being fed to chicks. Herring was the most common diet item fed to chicks and a majority of the fish were 1.75-2.25 culmen lengths.

Table 3. Principal prey items of common tern chick diet (%) at Ship Island, 2011-2019.

COTE diet %	2011	2012	2013	2014	2015	2016	2017	2018	2019
Atlantic Herring	24.4	78.4	45.6	60.8	53.1	77.2	80.3	--	63.5
Sandlance	17.3	0.9	20.9	1.0	21.4	4.6	1.8	--	2.6
Crustaceans	--	--	10.5	--	0.9	1.1	--	--	--
Pollock	18.1	--	4.3	10.0	4.1	1.1	--	--	0.4
Invertebrates	1.7	1.6	5.7	0.7	0.7	0.7	--	--	0.4
Butterfish	0.4	--	1.7	--	--	--	--	--	--

COTE diet %	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stickleback	10.7	0.2	1.5	--	0.5	0.3	--	--	--
Hake	--	--	1.1	6.6	2.5	6.6	3.7	--	13.7
Unknown	20.5	7.2	--	1.0	16.3	3.1	3.5	--	15.9
Larval Fish	--	--	--	--	--	--	--	--	3.3
Haddock	--	--	--	--	--	--	--	--	0.4

Predator Control

An average of 13.86 mink traps were present each day throughout the field season, the earliest being set on May 7. No signs of mink were detected throughout the nesting season. We believe the 2018 abandonment of the Ship Island tern colony was due to owl predation, so five paddled leg-hold traps and two Swedish goshawk traps were deployed in early May. In addition, the crew conducted night stints of the colony between 8:30PM-1:00AM and early morning stints which occurred 4:30-7:00AM. No sign of owl predation was detected by the crew this season.

Peregrine falcon visits occurred briefly in late May, and did not occur again until mid-late July when the colony was fully established. Peregrine falcon visits increased sharply in August with up to five visits a day. We used pyrotechnics as the main falcon deterrent in May, as the colony was not present on the island. The peregrine killed at least three terns in early August. To deter gulls from loafing on the beach, we used pyrotechnics early in the season, followed by an Agrilaser lite® laser and physically chasing gulls off. These methods worked initially, but the gulls became accustomed over time and our non-lethal predator harassment efforts became less effective. We lethally removed 4 gulls and displayed them on posts along the tern colony beach, which effectively decreased the number of loafing gulls. Bald eagles were frequently observed preying on the gulls, eiders, and cormorants on East and West Barge, and Trumpet Island. Eagles occasionally loafed on Ship, but the laser was extremely effective at flushing them. Mustelid scat was found on June 13 and 14, five samples were located on our trails throughout the island. Baited camera traps and live traps were placed strategically across the island, but the mustelid was never captured.

Habitat Management

Gravel tern plots were weeded throughout the summer, and 30-40 nests were located in the plots by August 5. Four contractor bags of flowering garlic mustard were pulled, and 7 gallons of a concentrated vinegar solution were sprayed on rosettes from June 3-10. A new sheep grazing study was started in 2019, with pre-grazing vegetation data collection. If the tern colony is stable in 2020, sheep may be introduced to control rank vegetation.

Seal Island National Wildlife Refuge

Report Author: Keenan Yakola, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

A partial tern census was conducted on June 18, where 14 of the 30 grid squares were surveyed, as in the 2009-2017 censuses, due to safety concerns on the island. The censused area has been determined to represent, on average, 57% of the total nest number of the colony over the last twelve years in which a complete census was performed (1996-2006). The extrapolated total was 2,069 tern nests (after a Lincoln Index of 1.014 was applied). The species ratio of the colony was determined by marking a 16m radius around nine blinds and identifying as many nests to species as possible within each circle. With this, in addition to the composition of four productivity plots on the island, the species ratio was estimated at 38.5% Arctic Terns and 62.5% Common Terns (n=974).

Table 1. Adjusted number of tern nests found on Seal Island NWR from 2013-2019.

Year	COTE	ARTE
2013	1,448	1,039
2014	1,383	855
2015	1,345	902
2016	1,309	949
2017	1,064	733
2018	1,204	829
2019	1,293	776

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Productivity was average for both Common and Arctic Terns on SINWR and notably higher for both species compared to 2018 (Table 2).

Table 2. Tern productivity on Seal Island NWR in 2019. Data for 2018 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	1.83 (1.87)	1.58 (1.55)	0.96 (0.48)	71 (71)
ARTE	1.73 (1.86)	1.52 (1.66)	0.85 (0.76)	29 (29)

Tern Provisioning

12 Arctic Tern nests were observed for 356 cumulative hours, with an average feeding rate was 1.35 feedings per nest per hour. 17 Common Tern nests were observed for 616 cumulative hours, with an average feeding rate of 0.92 feedings per nest per hour. Hake and herring were the most common prey items fed to Common and Arctic Tern chicks and made up over 60% of chick diet for both tern species (Table 3).

Table 3. Principal prey items (percent of diet) in tern chick diet on Seal Island NWR in 2019. Total number of prey items observed n=481 for ARTE and n=564 for COTE.

Prey item	ARTE %	COTE %
Hake	44.7	18.26
Herring	22.7	49.5
Euphausiid	5.82	0.5
Unknown Fish	9.4	14.2

Predator Activities and Gull Control Efforts

Gull predation was observed nearly daily, usually just before dusk along the eastern bight in Area 1. Gull control efforts included poking eggs in all gull nests found during two gull censuses, conducted on May 31-June 1 and June 23, as well as attempts to shoot individual predatory gulls. Control efforts are summarized in Table 4. Laughing Gulls were observed daily, however no nests were found and high counts were notably lower this season compared to the last few years.

Table 4. Gull control measures by species at Seal Island NWR in 2019.

Species	# Nests destroyed	# Shot
Herring Gull	212	0
Great Black-backed Gull	39	0
Laughing Gull	0	0

Atlantic Puffins

A puffin nest census was performed by determining burrow activity within 15 circular plots spaced throughout the main colony in Area 1, as well as at all nesting areas outside Area 1. From observations of incubating adults, eggs, chicks, and feedings, it was estimated that a minimum of 573 active burrows were present. Puffin productivity was monitored at 71 burrows. Hatching success was 0.89 chicks hatched per egg and productivity was 0.85 chicks fledged per pair (Table 5).

Table 5. Atlantic Puffin hatch success and productivity at Seal Island NWR from 2014-2019.

	# Burrows monitored	Hatch Success	Productivity
2014	71	0.83	0.75
2015	62	0.94	0.81
2016	67	0.88	0.57
2017	68	0.91	0.89
2018	63	0.92	0.60
2019	71	0.89	0.85

Prey items delivered to puffin chicks were recorded from late June through early August, with a total of 1,394 prey items observed. The dominant prey species in chick diet this season were hake and haddock at 43% and 39% respectively. This was followed by herring which comprised around 5% of diet. Diet consisted mainly of hake earlier in the chick rearing period, but then switched to a mixture of hake, haddock, and some herring through the latter half of July and early August.

Black Guillemots

Black Guillemot productivity was monitored at 45 burrows. Average clutch size was 1.82, average hatched per nest was 1.31, and productivity was 1.02 chicks fledged per pair.

Razorbills

A high count of 180 Razorbills were observed this season and 60 active burrows were located, however it is likely that several burrows went undetected.

Cormorants

25 Great Cormorant and 23 Double-crested Cormorant nests were counted on June 5, however additional nests were laid by both species after this date.

