

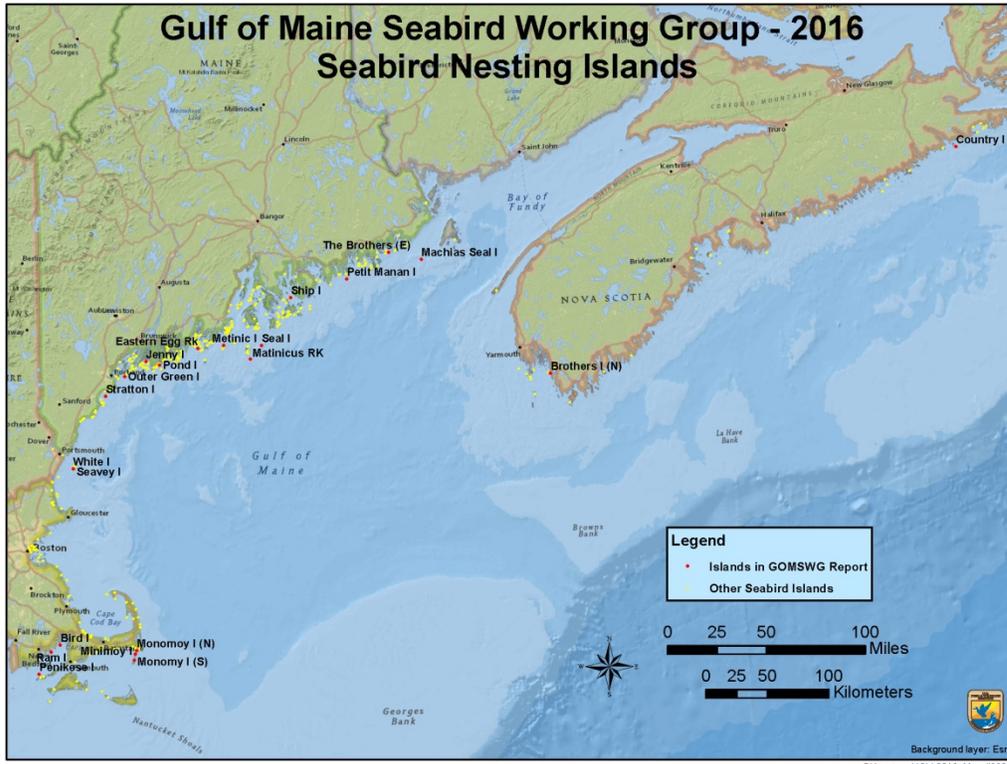
Gulf of Maine Seabird Working Group
32nd Annual Summer Meeting

Hog Island, Bremen, Maine
August 12, 2016

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gomswg.org

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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 2016 GOMSWG census results will be distributed when it is complete.

ISLAND AND SITE REPORTS

CANADA

Country Island

Virginia Noble, Island Coordinator

Myrium Trottier-Paquet & Victoria Hartley, Island Assistants

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Population

A first census on June 17-20 resulted in 1491 terns counted (Table. 1). To account for late nesters, 50% of the colony was re-sampled on July 6 & 7 and counts were adjusted using a Lincoln index of 1.137 resulting in a corrected colony size of 1695 tern nests, including 18 Roseate Tern nests¹. Tern colony species composition² was similar to previous years, comprising 60% Arctic, 39% Common and 1% Roseate Tern.

Tern numbers were the highest on record since island restoration began in 1998 and the number of ROST appears to have stabilized over the past five years (with the exception of 2015 when predation events at Country Island may have contributed to dispersal of breeders to neighboring sites - birds banded on Country Island were re-sighted at a nearby tern colony).

Table 1. Number of tern nests found at peak laying (1st census) at Country Island, NS from 2012-2016

Year	ARTE[†]	COTE[†]	ROST¹	Total tern colony
2012	754	492	18	1263
2013	868	426	16	1309
2014	754	502	15	1270
2015	622	420	6	1061
2016	893	581	18	1491

Productivity

Table 2. Mean hatch success \pm SE (eggs hatched / eggs laid per nest) at Arctic, Common and Roseate Tern nests at Country Island, N.S. from 2011-2016.

