Gulf of Maine Seabird Working Group
34th Annual Summer Meeting

Common Tern and chick by Brette Soucie

Hog Island, Bremen, Maine
August 10, 2018

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Contents

Meeting minutes were compiled by Maine Coastal Islands NWR

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 three afternoon presentations. A table with 2018 GOMSWG census results will be distributed concurrently with this report.

ISLAND REPORTS

CANADA

Machias Seal Island

Mark Dodds, Island Supervisor/MSc student - University of New Brunswick; Mark Baran, MSc student - University of New Brunswick; Angelika Aleksieva, field technician

Tern Census

A census was completed on June 15-16, 2018 with an estimated total of 450 ARTE and 26 COTE nesting on MSI. Terns were already present on MSI when the crew arrived on May 9. 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
175	75	50	90	187	150	175	300	**476**

Productivity

Terns breeding on MSI had another successful season, fledging chicks for the fifth successive year since the colony collapse in 2006. 132 ARTE nests with a total of 216 eggs and 8 COTE nests with a total of 17 eggs were monitored this season. The first tern egg was encountered on May 23 for ARTE and June 10 for COTE, mean lay date was June 4 for ARTE and June 25 for COTE. The rate of egg predation was low this year, with only 5 of the 216 ARTE eggs (0.023) and none of the COTE eggs having been depredated. Mean hatch date was June 25 for ARTE and July 5 for COTE; hatching success was 0.76 for ARTE and 0.82 for COTE.

A total of 86 ARTE chicks fledged (alive at day 15), with 74 monitored nests raising 1 chick to fledge and 6 monitored nests raising 2 chicks to fledge. The fledge success for monitored nests this season was 0.65 fledge/nest (to day 15). A total of 2 COTE chicks fledged (alive day 15), with 2 monitored nests raising 1 chick to fledge and no monitored nests raising 2 chicks to fledge. The fledge success for monitored nests this season was 0.25 fledge/nest (to day 15). Although COTE hatching success was high, 11 of the 14 monitored chicks were found dead over the course of the season with no apparent injuries or weight loss, ultimately resulting in low fledging rates.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Machias Seal Island in 2018. Data for 2017 shown in parentheses.

Species	Clutch Size	Hatching Success	Fledging Success	Nests Monitored
COTE	2.13 (NA)	0.82 (NA)	0.25 (NA)	8 (NA)
ARTE	1.64 (1.88)	0.76 (0.39)	0.65 (0.36)	132 (86)
ROST	NA	NA	NA	NA

Tern Provisioning

We completed 66.28 hours of ARTE chick provisioning observation on a total of 14 nests in 2 separate plots. We completed 21 hours of COTE chick provisioning observation on 3 nests in 1 plot. 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 2018. *n* is the total number of prey items identified. Data for 2017 shown in parentheses.

Prey Item	COTE	ARTE	ROST
n	91 (NA)	851 (532)	NA
Herring	9.9 (NA)	0 (0.2)	NA
Hake	27.5 (NA)	15.6 (16.5)	NA
Sandlance	2.2 (NA)	0.5 (6.8)	NA
Butterfish	0 (NA)	0.4 (1.1)	NA
Pollock	0 (NA)	0 (0)	NA
Stickleback	3.3 (NA)	2.5 (0.2)	NA
Euphausiid	4.4 (NA)	21.3 (3.9)	NA
Larval fish	49.5 (NA)	54.2 (65.6)	NA
Other	3.3 (NA)	5.5 (3.8)	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) was introduced this season as a nonlethal gull control tool and proved to be very effective. All points on the island could be reached from the lighthouse. In all instances of use, the laser was pointed on the ground within several meters of the target gull(s) resulting in all birds immediately flushing and not returning to the island for an extended period. There was little evidence of any habituation to the laser or any decrease in effectiveness throughout the season. The laser did not seem to negatively impact any other bird species on the island. The laser pointer proved to be ineffective in very bright conditions and very foggy conditions.

A contracted predator control specialist conducted lethal gull control and visited the island one time: May 27-30. A total of 3 gulls were removed; 2 HERG and 1 GBBG. Gull Rock, an adjacent island with a persistent breeding colony of HERG and GBBG, was visited six times during the season: May 24, June 7, June 21, July 5, July 21, and August 7. A total of 9 gull nests, all HERG, were found and destroyed by shaking and poking eggs. A total of 36 eggs were destroyed. Several pairs of Laughing Gulls were consistently seen on the island between May 20 and June 19. LAGU pairs were frequently observed copulating and prospecting in the colony, particularly in the vegetation on the north end of the island and around Visitor Blinds 1 & 2, however no active nests or nest sites were encountered on the island. A high count of 10 individual LAGU was recorded on June 23 and July 4. No gull nests were found on MSI this year.

Common Eiders

81 COEI nests were found during the tern census (June 15-16). Counts were conducted weekly with a high of 321 individuals (164 males, 157 females) on June 2. Ducklings were first seen in mid-June and were still present around the island in early August. Our highest count was on July 15 with 72 ducklings.

Alcids

No formal ATPU census was conducted this year. A total of 124 burrows were monitored for productivity this season. Linear growth rate this season was 3.6 g/day, much lower than that of 7.6 g/day in 2017 but higher than that of 1.8 g/day in 2016. A total of 117 hours of ATPU chick provisioning stints were conducted. Mark Baran successfully retrieved 19 GLS tags from 29 adult ATPU tagged in 2017.

Food was relatively stable throughout the season, however not as abundant as 2017. There was a noticeable decrease in food (both prey size and abundance) in early August. From an initial 162 monitored burrows, 124 were determined to be active and monitored for the season (76% occupancy). The final check of all productivity burrows was completed on August 15. 92 of the 124 active burrows (74%) had hatched; 37 (40%) were of known age. 24 eggs (19%) went missing (confirmed empty burrows), 7 eggs (6%) were confirmed dead, 4 chicks (4%) are missing, and 18 chicks (21%) were confirmed dead. 68 chicks from productivity burrows had been banded (age day 35). As of August 15, there were 21 confirmed fledges (23% fledge success, 17% nest success; age day 35 or older and

confirmed empty burrow). Based on final mass and wing chord measurements and final known ages, it is predicted an additional 19 chicks will fledge for an estimated total of 40 fledged chicks (43% fledge success, 32% nest success).

No formal RAZO census was conducted this year. A total of 73 burrows were monitored for productivity this season. Linear growth rate was 5.2 g/day similar to that of 5.3 g/day in 2017 but higher than that of 4.3 g/day in 2016. A total of 89.25 hours of RAZO chick provisioning stints were conducted. Mark Dodds successfully retrieved 15 GLS tags from 21 adult RAZO tagged in 2017.
From an initial 94 monitored burrows, 73 (78% occupancy) were determined to be active and monitored for the season. Mean lay was May 18. Of the 73 eggs, 10 (14%) cracked, 7 (9.5%) never hatched, 4 (5.5%) went missing, and 52 (71%) hatched.

COMU numbers remain high. On July 10 a minimum of 338 active nests were estimated. A total of 150 chicks were banded this year; GLS tags were recovered from 5 of the 10 adults tagged in 2017. A total of 65.25 hours of COMU chick provisioning stints were conducted.

Maine

Petit Manan Island

Alex Vidal: Island Supervisor – USFWS
Chris Gilbert, Kate O'Connor, and Lance Edwards Jr.: Island Technicians - USFWS

Census
The GOMSWG census was conducted on June 19 and 20, 2018. We recorded 1,166 tern nests and with a Lincoln's correction index of 1.035, we estimated 1,277 nesting pairs of terns nesting on PMI. This was 17.4% higher than last season's results (1088 pairs). We identified 530 nests to species (42%), and used a new species ratio method where COTE dominated shoreline nests and mixed interior habitats were uniquely calculated. The overall species ratio at PMI was 71% COTE and 29% ARTE, shoreline areas were 100% COTE, and interior habitat was 58% COTE and 42% ARTE. By calculating unique ratios for designated zones (core COTE area, core ARTE area, and mixed species), we estimate 374 ARTE and 903 COTE pairs on PMI in 2018. This new calculation may have lowered our ARTE estimates from prior years, but should be more accurate. Additionally, 47 common eider nests and 766 laughing gull nests (7.5% correction factor) were counted during the census.

Table 1. Number of tern nests found on Petit Manan Island from 2012-2018

Year	COTE	ROST	ARTE
2012	1186	2	758
2013	817	2	616
2014	670	0	533
2015	706	0	481
2016	574	0	384
2017	657	0	431
2018	903	0	374

Tern Productivity
Reproductive success for both species was slightly higher than the average over the last 11 years (0.83 for COTE and 0.56 for ARTE). COTE productivity was 0.88 chicks fledged per nest and ARTE productivity was 0.69 chicks fledged per nest. Prey availability appeared to be consistent throughout the season, with a period of low availability between July 22nd and July 29th (dense fog). Weather also appeared to be consistent, with the exception of a large storm on June 28th. We found 13 dead chicks in plots the next day.

Table 2. Breeding parameters for seabirds nesting on Petit Manan Island, 2012-2017.

	2013	2014	2015	2016	2017	2018
COTE						
# of Nests	817	670	706	574	657	903
N					34	34
Mean Clutch Size	1.77	1.94	2.09	2.04	2.33	2.03
Mean Hatch Success	62%	61.4%	85.1%	92.7%	92.4%	71%
Mean Fledge Success	48%	45.2%	68.4%	54.9%	65.8%	61.2%
Mean Chicks Fledged/Nest	0.51	0.54	1.22	1.04	1.32	0.88
ARTE						
# of Nests	616	533	481	384	431	374
N					40	39
Mean Clutch Size	1.49	1.70	1.87	1.53	1.67	1.79
Mean Hatch Success	66%	30.9%	81.7%	71.4%	64.7%	65.7%
Mean Fledge Success	30%	63.3%	62.1%	64.4%	67.3%	%58.7
Mean Chicks Fledged/Nest	0.35	0.33	0.94	0.71	0.78	0.69
ROST						
# of Nests	2	0	0	0	0	0
Mean Chicks Fledged/Nest	0	0	0	0	0	0
LAGU nests*	750	560	620	543	605	766
ATPU nests	47	73	77	54	58	62
COEI nests	55	54	62	60	46	47

Arctic Tern Metapopulation Project

As part of the Arctic tern metapopulation project, we re-sighted 46 adult Arctic terns, recaptured 10 adults, and banded 143 new birds (21 adults and 122 chicks).