Matinicus Rock

William Kennerley, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern and Laughing Gull Census

The GOMSWG census was conducted on June 18 and 19. A total of 764 Arctic Tern nests were estimated after adjusting the raw count with a Lincoln Index correction factor. Common Tern nests were counted directly, with a total of 327 nests, or 30% of the total colony. During the GOMSWG census 4 Laughing Gull nests were counted and destroyed.

Table 1. GOMSWG census results on Matinicus Rock, 2014-2019

Year	ARTE	COTE	LAGU
2014	564	223	689
2015	701	206	0
2016	621	167	30
2017	600	166	3
2018	717	268	1
2019	764	327	4

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Arctic Terns fledged 1.02 young per nest. Mean clutch was 1.83 for 48 nests. Common Terns fledged 1.07 young per nest, well above the long-term average on Matinicus Rock of just 0.89. Mean clutch was 1.81 which is lower than last year and below average for this island. As a whole, average clutch size was lower than in 2018 though productivity was significantly higher, likely due to good prey availability throughout the season.

Table 2. Tern productivity on Matinicus Rock in 2019 with 2018 data shown in parentheses for comparison

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
ARTE	1.83(1.83)	1.65(1.38)	1.02(0.55)	48(47)
COTE	1.81(2.00)	1.63(1.88)	1.07(0.54)	27(26)

Tern Chick Provisioning

The most common food items provisioned by Arctic Terns to their chicks were hake (32%), followed by amphipods (21.5%), and herring (12%). The most common food item in the Common Tern chick diet was hake (35%), followed by herring (13%). Common Terns fed a very large variety of prey items, with 21 different food items identified.

Predator Activities and Control Efforts

Peregrine Falcons and Merlins were observed on numerous occasions throughout the season, although few successful hunts were witnessed. Herring Gulls were observed frequently flying through the colony with one particular individual frequently attempting to predate chicks just north of the light tower. Unfortunately, this individual could never be uniquely identified and little was done aside from verbal harassment during these forays.

Numerous Laughing Gulls attempted to nest on Matinicus Rock this season. All found nests (11 total) were destroyed (23 total eggs) and the nest bowl was scraped up. Persistent breeding attempts were discouraged by verbal harassment and eventually through the lethal control of nine Laughing Gull adults.

Atlantic Puffins

Puffin hatch success was 0.79 hatched per nest (n= 70) and productivity was 0.71 chicks fledged per nest, well above the 10-year average on Matinicus Rock of 0.58. Puffin bill loads delivered to chicks in 2019 consisted mostly of hake (41%), haddock (41%), herring (8%), and sand lance (6%). Herring and sand lance, in particular, comprised much higher components of the diet than in 2018, and feeding rate was higher as well, leading to 2019's higher productivity (2018 = 0.45).

Razorbills

Razorbill hatch success was 0.75 (n = 41), and productivity was 0.63 chicks fledged per nest – the second highest recorded on Matinicus Rock. The first Razorbill chick was seen on 7 June and hatching continued until the first week of July. Razorbill chick diet consisted primarily of hake (56%), herring (29%), and sand lance (9%). The last Razorbills had fledged and left the island by the end of July.

Black Guillemots

Mean clutch size was 1.68 (n=31) and productivity was 0.97 chicks fledged per nest, the highest recorded since Black Guillemot monitoring began on Matinicus Rock in 2010.

Common Murres

The high count for Common Murres in 2019 was 95, obtained by several observers counting murres simultaneously while at different points of the island. A minimum of five murre eggs were observed in June, all of which hatched and fledged by the middle of July. This was the second consecutive year that Common Murres successfully bred on Matinicus Rock.

Leach's Storm Petrels

Hatching success was 0.89 (n=132).

Manx Shearwaters

Manx Shearwaters were seen on the water regularly throughout the season in groups of as many as 7, and were heard calling from several parts of the island, especially the southwest quarter of the island. Six active burrows with chicks were confirmed this year – the most so far on Matinicus Rock – and five chicks were banded. Two banded adults were also captured in burrows and had geolocators that were deployed in 2018 removed.

Notable Birds

Rare bird sightings include a trio of Royal Terns, a hen King Eider, a Kentucky Warbler, and a lone Forster's Tern.

Metinic Island

Nick Ferrauolo (island supervisor) and Mary Negri (technician)

Tern Census

On June 18, we counted 765 tern nests during the Gulf of Maine Seabird Working Group (GOMSWG) census. After applying a Lincoln Index Correction Factor of 1.008 to the raw count and adding 60 productivity plot nests, we estimated a corrected total of 831 tern pairs at Metinic in 2019. While, this is a 1% decrease from 2018, it represents the second largest nesting population since restoration began in 1998. We identified the species of 27% of the nests (n=226) and calculated a species ratio of 62% common terns (515 pairs) and 38% Arctic terns (316 pairs). Productivity was higher than in 2018 for both species, and Arctic terns exceeded the refuge objective of 1.0 chick fledged per pair. We suspect that productivity was higher due to more available food than in 2018.

Table 1. Estimated number of terns counted during the GOMSWG census at Metinic Island, 2015-2019.

Year	COTE	ARTE	LAGU	COEI
2015	706	481	620	62
2016	574	384	543	60
2017	657	431	605	46
2018	903*	374*	766	47
2019	939*	363*	656	45
*new species ratio method used				

Table 2. Tern reproductive success at Metinic Island, 2015-2019.

	2015	2016	2017	2018	2019
COTE					
# of Nests					
Mean Clutch Size	2.26	2.43	2.35	2.24	2.25
Mean Hatch Success	77.4%	88.2%	90.7%	88%	90%
Mean Fledge Success	85.4%	42.2%	69.4%	42%	46%
Chicks fledged/pair	1.52	0.9	1.48	0.83	0.93
ARTE					
# of Nests	19	35	48	26	24
Mean Clutch Size	1.95	1.89	1.90	1.69	1.71
Mean Hatch Success	94.6%	89.4%	89.0%	93.2%	85.4%
Mean Fledge Success	82.9%	44.1%	93.8%	61%	91.4%
Chicks fledged/pair	1.53	0.74	1.58	0.96	1.33

Provisioning

During chick provisioning observations, we watched seven common tern nests for 155 hours and recorded 211 feedings (1.36 feedings/hour per nest), and observed six Arctic tern nests for 126 hours and saw 142 feedings (1.13 feedings/hour per nest). Dominant food items delivered to common tern chicks were herring (37.9%) and hake/herring (20.9%). The most abundant food brought to Arctic terns was hake (31%) followed by herring (24.6%). Although feeding rates for Arctic terns declined slightly, average size increased for all prey species observed compared to 2018. Common tern feeding rates increased slightly but overall average prey size decreased. Both species' diets averaged 98% fish and we saw only a brief shortage during the 3rd week of July. This is reflected in our higher than average linear growth rate of (7.1g/day) for Arctic terns and (7.2g/day) for common terns. The average linear growth from 2015-2018 was 5.2g/day for common terns and 5.3g/day for Arctic terns.

Table 3. Principal prey items of tern chick diets (%) at Metinic Island in 2019.

Species	Nests	Feedings /hour	Herring	Hake	Invert	Sandlance	Butterfish	Unk Fish	Unk
COTE	7	1.36	37.9%	18.0%	1.4%	2.4%	0.5%	11.4%	2.4%
ARTE	6	1.13	24.6%	31.0%	--	0.7%	--	23.9%	--

Tern Foraging Study

In order to understand foraging sites and daily movements of terns on Metinic, eight terns (5 common and 3 Arctic) were fitted with GPS loggers. The loggers were deployed on June 13 and we consistently received data on two common terns throughout the season but occasionally observed a third during blind stints. In order to monitor for nest abandonment we checked these nests along with our productivity nests every day from July 10 – July 23. We documented that one common and two Arctic tern nests had been abandoned and that the remaining nests were active with chicks at the time of our departure.