Year	ARTE			COTE			ROST		
	Hatch success	SE	n	Hatch success	SE	n	Hatch success	SE	n
2012	0.94	0.02	79	0.93	0.02	79	0.78	0.09	18
2013	0.95	0.02	59	0.94	0.02	64	0.91	0.05	16
2014	0.89	0.04	60	0.91	0.03	60	0.77	0.11	15
2015	0.94	0.03	62	0.92	0.02	58	0.83	0.17	6
2016	0.96	0.02	48	0.87	0.04	48	0.81	0.09	18

Table 3. Mean Productivity \pm SE (chicks fledged / pair)³ at Arctic, Common and Roseate Tern nests at Country Island, N.S. from 2011-2016.

Year	ARTE			COTE			ROST		
	Productivity	SE	n	Productivity	SE	n	Productivity	SE	n
2012	1.37	0.08	79	1.78	0.09	79	1.06	0.16	17
2013	1.43	0.09	46	1.59	0.10	51	1.13	0.09	16
2014	1.51	0.10	43	1.79	0.11	42	1.33	0.14	12
2015	1.30	0.10	50	1.69	0.14	45	1.60	0.10	5
2016	1.23	0.20	39	1.18	0.22	28	0.82	0.15	17

³ For ARTE, COTE and ROST chicks are considered fledged at 15 days

For all three tern species hatch success was comparable to the previous five years; productivity however, was low and may be attributed to poor weather conditions during chick rearing.

Chick feeding rates

Table 4. Feeding rates for Arctic and Common Terns at Country Island, Nova Scotia, 2016.

Arctic Tern delivery/hour/chick				Common Tern delivery/hour/chick			
Mean	SE	N (nests)	Hours	Mean	SE	N (nests)	Hours
1.07	0.10	36	569	0.71	0.06	31	391

In 2016 chick feeding rates were similar to average values based on the past five years (ARTE mean \pm SE: 0.88 \pm 0.01; COTE mean \pm SD: 0.76 \pm 0.06)

Chick diet composition

Chick diet composition was described for nests that had ten or more prey items delivered and where at least 50% of items were identified.

Table 3. Principle prey items (percent) delivered to tern chicks at Country Island in 2016.

Prey item	Arctic Tern	Common Tern
White hake	71	64
Sand lance	4	13
Atlantic herring	1	0
Invertebrates	14	6
Other fish species ⁴	2	5
Not identified	7	12
Number of nests followed	27	18

⁴ Other fish species' is a pooled category including Atlantic saury (*Scomberesox saurus*), pollock (*Pollachius* sp.), silverside (*Atheriniformes* sp.), snipefish (*Macroramphosus* sp.), mackerel (*Scomber scombrus*), redfish (*Sebastes fasciatus*), and lumpfish (*Cyclopterus lumpus*), all accounting for less than 0.6% each.

Since monitoring began in 2001, white hake has become increasingly important in chick diets with the highest proportions delivered in 2016. Proportions of other more common prey types, such as Atlantic herring and Sandlance, have subsequently diminished over time.

Predator Activities

Only one gull nest was destroyed at Country Island, belonging to a Great Black-backed Gull. A river otter was present on the island and was suspected responsible for predation events resulting in the death of 48 nesting birds including 33 Leach’s Storm Petrel, 4 adult terns (2 Arctic, 1 Common and 1 unconfirmed species – not Roseate), 7 tern chicks (Arctic and Common Tern) and 4 Black Guillemots. The crew attempted to discourage the otter from the island however no directed trapping efforts were employed. Predation events were restricted to a few occurrences.

Common Eiders

In 2016 at least 222 Common Eiders nested on Country Island. For the past four years over 200 Common Eider nests have been counted during a single census conducted the 2nd week of June.

Black Guillemots

Since tern colony restoration was initiated in 1998 the number of Black Guillemots detected during daily surveys has continued to increase from a maximum of 19 individuals in 2001 to over 400 since 2012 (2016: max count was 523 birds). Black Guillemots have been confirmed breeding at the colony however the number of nesting pairs is unknown.

Roseate Tern Banding

As part of a collaborative effort to gain a better understanding of ROST movement and survival, Canadian Wildlife Service continued to band adults and chicks with plastic field readable bands; this initiative has been ongoing since 2011. In 2016, three adult ROST and fifteen chicks were marked with red field readable bands.