Tern and Puffin Provisioning

We conducted provisioning observations for 12 common tern nests and 10 Arctic tern nests for a total of 582.35 observation hours (240 Arctic tern and 342.35 common tern) and observed 612 prey deliveries (257 arctic tern and 355 common tern). Herring was the primary prey for terns this field season, contributing to 32.7% of the diet for arctic tern chicks and 52.4% of the diet for common tern chicks. On average, common tern adults delivered 1.32 prey items per nest per hour while Arctic terns delivered 1.14 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 14 hours in blinds, conducting feeding stints. We also found it productive to identify puffin prey opportunistically during trapping stints. In total, with both methodologies, we observed 66 feedings and were able to identify 200 prey species. Hake made up the majority (48%) of prey items identified.

Table 3. Principal prey items (percent) in tern and puffin chick diet on Petit Manan Island in 2018.

2018	ARTE	COTE	ATPU
Hake	25.5	10.4	48
Larval Fish	22	17.5	6
Invertebrate	0.39	0.28	0
Pollock	2.35	2.25	6
Squid	0.8	0	0
Herring	32.6	52.4	23
Sandlance	7.84	3.66	12
Butterfish	1.96	2.25	5
Unknown	0.39	0.56	not surveyed
Unknown Fish	6.27	7.6	

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, being observed several times per week until the end of the season. We found the remains of 14 terns (adults and fledglings) and 1 Atlantic puffin taken 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. A merlin was observed in the intertidal zone three times in May but was never observed making predation attempts on any birds. During the census, we oiled the eggs in 456 laughing gull nests and destroyed 282 laughing gull nests. Lethal removal of avian predators thought to be tern or kelptoparasitism specialists also occurred and included: 15 adult laughing gulls and 1 snowy owl. Snowy owl predation occurred once this season (June 20), the prey consisted of 2 adult Arctic terns, 2 adult common terns, and 1 adult laughing gull in one night. The owl was lethally removed by the crew the first morning is was observed.

Alcids

The highest alcid counts for the season were 178 Atlantic puffins (July 1st), 34 razorbills (June 4th), 10 common murres (June 5th, June 21st, and July 2nd) and 240 Black Guillemots (May 21st). We estimated the breeding population of Atlantic puffins to be at least 62 pairs (i.e. burrows with either an adult, egg or a chick). This estimate is slightly higher than 2017 (58 burrows) but still lower than 2015 (77 burrows). Colony-wide puffin hatch success was 81.6% and productivity was estimated to be 0.57. Most chicks weren't followed until actual fledging. Of the chicks that were still alive in early to mid-August that were counted as "fledged", 35% experienced significant weight loss or very little weight gain starting July 27 and continuing at least until August 15 (our last burrow check). The average linear growth rate of puffins was 4.1 grams/day (N=17). Due to asynchronous hatching, some chicks were older than 30 days when the food shortage occurred, and their LGRs don't reflect the food shortage. Chicks that hatched early and were >30 days old when the food shortage started had an average LGR of 6.3 grams per day (N=9). Later hatching chicks who were 10-30 days during the food shortage had an average LGR of 1.63 grams per day. We documented 3 active razorbill burrows, but no chicks fledged. Although common murres were observed loafing on the island, there was no evidence of any breeding attempts. Lastly, we estimated that the black guillemot breeding population was 68 burrows, a decrease from last year's 76 burrows. Black guillemot hatching success was 80%, and fledging success was 0.65 chicks/pair.

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 78 Atlantic puffins, recaptured 10 adults, and banded 43 new puffins (28 adults and 15 chicks). We did not re-sight or capture any adult razorbills this season. Finally, we recaptured 5 adult black guillemots and banded 55 new birds (4 adult and 51 chicks).

Petrels

We conducted 3 sweeps of the island to look for petrel burrow: during the first week of May to mark possible burrows, during the first week of June to determine occupancy, and during the first week of August to assess hatching. We were able to confirm occupancy by either grubbing burrows or using a recording 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 the playback elicited a response, we also considered that burrow occupied. We banded 20 Leach's storm-petrel adults during this effort.

Other Research

Last year 5 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 two tagged terns this summer. One had an active transmitter while the other was wearing a non-functioning transmitter (which we were able to remove). We monitored the nest of one of the terns still actively transmitting. We found that the tern spent more time preening than control bird. The tagged tern was able to hatch two chicks and successfully fledge one chick. The second chick nearly fledged but eventually died during a week-long spell of fog, during which feedings all over the island seemed to be down. So while we seemed to detect an effect on preening behavior, it does not seem that the transmitter negatively impacted the bird's ability to lay eggs, hatch chicks, raise chicks, or feed chicks.

This year we also had a graduate student from North Dakota State stay on PMI for three weeks. She 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. Additionally, we had two students and two professors from Long Island University conduct studies on stable isotopes for all the birds nesting on PMI and a UV color study on the puffins. Stable isotope samples were collected by taking fecal, breath, blood, and feather samples. These samples were used to compare the diet of chicks to adults, and to compare diet among the species. The Refuge is also working with University of New England to conduct DNA analysis of tern and alcid fecal samples to determine diet composition.

Ship Island

Bailey Yliniemi – Island Supervisor
Olivia Lappin – Island Technician

Census

Ship Island was monitored by a two-person crew from May 17-July 5, 2018. During the GOMSWG census on June 12, we counted 498 common tern nests for a total of 519 nests after applying a Lincoln Index of 1.042.

Common Terns	2013	2014	2015	2016	2017	2018
# of Active Nests	436	405	680	684	620	519
Mean Clutch Size	2.44	2.26	2.16	2.35	1.99	1.99
Mean Hatch Success	72.5%	81%	72.3%	85.6%	27.8%	--
Mean Fledge Success	46.4%	72.8%	87.7%	55.4%	70.3%	--
Chicks Fledged/Nest	0.80	1.44	1.45	1.32	0.39	--

Nesting and Productivity

The first nest was observed on May 26. The arrival of a predator on June 9 led to partial abandonment of the tern colony for weeks and final abandonment on July 2. Though 519 nests were counted during the census, there was no hatching or nest productivity in 2018. It is most likely an owl that caused the first disturbance causing partial abandonment. We believe the owl left and revisited the island throughout the three week period.

Tern Provisioning

Due to abandonment, only two chicks hatched and the chicks died because they were left unattended. We did not observe any chicks being fed. However, during courtship, we did see adult terns bringing back herring, hake, sandlance, and sandworms.

Diet Item	% of COTE Diet					
	2013	2014	2015	2016	2017	2018
Atlantic Herring	45.6	60.8	53.1	77.2	80.3	--
Sandlance	20.9	1.0	21.4	4.6	1.8	--
Crustaceans	10.5	--	0.9	1.1	--	--
Pollock	4.3	10.0	4.1	1.1	--	--
Invertebrates	5.7	0.7	0.7	0.7	--	--

Butterfish	1.7	--	--	--	--	--
Stickleback	1.5	--	0.5	0.3	--	--
Hake	1.1	6.6	2.5	6.6	3.7	--
Unknown	--	1.0	16.3	3.1	3.5	--
Other	--	--	--	--	--	--

Predator Control

Mink traps were set early in the season with an average of 16.59 traps maintained throughout the season, but no definitive signs of mink were observed. Though owl traps were set on June 11 immediately after the first sign of tern abandonment, no owls were captured this year and none were observed. A tern carcass was found on the beach near the western side of the tern colony during the census. Though no puncture marks were observed, the bird was likely predated. The crew did one night stint, and sporadic dusk and dawn watches and night checks throughout the weeks of abandonment. During this time, the crew found three tern feather piles and a tern head in the rack-line on the southeast shore. Refuge staff searched the island multiple times with a scent tracking dog and found no signs of mammals or mammalian predation. Eggs were not predated during the first two weeks, although the long absences of the terns allowed crow predation and geese with goslings to wander through the colony. After two weeks of partial abandonment, a merlin was observed chasing the terns on June 23. Also during this time, eagles became comfortable landing on the island, on the beach, and on the cabin roof, and were not dissuaded by pyrotechnics. A peregrine falcon was trapped on July 2 in an owl trap (probably triggered while it was holding a tern in its talons) and due to multiple leg fractures, was euthanized by Avian Haven. Terns did not return to the island again and the crew was removed and the field camp closed on July 5. Refuge staff revisited the island on July 19 and found no tern eggs remaining in the colony.

Habitat Management

In recent years, terns nesting on Ship Island have nested on a narrow sandy beach where they are vulnerable to high tides and storms. In 2014 and 2016, Refuge staff moved sand and gravel from the intertidal area to an upland location, providing nesting habitat that would not flood during storm events. Though numbers are lower than expected, a total of 91 common tern pairs nested in gravel areas. Despite weeding in early June, lambsquarters, ragweed, and black bindweed became abundant in gravel plots throughout the season. The island was burned on November 22, 2017. The prescribed burn was patchy, due to rain and limited fuels. We continue to battle invasive garlic mustard and garden valerian. This year, we hand-pulled 7 contractor bags of garlic mustard and sprayed rosettes in the pulled area with 15 gallons of a concentrated vinegar solution largely on May 24 and over the following two weeks. The Refuge is considering using sheep and rotational grazing strategy to control vegetation, but is waiting on permitting.

Observations from mid-coast Maine

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Supported by: Maine Department of Inland Fisheries and Wildlife

Great Cormorants:

- There were a total of 38 Great Cormorant nests at two sites, 32 at Seal Island and 6 at Brimstone ledge.
- There were 150 nests counted at six sites in 2004, and 50 nests counted at four sites in 2014.

Little Robert's,

- May 4, 4 adult Great Cormorant, on territory, two more nearby, no nesting material no displaying.

- May 19**,** 0 great Cormorant.
- By May 19 there were 30 Great Cormorant nests counted at Seal Island, up from 22 last year. There were five nests counted at little Roberts last year. It appears that this group moved quite efficiently to Seal Island during May of this year after spending some time at the site at which they had tried to breed in 2017 but abandoned due to eagles before the end of June. There had been Great Cormorant breeding at Little Roberts since 1994 when there were three nests counted, the highest total counted at this site was 21 nests in 2002.

Seal Island

- May 4, An Eagle flushed the Cormorants from the colony on the western head as we approached with the team to begin the observation season.
- May 19, 30 Great Cormorant nests, 18 Double-crested Cormorant nests.
- May 29, 32 Great Cormorant nests, 21 Double-crested Cormorant nests.
- Aug 25, 48 fledgling Great Cormorant were counted at the western head, plus two more down the island,
- Sept 8, 23 fledgling great Cormorant counted on the western head plus two more mid island roost.
- Sept 15, 8 fledgling Great Cormorant counted, mostly at the western head.
- Sept 17, 15 Great Cormorant fledglings counted, 10 of them at the western head.