Predators

The rate of predation on tern eggs (8.9% of 67 nests monitored) prior to the GOMSWG census was higher than in recent years. American crows were observed successfully predating tern eggs on three occasions in early June. We displayed two crow decoys, made of black trash bags, that proved very effective at reducing predation attempts. A peregrine falcon visited the colony several times in June and late July, and killed at least one adult tern and one fledgling. A single merlin was observed hunting in and around the tern colony throughout the season and is known to have taken at least one tern chick. At least three problem herring gulls visited the tern colony daily throughout July and successfully took tern chicks on 22% of observed attempts. A problem great black-backed gull was observed less frequently attempting to access the colony. Although laughing gulls did not breed on Metinic in 2019, they frequently disturbed the colony and were observed kleptoparasiting terns in early June. We lethally removed one great black-backed, two laughing, and seven herring gulls in 2019. We oiled one great black-backed and 229 herring gull nests this season. A great horned owl was detected near the forest, but is not believed to have predated any terns. We found the feathers, feet and heads of gulls and guillemots near the forest and in the tern colony in early May and June. We removed 35 eastern garter snakes from the tern colony, including one found in a productivity plot (although it is not believed to have predated any chicks or eggs).

Black Guillemots

We located 63 guillemot burrows on USFWS property, and determined a 71% hatch rate by July 24. Out of the 63 burrows we monitored, a total of 12 burrows completely failed and two of these were believed to have been predated. We found the first chick on June 27. As of the last burrow check on July 24th, 83% of chicks from monitored burrows (n=20) and 56% of chicks island wide (n=40 chicks) were at least 10 days old and still alive. We banded 28 chicks, one adult and recaptured two adults.

Leach's Storm-Petrels

We did not conduct a petrel census on Metinic, but we did confirm for the first time extensive nesting in the forest. . This season we concentrated our efforts on locating burrows on refuge property that contained an incubating adult and were accessible with either a burrow scope or for grubbing. Additionally, as part of a Masters student's project, adult birds from five burrows were equipped with GPS tags to document foraging sites and behavior. We were able to retrieve three of the five tags.

Common Eiders

We conducted a common eider census in conjunction with the gull census on the north end of Metinic Island on June 5th and 6th. We identified 30 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 June 9, and we continued to see ducklings throughout the season as they approached fledgling stage. The largest crèche was observed in North Cove and included 17 ducklings and seven hens.

Incidental Sightings

We documented 114 species of birds on Metinic in 2019, and confirmed breeding for 16 species. We observed a king eider in May, which was a first for the island.

Sheep

Sheep graze Metinic from September through May, and are kept on the south side of the island during the breeding season. On June 11 a section of the fencing was found down and sheep scat and tracks were found in and around the forest. Throughout the remainder of the season, more sheep sign was found farther down the eastern edge closer to the north point however, no sheep were ever observed. Sheep did not affect breeding success during the 2019 season.

Eastern Egg Rock

Sarah Guitart, Island Supervisor – National Audubon Society Seabird Restoration Program

Census

An island-wide Common Tern and Laughing Gull nest count was conducted on June 16 and 17. Common Tern numbers increased by 46 nests from 2018. During census, 996 tern nests were counted. The addition of the productivity nests, feeding study nests, and a Lincoln index of 1.0329 brought the total to 1,067 nests. The number of Laughing Gull nests located during census was 333. While significantly more than the single nest found during the 2018 census, it is less than the roughly 1500+ plus that were counted during the past 18 years. Arctic and Roseate Tern nests were identified between June 1 and June 20. The census count of Roseate Tern nests decreased from to 82 in 2018 to 73. However, 7 B-wave nests and 3 additional nests were located outside the census window, bringing the total to 83 nests. Roseate Terns appeared to arrive late this season and did not establish a large presence until early June. 70 Arctic Tern nests were located, a decrease from the 86 found in 2018. It is likely that the increase of Laughing Gulls in comparison to 2018 is a cause of the Arctic Tern decrease.

Table 1. GOMSWG census results on Eastern Egg Rock, 2014-2019.

Year	COTE	ARTE	ROST	LAGU
2014	698	62	65	1934
2015	894	75	77	1943
2016	852	76	78	1973
2017	886	76	104	1729
2018	1,021	86	82	1
2019	1,067	70	73	333

Tern Productivity

Common Tern productivity was calculated from 69 nests in both fenced productivity plots and unfenced feeding study plots. This year, productivity measured 1.13 chicks fledged per nest. Arctic and Roseate Tern productivity were each calculated from a sample of unfenced nests. Roseate Terns fledged 1.10 chicks per nest and Arctic Terns fledged 0.40 chicks per nest.

Table 2. Tern productivity on Eastern Egg Rock in 2019.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.04	1.58	1.13	69
ARTE	1.74	0.98	0.40	53
ROST	1.43	1.20	1.10	83

Tern Provisioning

Thirteen Common Tern nests were observed over a total of 594 nest hours with an average feed rate of 1.4 feedings per nest-hour. Hake was the most frequently fed prey item, comprising 30.9% of feedings, followed by herring at 24.0%. Six Arctic Tern nests were observed for a total of 378 nest hours with an average feed rate of 1.3 feedings per nest-hour. Hake comprised most of the diet at 33.6%, followed by herring at 17.5%. Eight Roseate Tern nests were observed over 381 hours, averaging 1.1 feedings per hour. Herring was the prey item most observed at 28.1%, with hake at 19.5%.

Table 3. Principal prey items (percent) in tern chick diet on Eastern Egg Rock in 2019.

Prey item	**COTE**	**ARTE**	**ROST**
Hake	31	34	20
Herring	24	17	28
Unknown Fish	17	19	21
Hake or Herring	15	16	13
Pollock	9	1	10

Predator Activities and Control Efforts

Herring Gulls were the predominant tern predator this season. Attempts to shoot predatory gulls were unsuccessful. Greater Black–backed Gulls did not exert much predation pressure on the colony this year. A juvenile Peregrine Falcon visited the island roughly 10 times, with several successful kills. A juvenile Bald Eagle was seen flying very low over the island several times, at one point landing in front of the cabin. The eagle was not seen to successfully take any terns.

Efforts were made to deter Laughing Gulls from nesting on the island. "Dead Laughing Gull" decoys, some displaying fake blood, were hung in mid-May when the crew arrived to open the island. These appeared to have little effect. Counts of Laughing Gulls were low early in the season, but increased in late May. Laughing Gulls became accustomed to effigies and attempts at lethal control. Laughing Gulls continued to lay eggs through mid-July, and all eggs were oiled during the census in mid-June and again in mid-July. A total of 862 nests were oiled. A somewhat curious but effective technique that was discovered was that Laughing Gulls appeared to become very agitated by loud, sustained, high pitched screams. Terns returned to their nests quite quickly but Laughing Gulls were agitated and hovering above their nests for quite a while following the "Big Scream." Loud whistles or high pitched pyrotechnics could potentially be employed as a deterrent.

Table 4. Gull control measures at Eastern Egg Rock in 2019.

	GBBG	HERG	LAGU
Gulls Shot	0	0	12
Nests Destroyed	0	0	862

Atlantic Puffins

There was a minimum of 188 active puffin burrows on the island, up 10 from 2018. Hake comprised the majority of puffin diet at 76%. Herring was second most prevalent prey species observed at 13.8%. Observations of bill loads once puffin chick diet studies were completed in late July seemed to be largely comprised of small haddock. The first chick feeding was observed on May 29 at Tower Blind.