North Brother Island

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

Tern Census

Ted D’Eon and four observers conducted the tern census for North Brother Island on 11 June. In total, 661 nests were counted of which 42 were Roseate Tern. Eight additional Roseate Tern nests were found over the season bringing the year-end total count to 50 pairs. Forty-seven of 50 Roseate Tern nests were located in nest shelters (26 in typical three-sided box shelters, eight in “Coquet Island-style” shelters, 12 in newly developed “shelter trap” boxes, one under salvaged plywood, one in a derelict lobster crate, and one completely in the open).

Table 1. Number of tern nests found on North Brother Island from 2012-2016

Year	COTE & ARTE	ROST
2012	633	25 (year end: 34)
2013	646	34 (year end: 38)
2014	694	37 (year end: 38)
2015	687	35 (year end: 42)
2016	619	42 (year end: 50)

Aerial tern surveys, followed by select ground counts, were conducted in Nova Scotia this year. Roseate Terns were observed on our Roseate Tern management colonies (North Brother Island and Country Island), Sable Island, and a single pair each were observed on Toby Island (Queens County) and an unnamed Island south of Cooks Island in Tor Bay (Guysborough County). North Brother Island was home to 70% of the Canadian population of Roseate Terns.

Tern Provisioning

Shawn Craik observed seven hours of food provisions to nestling Roseate Terns between 7 and 19 July. A total of 51 provisions were recorded, 41 (80%) of which were herring. Other fish species observed were sandlance (8% of all deliveries) and pollock (4% of all deliveries). Four fish were not identified.

Activities and Control Efforts

Evidence of predation was light. Three adult carcasses were discovered: a decapitated Arctic Tern and one Common Tern (no obvious signs of mortality) were found on 22 June. One dead adult Roseate Tern (C04 originally banded as an adult on Country Island in 2011) was discovered on the island on 11 July. This bird will be sent for necropsy but damage to the back was apparent and it is likely that it was struck by an avian predator.

One Great Black-backed Gull nest with three eggs was found on South Brother Island on 13 May and all eggs were destroyed. One Great Black-backed Gull nest with two eggs was found on North Brother Island on 18 May and all eggs were destroyed.

Common Eiders

Three Common Eider nests were observed on North Brother Island in 2016.

Other Notes

Winter storm damage to North Brother Island was extensive, especially on the southeast side of the island. The entire island appeared to have been over washed in at least one event (nearly all nest shelters and debris were found in the central wet depression). Large boulders were thrown up over the far southeast corner of the island, an area that was densely occupied by nesting Common Terns in 2015. We estimate that approximately ¼ of the Common Tern habitat used in 2015 was unsuitable for terns in 2016. Many nest shelters from previous years were destroyed. We salvaged what we could and also provisioned the island with 40 new “shelter trap” boxes. We were not able to place as many boxes as in 2015 (110 in 2016, 150 in 2015) due to habitat constraints and a lack of manpower.

Nest success was high in 2016. Of 46 nests with known outcomes, 80% successfully hatched at least one chick. Two nests were abandoned when strong winds blew nest shelters from the nest site and six additional nests were unhatched after 25+ days of incubation. One nest (in the open) was accidentally trampled during a nest check.

We captured 22 adult Roseate Terns; five unmarked individuals and 17 recaptures. One of these birds (1172-36262 | 2W/62) was originally banded as a chick on Great Gull Island, NY in 1998. Of note, this is the third year in a row that a double banded (with USGS and metal field readable bands) bird was encountered missing its USGS band. We’ve also had a report of a plastic field readable-banded bird (B93 banded as a chick in 2014) in Cape Cod missing its USGS band (Jeff Spindelov, pers. comm.).

Julie McKnight and Rob Ronconi (Canadian Wildlife Service) deployed PathTrack GPS archival data loggers on 12 adults from 12 nests on 16 and 17 June. We were able to recapture eight of these birds and retrieved seven tags. Data analyses are not yet started but some interesting information is already apparent. One retrieved tag, programmed to take a fix every 10 minutes throughout the day and night, captured at least one nocturnal foraging trip lasting over four hours. This foraging trip was to an entirely unexpected location (near Big Tusk Island). Numerous trips were made to locate the four “missing” tags and birds were not observed carrying them. It is likely the tags were dropped earlier than expected but we can’t confirm this.