Brimstone Ledge, (Burnt Coat Harbor)

- May 29, 6 Great Cormorant nests. There were none in 2017,
- I counted 4 Double-crested cormorant nests, there were several more adults the eventual total is likely to have been greater.
- Aug 20**,** 4 adult and 2 Great Cormorant fledglings, roosting on the intertidal zone.
- I saw no other this year's Great Cormorant fledglings on nearby cormorant roosts. As indicated by the presence of all the cormorants of the year at Seal Island on this date any dispersal of fledgling cormorants from this colony at this time would very likely have been forced.

Southern Mark

- May 29**,** There were, 0 Great Cormorant nests**.** There were 11 nests counted in 2017.
- I counted a total of 145 Double-crested Cormorant nests.
- Aug 20**,** Adult and Immature Eagle on the island, 0 young Cormorant, apparently there were zero young cormorants produced from this Double-crested cormorant colony this year.
- Despite the eagles there were many fledgling herring gulls at the island.

Saddleback, (Jericho Bay)

- May 29, 1 great Cormorant nest, which was abandoned and empty, there was an adult nearby, it was on the western side of the southern Knob, not where they had nested, years ago on western side of the northern part of the island.

Little Spoon

- May 29 17 Double-crested Cormorant nests NW corner.

Former breeding sites with Zero Great Cormorant Nests: Black Horse, White Horse, Great Spoon, Little Spoon, Green Ledge (Fog Island), Mason ledge, John's Island, Western Green, Little Duck, Little Robert's.

Razorbills:

Green Ledge Criehaven

- May 12, 5 razorbill, a couple of them from under boulders.
- 3-6 Double-crested Cormorant nests,

Common terns:

Great Spoon Spit

- May 29, Vigorous colony on the spit 50+ Individuals.
- Also a few terns near SE beach.
- Aug 20, no terns at the colony site.

Three Bush Island

- May 29, 70 Individuals

Arctic terns:

Wooden ball

- May 29, about 5 pairs, Arctic tern some close to the South west end near nesting Double-crested Cormorant, Also two other pairs down the island
- May 30, Double-crested Cormorant nesting in three distinct clumps. Total 84 nests.

Seal Island National Wildlife Refuge

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

Tern Census

A tern census was conducted on June 16, where 14 of the 30 grid squares were surveyed, due to restricted access to parts of the island. The censused area has been determined to represent, on average, 57% of the total nests in the colony over the last twelve years in which a complete census was performed (1996-2006). The extrapolated total number of tern nests was 2,033 (after a Lincoln Index of 1.006 was applied). The species ratio of the colony was determined by identifying nests to species within nine 16m radius circles around blinds and in four productivity plots. The species ratio was estimated at 40.8% Arctic Terns and 59.2% Common Terns (n=905), for a total of 1,204 Common Tern and 829 Arctic Tern nests (Table 1).

Table 1. Adjusted number of tern nests found on Seal Island NWR from 2013-2018.

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

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Productivity was below average for both Common and Arctic Terns (Table 2).

Table 2. Tern productivity on Seal Island NWR in 2018. Data for 2017 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	1.87 (1.75)	1.55 (1.42)	0.48 (1.15)	71 (59)
ARTE	1.86 (1.73)	1.66 (1.57)	0.76 (1.13)	29 (30)

Tern Provisioning

14 Arctic Tern nests were observed for 568 cumulative hours, with an average feeding rate was 1.81 feedings per nest per hour. 13 Common Tern nests were observed for 468 cumulative hours, with an average feeding rate of 1.24 feedings per nest per hour. Hake and butterfish were the most common prey items fed to both Common and Arctic Tern chicks (Table 3). Small haddock made up a significant portion of the diet for the first time, and several goosefish and squid were also observed.

Table 3. Principal prey items (percent of diet) in tern chick diet on Seal Island NWR in 2018. Total number of prey items observed n=1032 for ARTE and n=578 for COTE.

Prey item	ARTE %	COTE %
Hake	32.9	35.6
Butterfish	13.4	14.5
Amphipod	12.2	3.5
Haddock	5.3	10.7
Unknowns	16.8	11.3

Predator Activities and Control Efforts

Gull predation was observed nearly daily, usually just before dusk. Gull control efforts included poking eggs in all gull nests found during two gull censuses, conducted on May 30-31 and June 18-20, as well as shooting individual predatory gulls. Control efforts are summarized in Table 4. Laughing Gulls were observed daily, however no nests were found, though a few predated eggs were discovered. Gulls that were shot were displayed prominently to deter further predation. Peregrine Falcons and Bald Eagles we rarely seen.

Table 4. Gull control measures by species at Seal Island NWR in 2018.

Species	# Nests destroyed	# Shot
Herring Gull	316	2
Great Black-backed Gull	48	2
Laughing Gull	0	4

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 565 active burrows were present. Puffin productivity was monitored at 63 burrows. Hatching success was 0.92 chicks hatched per egg and productivity was 0.60 chicks fledged per pair (Table 5). Factors affecting productivity included a period of low feeding rate from mid-July until mid-August, when many chicks lost weight or died. Forage fish returned and feeding rate increased in mid-August, allowing chicks to resume growing and successfully fledge. Many chicks were greater than 60 days old at fledging, compared to a normal 38-42 days.

Table 5. Atlantic Puffin hatch success and productivity at Seal Island NWR from 2014-2018.

	# 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

Prey items delivered to puffin chicks were recorded from late June through early August, with a total of 1,894 prey items observed. The dominant prey species was haddock at 60% of the diet, followed by hake at 29%. Butterfish made up 2% of the diet. Haddock dominated the diet from late June to mid-July, while mid-July and August were dominated by hake, with lesser amounts of butterfish. Unusual diet observations included a relatively high percentage of squid (2% of diet), and a burst of sticklebacks (1.5% of diet) in late July/early August.

Black Guillemots

Black Guillemot productivity was monitored at 37 burrows. Average clutch size was 1.86, average hatched per nest was 1.62, and productivity was 1.0 chicks fledged per pair. A side project was conducted to determine the diet of guillemot chicks; 83 prey items were observed in 12.75 hours of observation, with the primary prey items being rock gunnel (77%), cunner (7%), and rosefish (6%).

Razorbills

A high count of 135 individuals was observed this season and 59 active Razorbill burrows were located.

Cormorants

32 Great Cormorant and 19 Double-crested Cormorant nests were counted in May. In August, 64 fledged and near-fledgling Great Cormorant chicks were counted, along with 34 Double-crested chicks, leading to productivity estimates of 2.0 chicks fledged per pair for Great Cormorants and 1.79 for Double-crested Cormorants.

Leach's Storm Petrels

343 storm-petrels were mist-netted, banded, weighed and measured. If a captured bird regurgitated its meal, the sample was collected for diet analysis.

Bird Sightings

This season 168 bird species were observed. Highlights included Brown Pelican, Brown Booby, Ancient Murrelet, Red-headed Woodpeckers, multiple King Eiders, Lark Sparrows, a singing Clay-colored Sparrow, Vesper Sparrow, South Polar Skua, and Caspian Terns. In addition, the resident Red-billed Tropicbird was seen again this year, for the fourteenth year since first being observed on the island in 2005.

Matinicus Rock

Frank Mayer, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern and Laughing Gull Census

The GOMSWG census was conducted on 15-16 June. We estimated a total of 717 Arctic Tern nests after adjusting the raw count with a Lincoln Index correction factor of 1.026. We directly counted a total of 268 Common Tern nests. During the GOMSWG census we counted 1 Laughing Gull nest.

Table 1. GOMSWG census results on Matinicus Rock, 2013-2018.

Year	ARTE	COTE	LAGU
2013	519	171	579
2014	564	223	689
2015	701	206	0
2016	621	167	30
2017	600	166	3
2018	717	268	1

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Arctic Terns fledged 0.55 young per nest. Mean clutch was 1.83 for 47 nests. Common Terns fledged 0.54 young per nest, which is the second lowest number since the study began in 2002. Mean clutch was 2.0 which is lower than last year and slightly below average for this island. About 50% of chicks died in a late June storm.

Table 2. Tern productivity on Matinicus Rock in 2018. Data for 2016 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
ARTE	1.83(1.78)	1.57(1.38)	0.55(0.91)	47(45)
COTE	2.0(2.15)	1.88(1.92)	0.54(1.58)	26(26)

Tern Chick Provisioning

The most common food items in the Arctic Tern chick diet were amphipods at 52%, followed by hake at 22% of their total diet. The most common food item in the Common Tern chick diet was hake at 32% of the diet, followed by butterfish at 18% and amphipods at 7%. Common Terns fed a very large variety of prey items, with 23 different food items identified.

Predator Activities and Control Efforts

Unlike last year, Peregrine Falcons and Merlins were not observed capturing adult or young terns. Peregrine Falcons were seen on only 5 days from 11 May to 1 September. Merlins were seen attempting to capture chicks near the Audubon House on multiple occasions but never successfully. They were seen a total of 19 days from 11 May to 1 September.

Predation of tern chicks or eggs by gulls was observed on four occasions, three times by Herring Gulls and once by a Laughing Gull. No large gulls were found nesting on the island this year. Laughing Gulls were not observed stealing fish from the terns this year. During census, only 1 Laughing Gull nest was found and destroyed. After the census a total of 8 more Laughing Gull nests were found and destroyed, for a total of 9 nests destroyed over the entire season. A few late Laughing Gull nests apparently were not detected, and about 4 chicks fledged from the island. 12 adult Laughing Gulls were shot from 21 May to 29 July. One Great Black-backed Gull was shot and 17 Herring Gulls were shot.

Common Ravens were occasionally seen about the island and cached Razorbill and Common Eider eggs were sometimes found. Many petrel burrows were found dug out by ravens as well. If a raven strayed beyond the Razorbill nesting areas in Area III then we would attempt to scare it away by shooting at it; in order to avoid disturbing Razorbills, no action was taken while ravens were in Area III.

Atlantic Puffins

Puffin hatch success was 0.89 hatched per nest (n= 85) and productivity was 0.45 chicks fledged per nest. Chick growth was slow in accordance with an apparent decrease in fish availability in July and August. Puffin bill loads delivered to chicks in 2018 consisted mostly of haddock (65%), hake (23%), and butterfish (5%). Herring and sand lance combined made up 1% of diet.

Razorbills

Razorbill hatch success was 0.89 (n = 35), and productivity was 0.62 chicks fledged per nest, which is the second highest ever recorded for this study, although chicks didn't gain as much weight as they normally do. The first Razorbill chick was seen on 11 June. Razorbill chick diet consisted primarily of sand lance (37%), herring (23%), and hake (11%).

Black Guillemots

Mean clutch size was 1.66 (n=38) and productivity was 0.76 chicks fledged per nest.