Black Guillemots

Productivity was monitored for Black Guillemots at 32 nests. Mean clutch size was 1.94 and productivity was 1.19 chicks fledged per nest.

Leach's Storm-petrels

Leach's Storm-petrels productivity was monitored at 20 nests. Hatching success was 0.60, which is lower than the 0.80 hatching success recorded in 2018.

Visitors

This season, Egg Rock received a little over a hundred visitors, primarily media personnel, donors, and campers from the Hog Island adult and teen camper programs. Notably, Maine Congresswoman Chellie Pingree visited the island on August 7.

Pond Island National Wildlife Refuge

Caitlin Bowman, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

Tern census was conducted on June 17. The unadjusted count for Common Terns (COTE) was 1,056 nests. An additional 72 COTE study nests were being followed at the time of census. The Lincoln Index was 1.03. The adjusted count of 1,159 nests, which includes study nests, is the highest number of nests recorded on Pond Island to date (see Table 1).

At the time of census, there were 7 Arctic Tern (ARTE) nests and 0 Roseate Tern (ROST) nests. Over the course of the season there were a total of 2 attempted ROST nests, one of which was found abandoned before the census date and one of which was laid well after the census date. Neither ROST nest is included in the census conducted on June 17th. A total of 13 attempted ARTE nests were found over the course of the season, 6 of which were laid after the census date and are not included in the census.

Table 1. Number of tern nests on Pond Island NWR from 2014-2019.

Year	COTE	ROST	ARTE
2014	612	0	4
2015	685	0	6
2016	773	1	6
2017	942	0	8
2018	1065	2	11
2019	1,159	0	7

Productivity

COTE productivity was determined by following 71 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 2.00 with a mean 1.68 hatched per nest and 1.46 fledged per nest. 13 ARTE nests were monitored. ARTE mean clutch size was 1.58, with a mean hatch of 1.17, and productivity was 1.17 chicks fledged per nest. Two ROST nests were monitored. ROST mean clutch size was 1.00, with a mean hatch of 0.50 and a productivity of 0.5. (See Table 2)

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Pond Island in 2019. Data for 2018 shown in parentheses.

Species	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	2.00 (2.53)	1.68 (2.34)	1.46 (1.28)	71 (58)
ARTE	1.58 (2.18)	1.17 (1.64)	1.17 (1.09)	13 (11)
ROST	1.00 (1.25)	0.5 (0.38)	0.5(unk)	2 (8)

Tern Chick Provisioning

Chick provisioning studies were conducted by observing 19 COTE nests from hatching through fledging. There were 1696 total feedings observed during 938 nest hours, resulting in a feeding rate of 1.81 feedings per hour. The principal prey species delivered were herring and sandlance. Lower quality prey items, such as butterfish and shrimp comprised less of the diet than in 2018 (0.40% versus 6.49% and 0.57% versus 1.27% respectively). The proportion of Killifish decreased from 2018, from 1.53% to 0.79%.

Table 3. Principal prey items in COTE chick diet on Pond Island in 2019. Data for 2018 shown in parentheses.

Prey item	Number of Items	% of diet
Herring	590 (481)	33.48 (25.38)
Sandlance	458 (821)	25.99 (43.32)
Hake or Herring	215 (47)	12.2 (2.48)
Hake	134 (100)	7.60 (5.28)
Unknown Fish	110 (159)	6.24 (8.39)
Unknown	105 (45)	5.96 (2.37)

Predator Activities and Control Efforts

Pond Island was subject to several predators during the 2019 season. On June 5th a dead adult COTE was found in the Dunes productivity plot and was believed to have been predated by a Great-horned Owl (GHOW). Weather did not permit setting up leg hold traps the night of the 5th. The morning of June 6th 31 dead COTE adults and 3 dead ARTE adults were found in the Dunes area. No tracks were seen due to continuous rain through the night and into the morning. The injuries sustained indicated owl and mink predation and 5 leg hold traps, 30 conibear traps and 2 have-a-heart traps were deployed that night. A Great-horned Owl (GHOW) was trapped on June 7th after depredating 3 COTE adults the previous night. No mink was caught and no further signs of mink were observed.

A juvenile and adult Peregrine Falcon (PEFA) visited the island occasionally in the early portion of the season and consistently in the latter half of the season.

Depredation from Great Black-backed Gulls (GBBG) and Herring Gulls (HERG) was minimal in the beginning of the season. Following fledging, tern chicks were seen being taken most days. Attempts at control were difficult due to the popularity of the Kennebec River and the close proximity of Popham Beach. With the use of the bird deterring laser HERG could be deterred in the early morning and late afternoon to much success. Some success was found deterring HERGs using water guns. No gulls nested on the island.

Bald Eagles (BAEA), were typically seen nearby on Wood Island, BAEA visits to the island were rare and mostly seen on the southern end of the island appearing to be hunting Common Eider (COEI) chicks.

American Crows (AMCR) were often seen in the marsh area of the island on the south end. Common Eider (COEI) eggs were seen predated throughout the island. Very few COEI chicks were witnessed on the water and GBBG and HERG were seen hunting them.

Jenny Island

Dallas Jordan, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 15. A total of 1,497 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs. A Lincoln index mark/recapture correction of 1.029 was applied to the uncorrected count. The addition of 54 productivity nests and 24 feeding study nests brought the total to 1,618 nests (Table 1). Twenty-one Roseate Tern nests were also presumed to be active during the GOMSWG census window. No additional B-wave nests were laid after the census window. While Arctic Terns were periodically seen on Jenny Island throughout the breeding season, no nests were found this year.

Table 1. GOMSWG census results on Jenny Island, 2014-2019.

Year	COTE	ROST
2014	1,120	12
2015	1,268	15
2016	1,122	13
2017	1,298	22
2018	1,426	24
2019	1,618	21

Tern Productivity

For Common Terns, five productivity plots containing 56 nests and three feeding study plots with 20 nests were monitored to determine productivity. 21 Roseate Tern nests were monitored for productivity. Common Tern productivity was 1.33 chicks fledged per nest, which was a marked increase in productivity from 2018. This increase is likely attributed to abundant high-quality food throughout the breeding season, as well as an absence of severe weather events in July. No Black-crowned Night Heron predation was observed this year, which likely contributed to lower than normal productivity in 2018. Roseate Tern productivity was 1.10, which is the highest Roseate Tern productivity on Jenny Island since 2012 (Table 2).

Table 2. Tern productivity on Jenny Island in 2019. Data for 2018 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.12 (2.27)	1.78 (2.06)	1.33 (0.94)	76 (61)
ROST	1.76 (1.84)	1.24 (1.24)	1.10 (0.62)	21 (25)

Tern Provisioning

Tern chick provisioning was monitored at three feeding study plots with 20 Common Tern nests. A total of 998 feedings were observed during 1,038 nest observation hours. Atlantic herring constituted the majority of observed feedings (44.5%; Table 3). Hake (including white hake and four-bearded rockling) made up another 23.5% of the feedings. Notably, butterfish (which constituted 3.8% of feedings in 2018, and are regarded as lower-quality prey) were not delivered as prey items during chick provisioning observations, though they were seen during courtship feedings.

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2019.

Prey item	Number of Items	% of Diet
Herring	444	44.5
Hake	235	23.5
Hake or Herring	90	9.0
Unknown Fish	59	5.9
Pollock	38	3.8

One feeding study plot with 5 Roseate Tern nests was monitored in 2019. A total of 229 feedings were observed during 246 nest-observation hours. Herring constituted the majority of observed feedings at 24.5% (Table 4). Unknown fish (unidentified fish prey) made up another 23.6 % of the feedings. Sandlance accounted for 16.2% of observed feedings, while hake (including white hake and four-bearded rockling) constituted another 14.4% of feedings.