Common Murres

The high count for Common Murres in 2018 was 54. The decoys and sound system were not put in place for the third year in a row. While checking Razorbill productivity nests on 14 May we observed at least 3 murres come out from under a rock and suspected they were nesting. At this point we decided it was best to minimize disturbance to this area, and subsequently only infrequent visits were made. On 16 June we looked under the rock and discovered at least 3 incubating murres. We checked the same rock on 7 July and heard murre chicks. We checked again on 12 July and saw 4 total chicks, two small and two large. We also found more murre nests under another rock that contained at least two chicks, an egg and an incubating adult. All told we found at least nine eggs, from which at least six chicks hatched and presumably fledged.

Leach's Storm Petrels
Hatching success was 0.8 (n=31).

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 the northwest, west central, and southwest areas of the island. We banded 4 of 5 confirmed chicks this year and discovered a new nest below the Common Tern plot that had a chick in it.

Notable Birds
The most notable bird of the year was a Red-billed Tropicbird which was seen once on 3 August.

Metinic Island

Nora Papian (island supervisor), Nicholas Ferrauolo (technician) and Olivia Lappin (technician)

Tern Census
On June 15, we counted 768 tern nests during the Gulf of Maine Seabird Working Group (GOMSWG) census. After applying a Lincoln Index Correction Factor of 1.029 to the raw count and adding 52 productivity plot nests, we estimated a corrected total of 842 tern pairs at Metinic in 2018. This is a 35% increase from 2017 and the largest population since restoration began in 1998. We identified the species of 26% of the nests (n=218) and calculated a species ratio of 62% common terns (522 pairs) and 37% arctic terns (320 pairs). Productivity was lower this year than 2017, but similar to 2016. We suspect that productivity was lower due to food limitations, especially from smaller average prey size across all prey items.

	2013	2014	2015	2016	2017	2018
COTE						
# of Nests	209	214	343	290	331	522
Mean Clutch Size	2.8	2.67	2.26	2.43	2.35	2.24
Mean Hatch Success	76.8%	84.5%	77.4%	88.2%	90.7%	88%
Mean Fledge Success	27.1%	78.5%	85.4%	42.2%	69.4%	42%
Chicks fledged/pair	0.76	1.68	1.52	0.9	1.48	0.83
ARTE						
# of Nests	142	257	260	317	295	320
Mean Clutch Size	2.1	1.9	1.94	1.89	1.94	1.69
Mean Hatch Success	89.5%	89.8%	94.7%	89.4%	89.2%	93.2%
Mean Fledge Success	52.4%	81.1%	86.1%	44.1%	91.6%	61%
Chicks fledged/pair	1.1	1.39	1.63	0.74	1.58	0.96

Provisioning
During chick provisioning observations, we watched 6 common tern nests for 306 hours and recorded 400 feedings (1.30 feedings/hour per nest), and observed 4 arctic tern nests for 220 hours and saw 416 feedings (1.89 feedings/hour per nest). Dominant food items delivered to common tern chicks were sandlance (21.2%) and hake (20.7%). One common tern nest specialized in sandlance, and may have skewed the data for common terns. The most abundant food brought to arctic terns was hake (23%) followed by invertebrates (20%). In addition to lower feeding rates, the average prey size was smaller than in 2017 (average prey size reduction of 40-50%), suggesting that food was a limiting factor in 2018. For example, hake averaged 1.88 culmen lengths in 2017 and 1.08 in 2018, while herring was 2.31culmen lengths in 2017 and 1.14 in 2018. This is corroborated by lower than average linear growth in both common (4.7g/day) and arctic (3.8g/day) terns. The average linear growth from 2013-2017 was 5.7g/day for common terns and 5.9g/day for arctic terns.

Species	Nests	Feedings /hour	Herring	Hake	Invert	Sandlance	Butterfish	Unk Fish	Unk
COTE	6	1.30	7.2%	20.7%	12.0%	21.2%	3.2%	18.2%	1.5%
ARTE	4	1.89	3.9%	23.6%	20.4%	1.7%	7.0%	16.4%	8.9%

Predators

The rate of predation on tern eggs (5.6%, n=74 nests) prior to the GOMSWG census was slightly lower than previous years. A peregrine falcon visited the colony several times in May and early June, and killed at least one adult common tern that was found during the GOMSWG census. A single merlin was seen repeatedly throughout the season and primarily preyed upon spotted sandpipers in the tern colony. At least one problem great black-backed gull visited the tern colony up to five or six times a day throughout July and successfully took tern chicks on 15% of observed attempts. A problem herring gull was observed less frequently in the colony. We lethally removed 3 great black-backed and 7 herring gulls in 2018, and oiled 2 great black-backed and 240 herring gull nests throughout the season. Laughing gulls were frequently present in the intertidal area surrounding the colony, and we observed some kleptoparasitism in July. A non-breeding great horned owl was observed in the forest, but was not documented in the tern colony. We found the feathers and skulls of gulls and alcids (guillemots and razorbill) near its roost, but no tern remains. We removed 43 eastern garter snakes from the tern colony, and observed a snake attempting to kill a tern chick on one occasion (the snake was captured and removed).

Black Guillemots

We located a total of 69 guillemot burrows throughout the season, and determined 85.4% hatch rate by July 25. Out of the 69 burrows we monitored, at least four burrows were depredated and at least six burrows had eggs roll out. We found the earliest hatch on June 19. As of the last burrow check before closing the island, 90.3% from monitored burrows (n=20) and 70% island wide (n=67 chicks) were at least 14 days old and still alive. We banded 30 chicks and 5 adults.

Leach's Storm-Petrels

We located 107 storm-petrel burrows throughout the season using a combination of day and night surveys. Fewer than 30% of the burrows were accessible, but we confirmed hatching from at least 3 burrows using a combination of playbacks and checks using a burrow scope. We determined burrows were active if an adult was present, but the overall hatch success on Metinic is unknown.

Common Eiders

We conducted a common eider census separate from the gull census on the north end of Metinic Island on June 1, during which we also had a high count of 162 adult eiders around the island. We identified 46 nests during the census by finding the nest, finding an incubating female, or flushing a female out of a patch of dense vegetation. We documented contents of 17 nests, which had an average clutch size of 3.5 eggs. The census did not include the forest interior, but we observed several broods of ducklings leaving the forest throughout the season. We observed the first eider ducklings on June 4, and we continued to see ducklings throughout the season as they approached fledgling stage. The largest crèche included 46 ducklings and 28 hens.

Incidental Sightings

We documented 155 species on Metinic in 2018, and confirmed breeding for 27 species. We documented several firsts for the island including scissor-tailed flycatcher, red crossbill, eastern meadowlark and Hudsonian godwit.

Sheep

Sheep graze Metinic from September through May, and are kept on the south side of the island during the breeding season. On June 19, two sheep were discovered just north of the fence in the forest and were successfully herded to the south side. On July 24, we found an additional four sheep on the north end of Metinic, and we herded them to the forest. Sheep did not affect breeding success during the 2018 season.

Eastern Egg Rock

Laura Brazier, Island Supervisor – National Audubon Society Seabird Restoration Program

Census

An island-wide Common Tern and Laughing Gull nest count was conducted on June 12. Common Tern numbers increased by 135 nests from 2017. During census, 886 tern nests were counted. The addition of the productivity nests, feeding study nests and a Lincoln index of 1.0791 brought the total to 1,021 nests. The number of Laughing Gull nests located during census was one, which is the lowest count since the 1980s, and a drastic decrease from recent years where close to 2,000 nests were observed. Arctic and Roseate Tern nests were identified between June 1 and June 20. The census count of Roseate Tern nests decreased from 104 in 2017 to 82 nests, however 5 B-wave nests laid after June 20 brought the season total to 87 nests. Arctic Tern nests increased from 76 nests in 2017 to 86 nests. It is suspected that this increase in Arctic Terns is a not a direct result of recruitment, but rather of fewer predation events prior to census, which is in itself most likely a direct consequence of reduced Laughing Gull presence.

Table 1. GOMSWG census results on Eastern Egg Rock, 2013-2018.

Year	COTE	ARTE	ROST	LAGU
2013	831	68	83	2083
2014	698	62	65	1934
2015	894	75	77	1943
2016	852	76	78	1769
2017	886	76	104	1753
2018	1,021	86	82	1

Tern Productivity

Common Tern productivity was calculated from 65 nests in both fenced productivity plots and unfenced feeding study plots. This year, productivity measured 1.0 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 0.56 chicks per nest. Productivity numbers of all tern species measured the lowest since 2013.

Table 2. Tern productivity on Eastern Egg Rock in 2018.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.18	1.73	1.00	65
ARTE	2.00	1.56	0.56	41
ROST	1.76	1.35	1.10	78

Tern Provisioning

Twelve Common Tern nests were observed over a total of 615 hours with an average feed rate of 1.8 feedings per nest-hour. Herring was the most frequently fed prey item, comprising 45.1% of feedings, followed by hake at 21.2% and butterfish at 12.4%. Six Arctic Tern nests were observed for a total of 153 hours with an average feed rate of 3.1 feedings per nest-hour. Amphipods were most prevalent, comprising 48.5% of the diet followed by hake at 24.9%. Three Roseate Tern nests were observed over 108 hours, averaging 2.1 feedings per hour. Hake was the most frequently fed item at 34.8%, followed by sandlance at 19.8%, and herring at 19.4%.

Table 3. Principal prey items (percent) in tern chick diet on Eastern Egg Rock in 2018.

Prey item	**COTE**	**ARTE**	**ROST**
Herring	45	5	19
Hake	21	25	35
Unknown Fish	6	3	11
Sandlance	3	0	20
Invertebrates	0	49	0

Predator Activities and Control Efforts

Herring and Great Black-backed Gulls were the predominant tern predators, though neither species attempted to nest. One Great Black-Backed Gull was shot over the course of the season, as it was seen to be specializing on tern chicks. A juvenile Peregrine Falcon visited the island 9 times throughout the season, and was flushed off of successful kills on two occasions. The island was also visited 7 times by a Merlin, which also had variable hunting success.

In an effort to deter Laughing Gulls from nesting this year, carcasses from previously dispatched gulls were brought out and hung up around the island in May. Almost immediately after the first carcass was erected, the entire colony became visibly agitated, calling and hovering overhead, and then proceeded to leave the island. This method was found to successfully keep the Laughing Gulls from landing on the interior of the island for days. When combined with occasional lethal control, the gulls were extremely hesitant to land. As the season progressed and more gulls mustered confidence to attempt nesting, it was discovered that walking the perimeter of the island with a dangling carcass proved to re-agitate and discourage landing once again. It seems that as the season advances, and the gulls are instinctively driven to breed, more effort is needed than in the early season to dissuade colonization. During census, the single Laughing Gull nest found was destroyed. Continued nesting attempts throughout the season were also thwarted by performing regular search transects, destroying any eggs or potential nest cups found. A total of 106 Laughing Gull nests were found during one such transect on July 13. The ensuing transect performed on July 23 recorded 66 nests. Since colonization was prevented until the later half of the season, USFWS personnel did not perform a Laughing Gull cull, as had been practiced in previous years.

Table 4. Gull control measures at Eastern Egg Rock in 2018.

	GBBG	HERG	LAGU
Gulls Shot	1	0	11
Nests Destroyed	0	0	106

Atlantic Puffins

This year there was a minimum of 178 active puffin burrows on the island, up 6 from 2017. Hake comprised the overwhelming majority of puffin diet at 85%. Haddock was second most prevalent prey species observed at 4.4%, followed by butterfish at 3.8%. Prey diversified in the second half of the season, when food availability seemed to drop off slightly, and as such, twice the amount of prey species were observed in the puffin diet this season when compared to 2017.

Black Guillemots

Productivity was monitored for Black Guillemots for the sixth year in 2018. Thirty-three nests were followed with a mean clutch size of 1.94 and productivity of 1.52 chicks fledged per nest, which is the highest number recorded since this study began in 2013.

Leach's Storm-petrels

Leach's Storm-petrels were monitored for the fourth season this year. 43 nests were followed with a hatching success of 0.84, which is higher than 0.74 recorded in 2017.

Visitors

This summer, Egg Rock welcomed 81 visitors, primarily media personnel, donors, and teen campers from the Hog Island Camp.

Pond Island National Wildlife Refuge

Lauren Lescure, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

Tern census was conducted on June 15. The unadjusted count for Common Terns (COTE) was 982 nests. An additional 64 COTE study nests were being followed at the time of census. The Lincoln Index was 1.02. The adjusted count of 1,065 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 11 Arctic Tern (ARTE) nests and 2 Roseate Tern (ROST) nests. During the season, there were 8 attempted ROST nests on Pond Island, 6 of which were abandoned.

Table 1. Number of tern nests on Pond Island NWR from 2013-2018.

Year	COTE	ROST	ARTE
2013	692	0	0
2014	612	0	4
2015	685	0	6
2016	773	1	6
2017	942	0	8
2018	1065	2	11

Productivity

COTE productivity was determined by following 58 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 2.53 with a mean 2.34 hatched per nest and 1.28 fledged per nest. Weather events later in the season caused a mass die off of large chicks. Eleven ARTE nests were monitored. ARTE mean clutch size was 2.18, mean hatch was 1.64, and productivity was 1.09 chicks fledged per nest. All 8 ROST nests were monitored. ROST mean clutch size was 1.25, 6 nests were abandoned due to COTE aggression and predator disturbance, and 3 chicks hatched. It is unclear if ROST chicks fledged, as the adults and chicks were observed moving around the intertidal zone and could have hidden elsewhere on the island (see Table 2).

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Pond Island in 2018. Data for 2017 shown in parentheses.

Species	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	2.53 (2.48)	2.34 (2.10)	1.28 (1.68)	58 (77)
ARTE	2.18 (1.88)	1.64 (1.75)	1.09 (1.25)	11 (8)
ROST	1.25 (1.5)	0.38 (1.0)	-	8 (3)

Tern Chick Provisioning

Chick provisioning studies were conducted by observing 17 COTE nests from hatching through fledging. There were 1895 total feedings observed during 798 nest hours, resulting in a feeding rate of 2.37 feedings per hour. The principal prey species delivered were sand lance and herring. Lower quality prey items, such as butterfish and shrimp comprised more of the diet than in 2017 (6.49% versus 0.24% and 1.27% versus 1.18%, respectively). The proportion of Killifish increased from 2017, although it is still a small percent of the overall diet (1.53%).

Table 3. Principal prey items in COTE chick diet on Pond Island in 2018. Data for 2017 shown in parentheses.

Prey item	Number of Items	% of diet
Sand lance	821 (839)	43.3 (39.5)
Herring	481 (450)	25.4 (21.2)
Unknown fish	149 (460)	8.4 (21.7)
Butterfish	123 (5)	6.5 (0.2)
Hake	100 (31)	5.3 (1.5)
Unknown	45 (154)	2.4 (7.3)

Predator Activities and Control Efforts

Pond Island was subject to several predators during the 2018 season. Unlike in past years, Great-horned Owl predation was not observed. However, after signs of an owl on the island were found in late May, 6 leg-hold traps were deployed and a Snowy Owl was trapped on the island on June 1 after depredating one adult Common Tern. A juvenile Peregrine Falcon (PEFA) visited the island consistently in the beginning of the season, and this may have caused the first wave of ROST nests to be abandoned. PEFA visits and Merlin visits continued throughout the season.

On July 21, mink tracks, a dead adult COTE and 12 dead chicks were found along the beach plot on the North end of the island. Tracks were found the next day along the intertidal zone and on the south end of the island as well as scat along the vegetation near the marsh. In response, 13 Conibear traps and 4 leg hold traps were deployed. No mink was caught and no further signs of mink were observed.

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 weather and the popularity of the Kennebec River. With the acquisition of a bird deterring laser, GBBG no longer perched along the rocks in the intertidal zone and HERG could be deterred in the early morning and late afternoon to much success. No gulls nested on the island.

Bald Eagles, which were typically seen nearby on Wood Island, would visit the island and were seen taking COTE chicks from the dunes. Human presence kept most birds from landing on the island and most visitations occurred after logistics runs or during rainy days when the research tent was closed up.

American Crows were often seen in the marsh area of the island on the south end. Common Eider (COEI) eggs were seen predated throughout the island. It is also believed that the AMCR caused the Red-winged Blackbirds to abandon their nest this season. Very few COEI chicks were witnessed on the water and GBBG and HERG were seen hunting them.

Jenny Island

Joanna Morelli, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 14. A total of 1,302 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs. A Lincoln index mark/recapture correction of 1.0365 was applied to the uncorrected count. The addition of 53 productivity nests and 24 feeding study nests brought the total to 1,426 nests (Table 1). Twenty-four Roseate Tern nests were also presumed to be active during the GOMSWG census window. Two additional B-wave nests were laid after the census window. One pair of Arctic Terns nested on Jenny Island this year on the rocks projecting from the southern tip of the island.

Table 1. GOMSWG census results on Jenny Island, 2013-2018.

Year	COTE	ROST
2013	946	7
2014	1,120	12
2015	1,268	15
2016	1,122	13
2017	1,298	22
2018	1,426	24

Tern Productivity

For Common Terns, five productivity plots containing 54 nests and two feeding study plots with 14 nests were monitored to determine productivity. 25 Roseate Tern nests were monitored for productivity. Common Tern productivity was 0.94 chicks fledged per nest, which was the lowest Common Tern productivity on Jenny Island since 2008. This may be attributed to a sudden drop in quality food in late July. This also may be due to poor weather conditions; 3 three heavy storms resulted in a large amount of chick mortality. Roseate Tern productivity was 0.62, which is the second lowest Roseate Tern productivity in Jenny Island history (Table 2).

Table 2. Tern productivity on Jenny Island in 2017. Data for 2016 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.27 (2.24)	2.06 (2.01)	0.94 (1.56)	67 (71)
ROST	1.84 (1.54)	1.24 (1.08)	0.62 (0.92)	25 (24)

Tern Provisioning

Tern chick provisioning was monitored at three feeding study plots with 20 Common Tern nests. A total of 1,374 feedings were observed during 811.23 nest observation hours, producing an average feeding rate of 1.69 deliveries per hour (compared with 1.51 deliveries per hour in 2017). Average prey size was 46.55 mm. Atlantic herring constituted the majority of observed feedings (46.1%; Table 3). Hake (including white hake and four-bearded rockling) made up another 34.6% of the feedings. Tiny larval fish that could not be identified due to the speed in which chicks consumed them and due to their size (24.12 mm) played a role in chick diet late in the season (1%).

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2018.

Prey item	Number of Items	% of Diet
Herring	633	46.1
Hake	476	34.6
Unknown Fish	57	4.1
Butterfish	52	3.8
Sandlance	50	3.6

One feeding study plot with 5 Roseate Tern nests was monitored in 2018. A total of 267 feedings were observed during 172 nest-observation hours, producing an average feeding rate of 1.55 deliveries per hour, an increase from 2017's 1.45 deliveries per hour. Average prey size was 54.86 mm. Herring constituted the majority of observed feedings at 32.2% (Table 4). Sandlance made up another 30.7% of the feedings. Hake (including white hake and four-bearded rockling) constituted another 16.9% of feedings.

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2018.

Prey item	Number of Items	% of Diet
Herring	86	32.2
Sandlance	82	30.7
Hake	45	16.9
Hake or Herring	32	12.0
Unknown Fish	10	3.7

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2018 field season. Great Black-backed Gulls were seen predating eider chicks and there were six incidences of large gulls taking chicks from the island (4 Herring Gull, 2 Great Black-backed Gull). No Herring or Great Black-backed Gulls nested on the island.

Though Laughing Gulls have nested on Jenny Island in the past, no signs of nesting were found on the island early in the season. 3-4 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 2018.

Multiple Common Tern eggshells were found during the beginning of the season with large, ragged holes in them; it is assumed that corvids predated the eggs in this way due to their obvious presence on the island. An estimated 25 to 30 eggs predated in this way were found over the course of the season. Corvids (1-2 American Crows and 2 Common Ravens) played an active role in disturbing the colony early in the season (May to June) and sporadically throughout the rest of the season. Common Eider eggs were found with ragged cracks in a similar area and were thought to have been the result of corvid predation.

Over the course of the season, at least two individual Peregrine Falcons were identified predating terns on the island. There were 14 observed Peregrine Falcon visits to the island and though the individuals did not always take adult terns when they visited, 5 Common Tern adults were observed taken or dropped on the island by Peregrine Falcons.

Black-Crowned Night Heron predation was observed beginning in mid-June, with the disappearance of at least 15 small chicks and eggs from the Northwest side of the island. Predation began on June 16 and continued until June 22 when a subadult Black-Crowned Night Heron was shot. A second Black-Crowned Night Heron was identified while hunting the first individual – an adult was seen flying onto the island around the same time the subadult was hunting. It is possible both individuals were foraging simultaneously on the island. The second individual was not as regular in its visits to the island, and was only confirmed predating chicks on one night. Black-Crowned Night Heron predation was observed again on July 22 and 27 with a sliced egg and a few messy, cracked eggs across the island; most of the eggs the individual predated were old eggs that were not being incubated any longer.

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. A Ruddy Turnstone individual was also observed within the rock perimeter around the island (within the colony).