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2019.

Prey item	Number of Items	% of Diet
Herring	56	24.5
Unknown Fish	54	23.6
Sandlance	37	16.2
Hake	33	14.4
Hake or Herring	23	10.0

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2019 field season. Great Black-backed Gulls and Herring Gulls were frequently seen loafing on the northern and southern ends of the island. There were two incidences of Herring Gulls entering the colony to predate chicks; one was chased off and the other was shot on July 14 after it was observed predating several chicks.

Though Laughing Gulls (*Leucophaeus atricilla*) have nested on Jenny Island in the past, no signs of nesting were found on the island early in the season. 2-4 Laughing Gulls were regular visitors to the island throughout the season, and though a small number of predated eggs could have been due to Laughing Gulls, they were not suspected to be significant a cause of chick mortality in 2019.

Great-horned Owl predation was observed during two periods in 2019. Multiple decapitated Common Tern adults were found during the beginning of the season, and nocturnal abandonment of the colony was observed for several consecutive days before normal behavior resumed. Though trapping efforts were made, no owl was caught during this time period. On July 2, four headless owl-killed adults and one headless chick were found. An additional seven Common Tern adults and 3 Common Tern chicks were found dead between July 3 and July 9 (including one chick found on top of a driftwood tree/owl post); all were either decapitated or left on their nests with puncture wounds in their necks. A Great-horned Owl was captured on July 9. The owl was already banded, and records show this was the same owl that was captured on Jenny Island in 2011. This owl was observed predating in a similar fashion in 2011 (leaving killed adults on nests with puncture marks in their necks).

Over the course of the season, at least two individual Peregrine Falcons (an adult and a juvenile) were identified predating terns on the island. There were 8 observed Peregrine Falcon visits to the island and though the individuals did not always take adult terns when they visited, 2 Common Tern adults were observed taken by Peregrine Falcons.

Black-crowned Night Heron predation, while significant in 2018, was not observed during the 2019 season.

Ruddy Turnstone predation was not directly observed, but cracked, empty eggshells with small bill-shaped holes in them were found around the edges of the island on several occasions, especially during late May and early June, and these were attributed to Ruddy Turnstones.

Common Eiders

Four Common Eider nests were found during the 2019 GOMSWG census.

Outer Green Island

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

Tern Census

The 2019 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on Outer Green Island on 15 June. A total of 1557 Common Tern (*Sterna hirundo*) nests were counted. The application of a Lincoln Correction Index of 1.0611 yielded an adjusted count of 1652 nests. The inclusion of 51 productivity study nests and 24 feeding study nests resulted in a final, corrected total of 1717 nests. This is another new record for Outer Green Island, making it the largest tern colony in Casco Bay and the largest colony of *S. hirundo* in Maine. At the time of the GOMSWG census, there were no known Arctic Tern (*S. paradisaea*) or Roseate Tern (*S. dougallii*) nests, and none were found later in the season.

Table 1. GOMSWG annual census on Outer Green Island, 2014-2019

Year	COTE	ROST	ARTE
2014	1139	0	0
2015	1353	0	0
2016	1367	0[1]	0
2017	1434	0	0
2018	1553	0[2]	0
2019	1717	0	0

[1] One ROST nest was laid after 20 June 2016

[2] Four ROST nests were laid after 20 June 2018

Tern Productivity

The first Common Tern egg was laid on 24 May. The average number of eggs per nest was 2.12 (n=75) of which an average of 1.81 hatched. The first recorded hatch was on 16 June, and peak hatch lasted approximately from 21-24 June. The average number of chicks fledged per nest (productivity) was 1.32, higher than both 2018 and 2016, but lower than 2017.

Table 2. Outer Green Island annual Common Tern productivity, 2014-2019

Year	Mean Clutch	Mean Hatch	Productivity
2014	2.13	1.92	1.42
2015	2.03	1.83	1.36
2016	2.40	2.12	1.26
2017	2.13	1.93	1.45
2018	2.16	1.87	1.14
2019	2.12	1.81	1.32

Tern Provisioning

Chick provisioning was observed at 21 Common Tern nests this season over 76 stints totaling 222.1 hours. A total of 1506 feedings to chicks over 872 nest-hours were recorded for an average feeding rate of 1.73 items per hour, which is roughly the same as the 2018 average of 1.72 items per hour. The most frequently observed prey item was herring (*Clupeidae spp.*), followed by hake (*Urophycis spp*.) which made up 38% and 31% of the observed diet, respectively, with another 12% identified as either hake or herring.

Predation

Outer Green Island saw a wide range of avian predators this season, although not all were confirmed as actively depredating the colony. A small amount of egg depredation was attributed to Ruddy Turnstones (*Arenaria* interpres), and one or two eggs may have been predated by a Great Blue Heron *(Ardea herodias),* which was observed on several occasions flying over the colony or on the nearby islet Junk of Pork. On 13 July, a juvenile Black-crowned Night Heron (*Nycticorax nyctiocorax*) was observed attempting to swallow a large tern chick in the

colony. Night stints were conducted, but no further nighttime disturbance of the colony was noted, although the heron was observed on 7 further occasions, both on Junk of Pork and on Outer Green Island. An adult Peregrine Falcon (*Falco peregrinus*) became a persistent predator, appearing on 38 days out of the 85 day field season. The Peregrine visited early in the season, then returned on a near-daily basis starting around hatch. These visits intensified later in the season as chicks began to fledge, with the Peregrine often seen multiple times throughout the day, starting just after sunrise and continuing until dusk. The raptor often circled the colony, then retreated to Junk of Pork, where it was able to avoid attacks by the tern colony. Large gulls were the other dominant predators in 2019. There was a low level of persistent egg depredation early in the season. Despite continued harassment efforts, gulls often roosted on Junk of Pork and a small number of specialized individuals began systematically hunting the colony. Depredation of chicks was observed beginning in early July and intensifying as chicks fledged. At least four Great Black-backed Gulls (*Larus marinus*) and two Herring Gulls (*Larus argentatus*) were observed successfully hunting the colony, with more suspected. Four Herring Gulls were shot towards the end of the season.

Table 3. Outer Green Island predator control efforts, 2019

Species	No. of Nests Destroyed	No. of Gulls Shot
Herring Gull	0	4
Great Black-backed Gull	0	0

Weather Events

While there were a few rain and thunderstorm events over the course of the season that contributed to the exposure-related deaths of some weaker chicks, particularly in the first two weeks after hatch began, there were no major storms that had a large colony-wide impact.

Black Guillemots

This year, two new Black Guillemot *(Cepphus grylle)* burrows were found, while three were found to have eroded away, leaving the island with a total of 25 marked burrows. At least 19 of these burrows were active in 2019 and 15 were monitored for clutch size and hatch success, with 14 followed for fledge success. The average clutch size was 1.8 and the average number of eggs hatched per nest was 1.2. Only 4 out of the 17 monitored guillemot chicks had fledged by the end of the Outer Green Island field season, so fledging success was estimated for nests with at least one chick with a wing chord over 65 millimeters; those displaying healthy growth at the end of monitoring were presumed to have fledged. Our estimated productivity was 1.22, the highest fledging success that has been recorded since 2008, when productivity was 1.29. This may be attributable to the fact that the 2019 field season was extended five days longer than the season has ended for the past few years, allowing for further data collection on later-fledging guillemot chicks.