Common Eiders

9 Common Eider nests were found during the 2018 GOMSWG census. An additional Common Eider nest was found after the census under the camp kitchen platform.

Outer Green Island

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

Tern Census

The 2018 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on Outer Green Island on 14 June. A total of 1448 Common Tern nests were counted. The application of a Lincoln Correction Index of 1.0168 yielded an adjusted count of 1472 nests. The inclusion of 41 productivity study nests and 25 feeding study nests resulted in a final, corrected total of 1553 nests. This is another new record for Outer Green Island, making it the largest tern colony in Casco Bay and the largest colony of Common Terns in Maine. At the time of the GOMSWG census, there were no known Arctic Tern or Roseate Tern nests. However, four Roseate nests were discovered later in the season.

Table 1. GOMSWG annual census on Outer Green Island, 2013-2018

Year	COTE	ROST	ARTE
2013	1143	0	0
2014	1139	0	0
2015	1353	0	0
2016	1367	0[1]	0
2017	1434	0	0
2018	1553	0[2]	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 23 May. The average number of eggs per nest was 2.16 (n=86) of which an average of 1.87 hatched. The first recorded hatch was on 14 June, and peak hatch lasted approximately from 20-25 June. The average number of chicks fledged per nest (productivity) was 1.14, the lowest productivity on Outer Green Island since 2008 (2008 prod = 0.62).

Table 2. Outer Green Island annual Common Tern productivity, 2013-2018

Year	Mean Clutch	Mean Hatch	Productivity
2013	2.60	2.27	1.15
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

Tern Provisioning

Chick provisioning was observed at 22 Common Tern nests this season over 75 stints totaling 214.4 hours. A total of 1370 feedings to chicks over 794.25 nest-hours were recorded for an average feeding rate of 1.72 items per hour, which is higher than both the 2017 feeding rate of 1.63 items per hour and the 2016 rate of 1.31 items per hour. The most frequently observed prey item was herring, followed by hake which made up 41% and 22% of the observed diet, respectively.

Predation

Early and late in the season, Peregrine Falcons and Merlins visited Outer Green on several occasions to hunt terns. A Great Blue Heron was also seen on the island on a few instances in May and several depredated eggs may be attributable to this predator. However, gulls were far and away the dominant predators on Outer Green Island in 2018. Despite continued harassment efforts, gulls often roosted on Junk of Pork, a nearby islet, and took small numbers of chicks almost daily beginning around peak tern hatch. Gull predation increased during late July during a long period of thick fog that often made harassment efforts impossible.

Weather Events

Several weather events caused tern chick mortality during the 2018 field season. A soaking rainstorm on 28 June was responsible for the deaths of numerous chicks. A micro-burst thunderstorm on 10 July, with rain, hail, and 66mph winds caused significant damage to many tern nests as well; hail damaged many nests that still contained eggs and all four Roseate Tern nests failed soon after this weather event, either from hail damage or abandonment immediately thereafter.

Black Guillemots

This year, three new Black Guillemot burrows were found, raising the island total to 28 marked burrows. At least 19 of these burrows were active in 2018 and were monitored for productivity estimates. The average clutch size was 1.74 and the average number of eggs hatched per nest was 1.16. Many guillemot chicks had not 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 1.00 with nest failure occurring from several instances of presumed gull predation and at least one instance of nest abandonment.

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 13-14, with an additional count of Least Tern nests on June 19. Roseate Terns increased from 2017 levels to a total of 128 nests during the GOMSWG census. This is Stratton's highest count of Roseate Tern since GOMSWG censuses began in 1984. Arctic Terns nests increased from 2 in 2017 to 8 in 2018, although shortly after census, 1 nest was predated and 6 were lost to a high tide. The Common Tern nest count of 1,044 nests was corrected with a Lincoln index of 1.093 to 1,141 nests, and the addition of 65 productivity and feeding study nests brought the total count to 1,206 nests. A total of 61 Least Terns nests were counted during the official Least Tern census on June 14, however, due to washouts and predation on mainland colonies, a second census was conducted on June 19. During the second census, 122 nests were counted, the highest

since Least Terns began nesting on Stratton in 2005. New nests were marked throughout the season, resulting in a final tally of 175 nests.

Table 1. GOMSWG census results on Stratton Island, 2013-2018.

Year	COTE	ARTE	ROST	LETE
2013	1284	3	93	92
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

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 66 nests in the Common Tern plots fledged at a rate of 0.53 chicks per nest. One plot experienced heavy predation on June 13, likely by a night-heron, which caused 10 out of 12 nests to fail. Because this appeared to be an isolated event that was unrepresentative of the colony as a whole, this plot has been excluded from the overall productivity estimate. Roseate Tern productivity was 1.27 chicks fledged per nest for the 74 nests followed. Least Terns produced at least 50 fledglings in 2018. This unusually high success rate was due at least in part to an apparent lack of Black-crowned Night-Heron predation this year. Of the 8 Arctic Tern nests followed, all but one failed due to washout and predation, and the remaining nest produced 1 chick. 3 Arctic Tern nests were observed later in the season, likely relays of the initial failed nests.

Table 2. Tern productivity on Stratton Island, 2012-2018.

	2013	2014	2015	2016	2017	2018
COTE						
Mean clutch	2.02	1.95	2.09	2.40	2.32	2.20
Mean hatch	1.83	1.69	1.72	2.25	1.98	1.92
Productivity	1.41	1.29	0.89	1.0	0.63	0.53
ROST						
Mean clutch	1.88	1.49	1.83	1.88	1.88	1.96
Mean hatch	1.52	1.10	1.48	1.28	1.59	1.73
Productivity	1.27	0.99	1.38	1.01	1.03	1.29
ARTE						
Mean clutch	2.00	2.00	1.83	-	2.00	2.00
Mean hatch	0	1.22	1.08	-	1.00	0.25
Productivity	0	0.22	0.25	0	0.5	0.13
LETE						
Mean clutch	1.97	1.86	-	-	-	1.82
Mean hatch	1.65	1.52	-	-	-	-
Productivity	0.72	0.38	0	0.2	~0.02	-

Tern chick provisioning

16 Common Tern nests were observed with a total of 870 feedings. Sand lance were the primary prey item offered to chicks, comprising 29.5% of the diet, followed by herring at 13.4% and hake at 7.1%. 35.8% of feedings were unidentified. 10 Roseate Tern nests were observed with a total of 527 feedings. Sand lance made up 46.8% of their diet, herring 5.2%, and hake 3.9%, with 41.4% of feedings unidentified. Least Tern feeding studies were conducted by observing nests within an unfenced plot approximately 2.5 meters in diameter. A total of 700 feedings were observed. Hake made up 70.0% of the diet, sand lance 6.2%, killifish 6.2%, and 16.5% of feedings were unidentified.

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. 2 Great Black-backed Gull nests were found and destroyed on Stratton Island, and 35 Herring Gull and 32 Great Black-backed Gull nests were poked on Bluff Island. 2 Herring Gulls were lethally removed from Stratton Island.

During the night of June 12, a Black-crowned Night-Heron predated nests in the vicinity of Li'l Big Blind. A game camera was deployed in the area, and two more were deployed on the Least Tern beach. The following night of the 13th an adult Black-crowned Night-Heron was captured on camera by Li'l Big Blind. Night stints commenced in LETErnity Blind on the Least Tern beach from 2200 until 0100 every night until July 8. No further night-heron predation was observed or suspected anywhere in the colony during this time.

Last year's attempt to trap a chick-eating muskrat may have been unsuccessful, as a muskrat was observed eating tern eggs on June 11. Two muskrats were trapped in the area and summarily dispatched over the next two days, and no further predation was observed.

Wading Birds
A census of the wading bird colony on Stratton Island was conducted on May 18-21. A total of 111 Glossy Ibis, 5 Black-crowned Night Heron, 49 Great Egret, and 74 Snowy Egret nests were found.

Common Eiders
A Common Eider census of Bluff and Stratton Islands was conducted on May 22 and May 27-30 respectively. 60 nests were found on Bluff and 551 nests were found on Stratton for a total of 611 nests.

American Oystercatchers
2 pairs of American Oystercatchers nested on Stratton Island and a third pair was suspected on Bluff Island, as a pair of adults were occasionally observed on the beach there. Both confirmed nests are suspected to have hatched and all three chicks from one nest survived to fledge.

Black Guillemots
6 active Black Guillemot burrows were confirmed in 2018. 4 were near East Beach while 1 was found in a rock jumble near Hannafuda blind, and 1 was found in a crevice on the south side of Gull Meadow. A high count of 35 adult Black Guillemots occurred on June 8.

Double-crested Cormorants
On June 10, 137 Double-crested Cormorant nests were counted on Bluff Island by visual estimate from a boat.

Visitors
In 2018, Stratton Island had over 120 visitors. Visitors included National Audubon, USFWS, and US Army Corp of Engineers personnel for research purposes, 4 donor trips, 3 Maine Audubon Society field trips, a Prout's Neck Audubon Society field trip, and numerous unscheduled visitors.

Notable Birds
A Snowy Owl was present for several days after the beginning of the field season on May 7 and a Clay-colored Sparrow was found on May 15.

New Hampshire

White and Seavey Islands

Liz Craig, Program Manager – Shoals Marine Laboratory
Caitlin Bowman & Amber Litterer, Seabird Technicians – Shoals Marine Laboratory

Tern Census

Common Terns

- COTE census was conducted on June 11th, 2017
- Unadjusted census:
    - 200 nests on White Island
    - 1,774 nests on Seavey Island
    - Lincoln Indices were calculated for White Island (1.083) and Seavey Island (divided into sections with indices ranging from 1.00 to 1.33)
    - 45 additional nests were located in productivity plots on Seavey
- Adjusted census:
    - 216.7 nests on White Island
    - 1,958.4 nests on Seavey Island
    - **Total estimated population was 2,175** (down from 3,210 in 2017)

Roseate Terns

- 55 ROST nests were established on Seavey Island by 20 June 2018
- B-wave ROST nests brought season total to 65

Arctic Terns

- 1 ARTE nest was established by 20 June 2018 on White Island.

Table 1. Number of tern nests found on White and Seavey islands from 2014-2018

Year	COTE	ROST	ARTE
2014	2,548	69	3
2015	2,686	68	2
2016	2,985	83	3
2017	3,210	92	2
2018	2,175	55	1

Productivity

Common Terns

- 9 fenced plots (~10x12 ft) containing 45 nests were used to determine COTE productivity.
- Productivity was low due to the combination of predation by SNOW, gulls, poor food provisioning, and extreme weather.

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 2014-2018. Only nests with known outcomes were used for ROST & ARTE calculations.