Stratton Island

Zeke Smith, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

An island-wide Common Tern nest count was conducted on June 15, with a count of Least Tern nests coordinated with mainland colony monitors on June 12, and a second independent Least Tern count on June 20. Roseate Terns decreased slightly from 2018 levels to a total of 125 nests during the GOMSWG census. This is Stratton's second highest count of Roseate Tern since GOMSWG censuses began in 1984. Arctic Terns nests increased slightly from 8 in 2018 to 9 in 2019, with two more nests found after the census window had closed. The Common Tern nest count of 1,111 nests was corrected with a Lincoln index of 1.055 to 1,172 nests, and the addition of 72 productivity and feeding study nests brought the total count to 1,244 nests. A total of 84 Least Terns nests were counted during the official Least Tern census on June 12, with 12 more laid by end of the census window. New nests were laid throughout the season, resulting in a final tally of 132 nests.

Table 1. GOMSWG census results on Stratton Island, 2014-2019.

Year	COTE	ARTE	ROST	LETE
2014	1314	8	103	97
2015	1395	12	108	81
2016	825	4	86	69
2017	1127	2	119	93
2018	1206	8	128	122
2019	1244	9	125	96

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 72 nests in the Common Tern plots fledged at a rate of 1.13 chicks per nest. Roseate Tern productivity was 1.28 chicks fledged per nest for the 77 nests followed. Least Terns produced at least 14 fledglings in 2019. From the 11 Arctic Tern nests followed, productivity was estimated to be 0.73.

Table 2. Tern productivity on Stratton Island, 2015-2019.

	2015	2016	2017	2018	2019
COTE					
Mean clutch	2.09	2.40	2.32	2.20	2.01
Mean hatch	1.72	2.25	1.98	1.92	1.59
Productivity	0.89	1.0	0.63	0.53	1.13
ROST					
Mean clutch	1.83	1.88	1.88	1.96	1.68
Mean hatch	1.48	1.28	1.59	1.70	1.42
Productivity	1.38	1.01	1.03	1.29	1.28
ARTE					
Mean clutch	1.83	-	2.00	2.00	1.82
Mean hatch	1.08	-	1.00	0.25	1.18
Productivity	0.25	0	0.5	0.13	0.73
LETE					
Mean clutch	-	-	-	1.82	1.89
Mean hatch	-	-	-	-	0.96
Productivity	0	0.2	~0.02	-	-

Tern chick provisioning

12 Common Tern nests were observed with a total of 400 feedings. Chick diet primarily consisted of herring, hake, and sandlance, comprising 28.5%, 16.3%, and 10.0% of deliveries, respectively. 39.5% of prey items were not identified to species. 12 Roseate Tern nests were observed with a total of 448 feedings. Diet primarily consisted of sandlance, herring, and hake, at 26.8%, 24.1%, and 21.4%, respectively. 37.3% of prey items were not identified to species. Least Tern feeding studies were conducted by observing nests within an unfenced area approximately 5 meters in diameter. A total of 349 feedings were observed. Prey primarily consisted of hake, sandlance, and herring at 49.0%, 21.5%, and 10.0% respectively (Table 14). Overall, 10.3% of feedings were not identified to species

Predation

Herring and Great Black-backed Gulls continue to prey on tern eggs and chicks and have had a devastating impact on Common Eider productivity. 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, and all gull nests found on Stratton Island were destroyed. No Great Black-backed Gull nests were found on Stratton Island, while three were destroyed on Little Stratton. One Herring Gull nest was destroyed on Little Stratton. 35 Herring Gull and 32 Great Black-backed Gull nests were poked on Bluff Island. Two Herring Gulls with broken wings were lethally removed from Stratton Island.

Night-heron disturbance was minimal to nonexistent until July 14 when tracks were found in the Least Tern colony. Signs of predation were observed across the island from July 19 until August 2. On July 20 at 01:34 an adult was photographed by a game camera situated in the Least Tern colony. Night stints were not conducted due to the lateness of its arrival in the nesting season and the large area in which it was hunting.

Wading Birds

A census of the wading bird colony on Stratton Island was conducted on May 18. A total of 96 Glossy Ibis, 4 Black-crowned Night Heron, 44 Great Egret, and 60 Snowy Egret nests were found. One pair of Little Blue Herons were strongly suspected to have nested in the colony again this year, as two individuals were commonly seen frequenting the same area of the colony.

Common Eiders

No eider census was conducted this year.

American Oystercatchers

One pair of American Oystercatcher were found attending a nest on Little Stratton on May 27, a second pair was found with chicks on Bluff Island on June 23, and a third was discovered with an egg on the eastern point of Stratton Island on June 27. On July 18 two additional pairs with recent fledglings were confirmed. Of the four confirmed pairs, three fledged a total of six chicks.

Black Guillemots

Nine active Black Guillemot burrows were confirmed in 2019, with 7 on Stratton Island and 2 on Bluff Island. A high count of 69 adult Black Guillemots was recorded on July 22.

Double-crested Cormorants

On June 1, 145 Double-crested Cormorant nests were counted on Bluff Island by visual estimate from a boat.

Visitors

Stratton Island had over 120 visitors. Visitors included National Audubon, Maine Audubon, Monomoy Bird Observatory, and USFWS personnel for research purposes, one donor trip, two Maine Audubon Society field trips, a Prout's Neck Audubon Society field trip, a middle school visit organized by Ocean Passages, and numerous unscheduled visitors.

Notable Birds

- Little Gull, two seen flying over the island on May 10

- Evening Grosbeak, first island record on May 18
- Leach's Storm-Petrel, heard late at night on four occasions in July and early August

NEW HAMPSHIRE

White and Seavey Islands

Liz Craig, Program Manager/co-PI – Shoals Marine Laboratory
Jenn Seavey, Program co-PI
Amber Litterer & Aliya Caldwell, Seabird Technicians – Shoals Marine Laboratory

Tern Census

Common Terns

- COTE census was conducted on June 12th and 14th, 2019
- Unadjusted census:
    - 422 nests on White Island
    - 2,297 nests on Seavey Island
    - Lincoln Indices were calculated for White Island and Seavey Island (divided into sections with indices ranging from 1.00 to 1.14 on White and 1.00 to 1.17 on Seavey)
    - 46 additional nests were located in productivity plots on Seavey
- Adjusted census:
    - 446.8 nests on White Island
    - 2452.7 nests on Seavey Island
    - **Total estimated population was 2,900** (up from 2,175 in 2018)

Roseate Terns

- 61 ROST nests were established on Seavey Island within the census window (before 20 June 2019)
- B-wave ROST nests brought season total to 80.

Arctic Terns

- 1 ARTE nest was established by 20 June 2019 on White Island.

Table 1. Number of tern nests found on White and Seavey islands from 2015-2019

Year	COTE	ROST	ARTE
2015	2,686	68	2
2016	2,985	83	3
2017	3,210	92	2
2018	2,175	55	1
2019	2,900	61	1

Productivity

Common Terns

- 9 fenced plots (~10x12 ft) containing 46 nests plus 20 unfenced nests observed for chick provisioning were used to determine COTE productivity.
- Nests were monitored until chicks reached "fledge" age (15 days).
- Productivity was high in comparison to previous years likely due to lower levels of predation and good food availability.

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 2015-2019. Only nests with known outcomes were used for ROST & ARTE calculations.