Species	Year	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2014	2.12	1.57	0.78	223
	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
ROST	2014	1.45	0.97	0.91	76
	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
ARTE	2014	1.67	1.67	1.30	3
	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

Tern Provisioning

- 14 COTE nests were monitored for diet
- A remote observation camera was used to record video of each nest every 1-2 days from 30 June 2017 onwards. Limited provisioning data were collected by observers in blinds to compare to camera observations. Data from camera recordings will be collected in fall 2018
- Diet items included Atlantic herring, hake, sandlance, butterfish, cunner, silverside, lumpfish, ants, and moths
- Partnering with a genetics lab at UNH (Drs. Gemma Clucas and Adrienne Kovach) to conduct DNA metabarcoding of feces to determine diet

Predator Activities and Control Efforts

Snowy Owl:

- A SNOW was observed on White and Seavey Islands from 22 May until 29 May
- The remains of 18 COTEs were found on White and Seavey
- Complete nighttime abandonment of colony from 21 May through 3 May
- Attempted to trap the SNOW for two nights using live mice and padded leg hold traps
- SNOW was lethally removed 29 May

Gulls:

- No gull nesting attempts on White or Seavey in 2018
- Used human presence, as well as pyrotechnics to dissuade gulls from lingering and predating.
- 148 pyrotechnics were used between 12 May and 6 August.

- Lethal control: removed 4 HERGs and 3 GBBGs during the chick rearing period. Dissected stomachs and found tern remains in 3 of the stomachs including COTE and ROST chicks and tern eggs.
- The Appledore Island gull specializing in tern predation was absent in 2018.

Other Avian:

- RUTU from the end of May through early June and again in late July. Direct observations of egg predation were seen from remote camera.
- A juvenile PEFA visited the colony in late July and early August. Terns responded by mobbing the falcon. 1 adult COTE observed predated
- Found the remains of 2 COTE HYs

Mammalian:

- No evidence of mammals (including muskrats) on White or Seavey in 2018
- SNOW pellets containing muskrat remains were found on Seavey in May

Other Nesting Species

- Both Common Eider (26 nests on 6/11) and Spotted Sandpipers (at least 9 nests) were found nesting on the islands.

Other observations

- Alcids: BLGU (confirmed nesting on Appledore Island) and RAZO

Research:

- Collected tern remains and diet items for microplastics analysis (very little evidence found of plastics exposure for terns, more was found for Gulls)
- Trialed a grid method for census to improve spatial resolution of nesting data.
- Tested habitat management treatments including seawater, hypersaline seawater, and turf.
- Tern fecal collection conducted to determine diet

Monomoy National Wildlife Refuge

Kate Iaquinto – Wildlife Biologist, U.S. Fish & Wildlife Service
Shilo K. Felton – Volunteer, U.S. Fish & Wildlife Service

Minimoy Island

Tern Census and Productivity
No roseate or least tern nests were found on Minimoy Island this field season. Productivity on Minimoy Island was zero. One common tern nest was found on 1 July however it was missing at the next visit to the island. Minimoy Island was not visited frequently this summer due to staff shortages.

Table 1. Number of tern nests found on Minimoy from 2016-2018

Year	COTE	ROST	LETE
2018	1	0	0
2017	0	0	0
2016	0	0	3

North Monomoy Island

Tern Census and Productivity
No common, roseate, or least tern nests were found on North Monomoy Island this field season. Productivity on North Monomoy Island was zero.

Table 2. Number of tern nests found on North Monomoy from 2016-2018

Year	COTE	ROST	LETE
2018	0	0	0
2017	0	0	0
2016	2	0	0

Wading Birds
A wading bird census on North Monomoy Island was conducted on 16 May. Observers counted 225 active black-crowned night-heron nests, 94 snowy egret nests, 27 great egret nests, and 1 pair of glossy ibis (likely nesting). Productivity was not monitored.

Predator Activities and Control Efforts
Gulls. A gull census was conducted in concert with the wading bird census on 16 May this year. Observers counted 625 active great black-backed gull nests and 599 herring gull nests. Gull productivity was not monitored.

Coyotes. Refuge staff observed coyote tracks on North Monomoy Island on one occasion in July.

South Monomoy Island

Tern Census
The annual tern and gull census was conducted by a team of refuge staff and volunteers on 8 and 10 June. The nesting area is delineated into 60m^2 grids, and all nests were tallied by grid number. A Lincoln Index was performed at the end of each day to compensate for error, providing a final adjusted estimate of 13,472 nests. A B-census was not conducted; however, based on the number of nests initiated in productivity plots after 20 June, we estimated there to be an additional 990 nests in the colony during the B-period.

Thirty roseate tern nests were counted during the A-census window. There were no new nests laid after 20 June. This was an increase of twelve pairs compared to 2017.

Most of the nesting least terns on South Monomoy Island were found within a single colony on the northern end of the island. Seven nests were also discovered on the far southern end of the island. An A-period census was

conducted by using an incubating adult count in the main colony on 19 June, the other sites were censused by nest count on 15 June. A total of 499 nests were counted refuge-wide. No B-period census was conducted.

Table 3. Number of tern nests found on South Monomoy from 2016-2018

Year	COTE	ROST	LETE
2018	13,472	30	499
2017	11,723	11	773
2016	10,505	14	839

Tern Productivity

Common tern reproductive success was good, based on results of the 381 A-count nests that were monitored in 42 fenced productivity plots. Reproductive success within the monitored plots was 1.10 fledged chicks per nest attempt. Final productivity calculations were made based singularly on A-period nests.

At least 31 roseate tern chicks hatched, 22 of which could be considered fledged by GOMSWG standards. This is lower than previous years. However, staff shortages limited observations, chick banding, and chick checks, so the success rate was likely much higher than observed.

Least tern productivity was not strictly monitored. Substantial evidence of coyote presence was observed, suggesting a moderate degree of depredation on least tern chicks throughout the season.

Table 4. Breeding parameters for common (COTE) and roseate (ROST) terns on South Monomoy Island in 2018. Data for 2017 shown in parentheses. Clutch size provides the average clutch size (eggs per nest). Hatching success provides the number of nests hatched out of the total laid. Fledging success provides the number of chicks fledged out of the total number of chicks hatched. Reproductive success provides the number of chicks fledged out of the total number of nests monitored. Standard deviations are provided where available. COTE parameters are estimated from A-period nests.

Species	Clutch size	Hatching success	Fledging success	Reproductive success	Nests monitored
COTE	2.14±0.54 (2.31)	0.826 (0.875)	0.625 (0.758)	1.10±0.79 (1.53)	381
ROST	1.54±0.59 (1.80)	0.622 (0.722)	0.647 (1.000)	0.73 (1.36)	30* (11)

*Only 24 nests used to determine average clutch size, hatching success, and fledging success because 6 nests were discovered after chicks had already hatched.

Tern Provisioning

Results from this year's feeding observations are not meaningful due to low sample sizes (4 hours).

Laughing Gull Kleptoparasitism

Results from this year's feeding observations are not meaningful due to low sample sizes (7 hours).

Tern Trapping and Banding

Staff trapped 20 common tern adults, four of which were previously banded and 15 which were affixed with new bands. All recaptured adults were originally banded at Monomoy NWR.

One previously banded roseate tern adult was re-captured in 2018. Only 11 of the total 31 newly hatched chicks were banded with dark blue PFRs with white lettering. PFRs were placed on the lower left and stainless steel BBL bands on the lower right. At minimum, 14 of the 91 terns affixed with PFRs in the 2014 – 2017 seasons returned to nest in 2018. All bands were reported to the Bird Banding Lab and Jeff Spendelow of USGS.

Roseate Tern Attraction Project

The roseate tern attraction project was not implemented in 2017 or 2018 due to staff shortages.

Staging and Re-sighting

Jeff Spendelow of USGS conducted re-sighting and staging counts with the assistance of refuge staff on four days between 8 August and 7 September.

Black Skimmer Census and Productivity

In 2017, black skimmers were discovered nesting within the tern colony for the first time since 2011. However, no skimmers attempted to nest on the island this year.

Laughing Gull Census and Productivity

A total of 3,272 laughing gull nests were counted during this year's tern census on 8 and 10 June. This number is an increase from the 2,714 nests found in 2017 and 2,738 nests found in 2016. Productivity was not monitored. To minimize competition for food and nesting area with the terns, 1,081 active nests were destroyed within the tern colony area between 10 June and 5 July. We intend to continue nest destruction annually until there are fewer than 1,000 nesting pairs of laughing gulls within the common tern colony.

Wading birds

Wading birds have not nested on this island since 2007, so no census was conducted. Staff sighted black-crowned night-herons (or tracks) on eight days (six within the tern colony). Staff attributed 15 common tern egg depredations to wading birds between 29 May and 24 August. No wading birds were lethally removed from the refuge.

Predator Activities and Control Efforts

Gulls. Only two official gull harassments were conducted this season, though staff flushed great black-backed gulls and herring gulls opportunistically when observed in the colony. A total of five herring gull nests were destroyed during early June. Two adult herring gulls were lethally removed from South Monomoy Island. Great black-backed gulls were observed within the colony 20 times, while herring gulls were sighted 47 times. Staff attributed 36 depredated tern eggs (all common terns) to large gulls.

Northern harrier. Northern harriers were observed 20 times during the field season. Of those 20 sightings, 9 were within the tern colony. No depredations were attributed specifically to northern harriers.

Coyote. Two adult eastern coyotes and eight pups were lethally removed from the refuge. Evidence of coyote (scat, tracks) was discovered 103 times (23 of which were within the colony). Refuge staff sighted a coyote within the tern colony only once and did not report any sightings outside of the tern colony.

American crow. American crows were observed three times between May and July, and one was lethally removed.

Common grackle. There was no evidence of common grackle predation in the tern colony, though they were responsible for taking at least two piping plover nests. Eleven common grackles were lethally removed.

Owls. A snowy owl female was present on the island throughout the nesting season and into the fall. It spent most of its time near the piping plover nesting areas on the eastern facing ocean beach. Staff reported sighting a snowy owl within the tern colony on four occasions and collected owl pellets within the colony four times early in the season. Seventeen adult terns were found dead in the colony with evidence of owl predation during late May and early June.

Peregrine falcon. Staff sighted falcons in the colony four times and attributed five depredated common tern adults to this species.

Mute Swan. USDA staff removed five mute swan from the island on 21 April.

Research Updates and Presentations

Machias Seal Island MS Projects on Alcid Overwintering Patterns

Mark Baran: During the 2018 field season, 20 of 29 geolocator tags deployed on puffins in 2017, as well as one tag deployed in 2015, were retrieved by the crew. Preliminary analysis of tag data suggest that most MSI puffins are staying within the Gulf of Maine for much of the winter and making a southward movement in the spring before returning to breed.

Mark Dodds: 21 tags were deployed on MSI razorbills in 2017 and we retrieved 15 this past summer. Preliminary track analysis suggest most razorbills are staying in the Gulf of Maine for the duration of nonbreeding period. Some individuals are showing movement south (to the Carolinas, potentially as far south as Florida) during the winter (Dec-Feb).

Spatial and temporal influences on Atlantic puffin nest success for Seal Island and Matinicus Rock

Bob Houston - Biologist/GIS Specialist, USFWS Gulf of Maine Coastal Program
Margaret Conley and Charlie Southwick – Students, Bowdoin College
Eileen Sylvan Johnson, PhD – Professor, Bowdoin College
Term Projects/Poster for Bowdoin College Environmental Studies class - Understanding Place: GIS and Remote Sensing.

Atlantic Puffin nest success data and GIS data for Seal Island and Matinicus Rock were provided to two students in an entry level GIS class at Bowdoin College. A basic introduction to the data and suggested analysis topics were provided to the students so they could use the data in their term project to produce a poster and term paper. Students produced a very insightful and informative poster and technical papers that used a variety of detailed GIS spatial analysis tools to evaluate the distribution of successful Atlantic Puffin nests. Results can be seen on the posters on display today and Bob will present some results at GOMSWG today. We welcome any comments or suggestions for analysis/research with future students in this class.

Satellite Tracking Common Terns

Linda Welch, USFWS, Maine Coastal Islands NWR

In 2017, MCINWR partnered with the Region 5 Migratory Bird, Bureau of Ocean Energy Management and the Avian Conservation and Research Institute to tag five breeding common terns with 2 gram solar satellite tags. All birds were tagged using backpack harnesses on Petit Manan Island in June 2017. We were able to document foraging efforts throughout the nesting season, and the use of Cape Cod as a staging location for all five terns. In addition, we were able to track four terns as they migrated south to Venezuela and later wintered along the coasts of Suriname, French Guiana, and Brazil. In 2018, two transmitters documented northward migration in the spring and another season of foraging behavior in the waters surrounding Petit Manan Island. One transmitter continued to operate during the 2018 fall migration period and continues to document wintering movements as of December 2018.

2018 Maine State Synopsis of Nesting Least Terns

On June 5th and 8th, a coordinated least tern census documented a minimum of 170 least tern pairs within the State of Maine, however predation events and flooding occurred before the count, making this an underestimate. Another coordinated count on June 19th documented 186 pairs in the state. This number is likely still a very low estimate, with the actual number being closer to around 240 pairs. During the count on June 19th, 43 least tern pairs nested at Crescent Surf, 21 nested at Laudholm Beach, and 122 nested on Stratton Island. Later in the season, least terns nested at Goose Rocks, and Western and Higgins beaches. Crescent Surf produced a minimum of 19 fledgers, and Stratton Island produced a minimum of 50. State productivity was estimated to be between 0.28 and 0.38 fledgers per pair. Overall, productivity was low.

Laudholm Farm Beach, Wells
Katie Fernald and Marlie Perkins, Rachel Carson NWR

Population Estimate*:* 21 pairs were nesting at Laudholm Farm Beach during a coordinated count on June 19th. An electric fence was set up around the colony. The fence malfunctioned and a fox predated most of the nests on July 2nd. The few remaining nests were abandoned and there was no attempt to renest at Laudholm.

Comparison*:* Four pairs nested at Laudholm Farm Beach in 2014 and fledged a total of four chicks. Since then, terns have nested unsuccessfully every year. Before 2014, terns had not nested at Laudholm since 2005.

Predator Control*:* No predator control was conducted at Laudholm Farm Beach in 2018.

Crescent Surf Beach, Kennebunk
Katie Fernald and Marlie Perkins, Rachel Carson NWR

Population Estimate*:* 120 pairs were nesting during the coordinated Least Tern census on June 8th. 43 active nests were counted on June 19th when a second coordinated count was conducted after predation and wash out events occurred at Crescent Surf. Crows were frequently seen in the dune early in the season and likely predated tern nests, but they became scarce after a few problem crows were removed. The washouts and predation events made an accurate count of nesting pairs difficult for this year, the initial census window count was 120, but many of those birds dispersed to Stratton Island or other sites.

Most of the tern chicks observed didn't make it to fledging. 10 dead chicks were found in the month of July still inside the nest cup without any obvious injuries. It is most likely they were abandoned. A great-horned owl was present in the colony again this season, starting on June 11. Feathers and tracks were seen occasionally in and near the colony, but sign increased sharply near the end of July as the number of tern chicks and fledglings reached its peak. After one weekend where the owl visited multiple times, all the remaining nests and young chicks were abandoned. Two fledglings were confirmed predated by the owl on 7/30 and 8/1.

Seven fledglings were counted during a chick survey on July 20. Up to 12 fledglings were observed on the beach over two weeks later, so the final estimate is 19 fledglings for a productivity of 0.16. (19/120).

A pilot foraging study was conducted this year, due to small numbers of chicks present, sample sizes were also small. The most frequently fed forage item was sandlance, followed by stickleback and hake. Small sample size hampered statistical analyses.

Comparison*:* 2015, 2013, and 2012 were successful years on Crescent Surf, with productivity of 1.04, 0.76, and 0.79. Both 2014 and 2016 had productivity below 0.2. Productivity was also poor from 2003-2007. Although there have been multiple years recently with low productivity, the total number of adults at Crescent Surf has remained between 120 and 150 pairs since 2010.

Predator Control*:* USDA Wildlife Services removed specialist predators from the Crescent Surf Beach area throughout the breeding season. An electric net fence was also set up around the colony.

Goose Rocks Beach, Kennebunkport
Maine Audubon

Population Estimate*:* Two pairs of Least Terns nested on the western end of Goose Rocks in 2018 but they were both unsuccessful.

Comparison*:* At least seven pairs attempted to nest in 2017 but all were unsuccessful. Ten pairs of Least Terns made nest attempts on Goose Rocks Beach in 2016 fledging at least seven chicks. No Least Terns attempted to nest at Goose Rocks Beach from 2012-2015. In 2011 a season high of 46 birds were documented and produced a minimum of 12 fledglings. In 2010, a small colony set up after failures at Crescent Surf Beach and Stratton Island, however no chicks survived.

Predator Control*:* None.

Western/Ferry Beach, Scarborough
Maine Audubon

Population Estimate*:* There were a minimum of five Least Tern nest attempts at Western Beach in 2018. At least four chicks from two nests hatched. No chicks fledged off of Western Beach in 2018. Terns did not attempt to nest on Western until after they had already failed on Higgins, and a substantial colony never formed. Many fledgling Least Terns from nearby Stratton Island were observed in August on Western Beach.

Comparison*:* There were a minimum of 48 Least Tern nest attempts on Western Beach in 2017, and they fledged at least five birds. In 2016, there were at least four nest attempts on Western Beach, with no fledglings produced. Before this, terns had not nested on Western Beach since 2008, and the site had not fledged chicks since 2005 when there was a total of 40 active nests. Prior to 2005, Least Terns had not nested at the site since 1981.

Predator Control: USDA Wildlife Services removed specialist predators from the area throughout the breeding season. An electric net fence was used during the breeding season.

Stratton Island
National Audubon Society

Population Estimate: A colony-wide census was conducted on June 19, and 122 active nests were found. This is a record number of nests for Stratton Island. New nests were found throughout the rest of June and most of July, with many of these nests believed to be from individuals relocating from the mainland following washouts and a predation event around June 11. The total number of nests tallied over the season was 175 nests, although this number may include re-nests.

Daily counts for fledglings were used to monitor productivity. As chicks began reaching fledging age, counts occurred each afternoon during 90 minutes of observation from a blind located centrally in the Least Tern colony. The number of visible fledglings and near-fledglings was counted every 15 minutes. The high count of fledglings was then used to calculate a minimum productivity estimate. The maximum number of Least Tern fledglings counted on Stratton was 40 on July 15. However, during a coordinated count of fledglings with mainland colonies on July 20, 15 fledglings were counted on Stratton, with 22 at Western Beach and 13 at Higgins Beach for a total of 50. Minimum productivity was calculated at 0.29 chicks per nest.

Least Tern chick diet was monitored by observing feedings to chicks from a bird blind for a total of 12 hours per week. For each prey delivery, the prey item was identified to species where possible, and prey size was estimated in relation to adult bill length, in 0.25 bill length increments. Overall, 699 feedings were recorded. They primary prey item delivered to chicks was hake, followed by sand lance and killifish.

Comparison: In 2017, 87 nests produced at least one chick. In 2016, 69 pairs produced 14 fledglings. In 2015, the minimum number of pairs was 69, with zero fledglings.

Predator Control: Yes

Higgins Beach, Scarborough
Maine Audubon

Population Estimate*:* A colony of LETE started to form at the end of May, with at least ten nests detected in the beginning of June. An electric net fence was erected on June 1st, although it was not operational. Sometime before June 7th a fox got through the fence and preyed on the eggs, and the colony relocated to Western.

Comparison*:* No terns nested in 2017 on Higgins. In 2016, a colony had begun to form at the end of May, but a storm tide in early June washed over the area, and no nests were laid. In 2015, up to 95 adult Least Terns were observed at Higgins Beach, with a high of 25 nests at one time. Initial nest attempts were lost to crows and foxes, but some later nests were successful. A

conservative estimate of 13 chicks fledged from Higgins Beach in 2015. In 2014 there were 11 nesting pairs, however a fox destroyed the colony and no chicks fledged. No Least Terns nested on Higgins Beach in 2010-2013. In 2009 a minimum of 16 nesting pairs were observed, however all nests were predated and the colony was abandoned. In 2008 there were no nesting pairs. Scraping was seen in 2007, but no nests were established. In 2006, a single nest was abandoned. Higgins hosted successful colonies in 2003 and 2004, fledging 53 and 54 chicks, respectively.

Predator Control*:* Predator removal by USDA Wildlife Services.

Popham Beach State Park, Phippsburg
Maine Audubon

Population Estimate*:* No Least Terns nested on Popham Beach in 2018.

Comparison*:* In 2016, there were at least 22 active nests; some hatched but all were unsuccessful due to predation. In 2015, there were 40 nesting attempts, fledging four chicks. Three Least Tern pairs nested on Popham Beach in 2013 producing no fledglings, and two pairs nested in 2012, fledging three chicks. Prior to that, no birds have attempted to nest on Popham Beach since 1997, when a 15-pair colony failed to produce any fledglings.

Predator Control*:* None

Estimate of Least Tern Pairs

Table next page.

Maine State 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)

[ ] 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.

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