Species	Year	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2015	2.04	1.52	1.10	188
	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
ROST	2015	1.58	1.20	0.93	74
	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
ARTE	2015	1.33	0.67	0.33	3
	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

Tern Provisioning

- 20 COTE nests were monitored for diet.
- A remote observation camera was used to record video of each nest every 1-2 days from 17 June 2019 onwards. Complementary provisioning data were collected by observers in blinds to compare to camera observations. Data from camera recordings will be collected in fall 2019
- Diet items included Atlantic herring, hake, sandlance, butterfish, cunner, lumpfish, goosefish, Acadian redfish, long-nosed dace, shrimp, ants, grasshoppers, dragonflies, and moths
- Partnering with a genetics lab at Cornell Lab of O (Dr. Gemma Clucas) to conduct DNA metabarcoding of feces to determine diet to species level.

Predator Activities and Control Efforts

Muskrats:

- Muskrats were observed on Seavey Island from the camera starting in early May.
- Due to predation issues in previous years, muskrats were trapped using havahart and conibear traps.
- 9 muskrats (1 from White Island, 8 from Seavey Island) were trapped and lethally removed between May 15th and July 1st.

Gulls:

- No gull nesting attempts on White or Seavey in 2019.
- Used human presence, as well as pyrotechnics to dissuade gulls from lingering and predating.
- 47 pyrotechnics were used between 12 May and 21 July.
- Lethal control: removed 2 GBBGs (1 during incubation period and 1 during the chick rearing period). Dissected stomach of one and found tern remains (egg shells and chick remains).
- The Appledore Island gull specializing in tern predation was absent in 2019 and is presumed to have been lethally removed during 2018 predator control.

Other Avian:

- RUTU from the end of May through early June and again in late July and early August. RUTU found dead on the colony in August (assumed to have had food-related poisoning from consumption of rotten tern eggs).
- PEFAs were seen on 11 occasions from May through mid July; the colony responded by mobbing and pursuing.
- MERLs were seen in mid May; the colony responded by mobbing and pursuing.
- One AMKE was seen in mid July and the colony responded by mobbing and pursuing. .
- One BCNH was seen in late June and was mobbed by the colony.
- Found the remains (wings and heads) of 2 COTE adults in the colony in mid June.

Other Mammalian:

- No other mammalian predators were observed on White or Seavey islands between 12 May and 1 August 2019.

Other Nesting Species

- Common Eider: at least 13 nests (1 on White and 12 on Seavey)
- Spotted Sandpipers: at least 5 nests (1 on White and 4 on Seavey)
- Mallard: 1 nest (hatched) on Seavey Island
- Song Sparrow: 1 nest (observed) on Seavey Island

Research:

- Deployed GPS tags on 11 adults COTE to observe fine-scale movements
- Collected tern remains and diet items for microplastics analysis to be conducted in the fall of 2019.
- Created and used a permanent grid method (trialed in 2018) for the census to improve spatial resolution of COTE nesting data.
- Collected GPS locations for all ROST nests in the ArcCollector app to improve the spatial resolution of ROST nesting data.
- Tested habitat management treatments including freshwater, hyper-salinated water, and astroturf.
- Tern fecal collection (for DNA metabarcoding) and visual diet observations conducted to determine diet.

MASSACHUSETTS

Monomoy National Wildlife Refuge

Eileen McGourty, Fish and Wildlife Biologist - USFWS
Kristina McOmber, Tern Technician – Northwoods Stewardship Center and USFWS

Minimoy Island

Tern Census

In 2019, no black skimmers, roseate terns, least terns, or big gulls apparently nested on Minimoy. Staff visits to the island were minimal because of staff shortages. One common tern nest was found on June 18, but it failed soon after.

Table 1. Number of tern nests found during census window on Minimoy from 2015-2019. Numbers in parentheses reflect nests found outside of the census window.

Year	COTE	ROST	LETE
2015	1	0	10
2016	0	0	0 (3)
2017	0	0	0
2018	0 (1)	0	0
2019	1	0	0

North Monomoy Island

Tern Census

No common, roseate, or least tern nests were found on North Monomoy Island during island visits, but no census was completed this field season.

Table 2. Number of tern nests found during census window on North Monomoy from 2015-2019. Numbers in parentheses reflect nests found outside the census window.

Year	COTE	ROST	LETE
2015	3	0	0
2016	0 (2)	0	0
2017	0	0	0
2018	0	0	0
2019	No census	No census	No census

Gull Census

In 2019, though plenty of great black-backed gulls and herring gulls were observed nesting on North Monomoy during the annual wading bird census, gull nests were not counted this field season. Gull census is conducted every five years and the most recent census was completed last year. The next gull census is anticipated to be in 2023.

Wading Bird Census

A wading bird census on North Monomoy Island was conducted on May 21. Observers counted 252 active black-crowned night-heron nests, 94 snowy egret nests, and 48 great egret nests. No nesting glossy ibis were observed. Productivity was not monitored.

Table 3. Number of wading bird nests found on North Monomoy from 2015-2019 during census window.

Year	BCNH	GREG	SNEG	GLIB
2015	145	11	75	0
2016	No census	No census	No census	No census
2017	185	25	99	3
2018	225	27	94	1
2019	252	48	94	0

South Monomoy Island

Census

Common Terns

The annual South Monomoy Island tern and gull census was conducted by a team of refuge staff and volunteers on June 9, 10, and 12. The nesting area is delineated into 60m^2 grids, and all nests were tallied by grid number. The total raw nest count was 12,599. This year, an average of the Lincoln Index over the past five years was used to compensate for error during the count. Due to the lack of experience in volunteers on the count, the high number of empty scrapes, the possibility that terns were laying eggs in those scrapes between the count and when the daily Lincoln Index was completed, and timing restrictions on completing a Lincoln Index each day of census, led us to the determination that using an average over the past 5 years would be a better representation of error in our count. The average Lincoln index over the last five years was 1.02. An additional adjustment to compensate for late nesting and early counting derived from productivity plots was applied, providing a final adjusted estimate of 14,343 nests on South Monomoy Island for 2019. This is an increase of a little over 6% from last year's total of 13,472. 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 1973 nests in the colony during the B-period.

Roseate Terns

Twelve roseate tern nests were counted during the A-census window on South Monomoy Island. There were no new nests laid after June 20th. This was a decrease of 18 total pairs compared to 2018. At least 14 chicks hatched, 10 of which could be considered fledged by GOMSWG standards. Observations of roseate terns were limited this year due to staff shortages and the success rate was likely much higher. With limited staff and hours designated to the project, roseate tern chicks were frequently not found during checks and since limited banding was done, we can't be sure how many of the missing chicks actually survived.

Least Terns

The majority of nesting least terns on South Monomoy Island were found within a single colony on the northern end of the island, just south of the connection with South beach. A high count of approximately 500 pairs of least terns were observed in this area early in the season prior to the census window. During the census window there was approximately 200 pairs remaining in this area. Several smaller colonies were observed scattered across the island including 30-40 pairs on the south tip, 20 pairs at Powder Hole, 20-30 pairs on Lighthouse Beach, 10 pairs on Plover Beach and 5 pairs on the western side just south of Hospital Pond. An estimate of approximately 268-285 pairs of least terns were present scattered throughout South Monomoy Island during the beginning of the census window. An A-period census was conducted by using an incubating adult count in the main colony on 20 June, a total of 12 incubating birds were seen within the north end colony. None of the satellite colonies were counted at this time. No B-period census was conducted. Productivity was not quantitatively monitored; however, it was estimated to be very poor overall based on the abandonment of most of the colonies on the island during early to mid-June. Under a dozen pairs were observed to continue nesting and only 2-3 chicks were seen during the season. The census count for 2019 was significantly less than in 2018 and even our unofficial high counts during the census window were below 2018 numbers.

Table 4. Number of tern nests and laughing gull nests found on South Monomoy from 2015-2019. Numbers in parentheses reflect nests found outside the census window.

Year	COTE *	ROST	LETE	LAGU
2015	9203	11	522	1424
2016	10505	12 (2)	839	2738
2017	11723	11 (7)	773	2714
2018	13472	30	499	3272
2019	14343	4 (8)	12**	3659

*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.

Productivity

Common terns had below average productivity in 2019, fledging an average 0.98 chicks per pair. This number is below the long-term average of 1.26 chicks fledged per nest. The below average productivity number can mostly be attributed to the low clutch size (1.68 eggs per nest, lowest clutch size since data began to be collected in 1998). Productivity success was based on 189 A-count nests that were monitored in 19 fenced productivity plots.

Roseate terns had below average productivity in 2019, fledging an average 0.83 chicks per pair.

Table 5. Breeding parameters for common and roseate terns on South Monomoy Island in 2019. Data for 2018 shown in parentheses.

Species	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	1.68 (2.14)	89.2% (82.6%)	66.4% (62.5%)	189 (381)
ROST	1.29 (1.54)	88.9% (62.16%)	71.4% (64.71%)	12

Table 6. Common and roseate tern productivity on South Monomoy Island from 2015 - 2019.

Year	COTE Hatch Success	COTE Reproductive Success (chicks/pair)	ROST Hatch Success	ROST Reproductive Success (chicks/pair)
2015	88.3	1.50	63.64	1.27
2016	90.7	1.96	70.83	1.00
2017	87.5	1.53	72.22	1.36
2018	82.6	1.10	62.16	0.73
2019	89.2	0.96	88.9	0.83

Tern Provisioning

Due to staff shortages, there were only 8 hours of feeding observations conducted in 2019. Due to the small sample size, results are insignificant and will not be reported here. It should be noted that there were no unusual observations regarding forage fish or other items during this season. As in most years the primary food resource for this colony continues to be sand lance, based on informal observations throughout the season.

Predator Activities and Control Efforts

Predators were a constant presence during the 2019 field season, so much so that actually documenting them and their activities became too large a task for the crew, and our reports on predator visits are largely narrative in nature. We believe the predator species that had the greatest impact on the colony in 2019 were black-crowned night-herons and large gulls (great black-backed gulls and herring gulls). The refuge prioritized laughing gull nest destruction in June 2019 as part of predator management, removing a total of 2,524 laughing gull nests (2,229 first nest attempts and 295 re-nest attempts), but anecdotally it seems as if most gulls re-laid and were successful in chick-rearing because counts of fledglings in mid-August suggest productivity rates of 1.03 to 1.5 for laughing gulls in 2019. On July 1, we brought firearms to tern camp for the first time in 2019 and within 4 days dispatched 1 herring gull, 1 great black-backed gull, and 1 black-crowned night heron. Though we continued to observe these predators for the

remainder of the season, predation rates in productivity plots seemed to slow down afterwards, but gaps in our data collection and night-heron preference for smaller chicks makes data analysis difficult to tease apart the effect of predator removal. We did not take any more birds because of logistical issues related to short-staffing.

Other predators that were present and had an impact (including just disturbances) included peregrine falcon, bald eagle, owls, coyote, northern harrier, and turkey vulture. Coyote tracks were continually seen throughout the season along the beach but did not seem to enter the colony. It is believed that only one pair of coyotes were on the island. Early season removal of one coyote den was conducted in April. The two adults escaped predator control efforts. A snowy owl was also present on South Monomoy Island during the end of May. It was consistently seen near the connection area with South Beach and had limited impacts within the tern colony. The owl was not seen again after May 29th. A peregrine falcon was seen daily on the island and early in the season it could be observed within the colony taking adult terns. Presence of the peregrine falcon diminished between early June and mid-July when terns became more aggressive. An immature bald eagle was also observed within the colony early in the season taking adult terns as well as willets, gulls and oystercatchers. Balloons were also noted as causing a disturbance to the colony.

Research Updates and Presentations

(not a comprehensive list of presentations)

PILOT STUDY OF UNMANNED AERIAL SYSTEMS (UAS) AS A CENSUS TOOL FOR SEABIRDS

Richard Podolsky and Dave Sprague

On July 3, 2019 several UAS flights were made over Eastern and Western Egg Rock in Muscongus Bay, Maine. The primary goal of these flights were to see whether or not seabirds could be distinguished and counted from the 12MP imagery taken from a UAS at an average elevation of 70.88 feet AGL. A second goal was to gauge the response of nesting seabirds to low flyovers of UAS. The birds tolerated the low flyovers without any noticeable reaction such as dreading. The high-resolution, low elevation flyover of EER covered an area of 3.53 acres and yielded a total of approximately 700 seabird individuals detected. Terns were the most abundant seabird observed with laughing gulls, Atlantic puffins, herring gulls and cormorants less abundant. The pilot study was deemed a success in that disturbance was negligible and seabird detection was very high.

GPS TRACKING OF LEACH'S STORM-PETRELS IN THE GULF OF MAINE

Sam Albright

Recent research on Leach's Storm-Petrel populations in Maritime Canada has shown a 40% drop in populations, but less is known about Maine populations. Leach's Storm-Petrels breed on a number of islands in the Gulf of Maine. As part of an effort to update our knowledge on the Maine population we used GPS tags to track where petrels from Petit Manan Island and Metinic Island were foraging during incubation. Preliminary results show that the birds use the entire gulf, and in one case went out to seamounts 535 miles offshore. We are considering tagging adults from additional islands in the summer of 2020.

OVERWINTER MOVEMENT OF ATLANTIC PUFFINS BREEDING IN THE GULF OF MAINE

Mark Baran

Conservation has become increasingly reliant upon spatial data to prioritize areas for protection. Determination of these areas of priority can be complicated, especially in marine systems where distribution of pelagic birds, for example, is not always determined by obvious habitat distinctions. We examined where Atlantic Puffins (*Fratercula arctica*) breeding in the Gulf of Maine spend the nonbreeding season and whether birds from different colonies or parts of the same colony used different overwintering strategies. Between 2013 and 2018, archival light geolocator tags were deployed on puffins breeding on three islands in the Gulf of Maine: Machias Seal Island, Matinicus Rock, and Seal Island. Based on geolocator data, puffins from all three colonies generally remained in and near the Gulf of Maine throughout the autumn and early winter months, venturing southward as far as Cape Hatteras, North Carolina in February, March, and April, before returning to their respective colonies. A small proportion of individuals

travelled to the Gulf of St. Lawrence and waters around Newfoundland immediately after breeding, returning to the Gulf of Maine in mid-winter. We found no evidence of inter- or intra-colony differences in overwinter movement. These overwinter locations can inform policy regarding protection of important marine areas for all Gulf of Maine puffins.

ANNUAL MOVEMENTS OF RAZORBILLS (*ALCA TORDA*) BREEDING IN ATLANTIC CANADA

Mark Dodds

2019 Maine State Synopsis of Nesting Least Terns

Estimate of Least Tern Pairs

On June 12th, a coordinated least tern census documented a minimum of 296 least tern pairs within the State of Maine. During the count on June 12^{h}, 156 least tern pairs nested at Crescent Surf, 84 nested on Stratton Island, 35 nested at Western and 21 nested at Higgins. Later in the season, least terns increased at Higgins beach, reaching a high of over 55 pairs in July. Crescent Surf produced a minimum of 31 fledgers, and Stratton Island produced a minimum of 14, with Higgins producing 16. State productivity was estimated to be about 0.21 fledgers per pair. Overall, productivity was low.

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)

[ ] 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**