An additional 20 individual Roseate Terns were resighted on North Brother Island in 2016 for a total of 42 “known” individual adult birds.

40 Roseate Tern chicks were banded with USGS bands and 39 of these received plastic field-readable bands as well (one chick was deemed too small). Banding trips for chicks occurred on 5 and 11 July.

Overall it was a very successful season on North Brother Island. Precipitation rates for June and July were far below normal (only 37% of the normal precipitation fell for Yarmouth according to CBC 2-Aug-2016). This, in addition to habitat changes due to winter storms, kept invasive vegetation from proliferating as in previous years. The depressed vegetation, along with hard work by staff and volunteers in late April, meant that all the Roseate Tern nest

shelters remained accessible by terns throughout the season. We believe this contributed to apparently high productivity. See www.teddeon.com/tern16.html for a full account of the tern season.

Machias Seal Island

Stefanie Collar - island supervisor; Marla Koberstein - field technician; Angelika Aleksieva-MSc. Student, McGill; Lucy Smith- MSc. Student, University of New Brunswick

There was a marked difference between the first and second halves of the breeding season this year, reflected in weather, food availability and reproductive success for seabird nesting on Machias Seal Island. Throughout June, there was little rain, and newly hatched chicks were provisioned well with a diet dominated by hake. July brought heavy rain and persistent fog, resulting in chick loss from exposure and flooding both at tern nests and in alcid burrows. In addition to the changing weather, we saw an abrupt transition in prey type and abundance brought to the colony. Chick diet became predominantly euphausiids, supplemented with insects and very small hake and stickleback. A majority of tern, razorbill and common murre chicks were close to fledging age at the time of this prey decline and were marginally affected. Atlantic puffins however have been largely unable to adequately provision their chicks, and there has been very limited chick growth (by far the lowest ever recorded), numerous tick infestations and island-wide puffling mortality.

Terns

Terns breeding on MSI had a successful season, fledging chicks for the third successive year since the colony collapse in 2006. We monitored 58 ARTE nests located throughout the core of the island, including two fenced plots. We estimate that island-wide there were ~ 175 ARTE nests. In addition to our monitored nests, about 50 nests were counted on the rocky island perimeter, many of which produced chicks. This is an encouraging sign that lethal gull control is working, and that in the future the tern colony may once again encompass the whole island. This season we re-sighted 5 prospecting ARTE, all banded at EER, PMI, MR or SINWR between 2013 and 2014, and an ARTE banded as a fledgling at MSI in 2014!

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

2010	2011	2012	2013	2014	2015	2016
175	75	50	90	187	150	175

Productivity

We monitored 58 ARTE nests this season. The first tern egg was encountered May 26, and mean lay date was June 3. There were 6 eggs depredated in early June, but then no other egg predation until mid-July. Mean hatch date was June 24, and hatching success was 0.68 (the highest since 2004 – see Table 2, below). We had a noticeable increase in abandoned eggs this season, making up about ~20 of our monitored nests. In July, wet weather and declining prey availability resulted in the loss of the majority of the ‘B’ chicks in our productivity plots. However, the remaining chicks did well, with 27 monitored nests raising 1 chick to fledge, and 3 monitored nests raising 2 chicks to fledge. The fledge success for monitored productivity nests this season was 0.55 fledge/nest (to day 15). This is lower than 2015, but still better than any other year since 2003. We estimate ~50 ARTE fledgers island wide. The ratio of COTE to ARTE this season was 94% ARTE and 6% COTE, and COTE presence was more conspicuous. We noted at least 7 active COTE nests. Five of these COTE nests were within 10 m of one observation blind, all successfully hatching chicks, and at least 1 raising a chick to fledge.

Table 2. Breeding Success of ARTE on MSI in 2004, 2005, 2014, 2015, 2016

Year	n	Clutch Size	Hatching Success	Chicks/nest alive at Day 15	Chicks/nest alive at Day 20	Fledglings/nest
2004	170	1.42 (0.50)	0.84	0.38	0.30	0.05
2005	183	1.42 (0.50)	0.57	0.03	0.02	0.01
2014	69	1.68 (0.53)	0.57	0.11	0.08	0.08
2015	51	1.69 (0.55)	0.56	0.72	0.66	0.66
2016	54	1.52 (.60)	0.68	0.55	0.46	0.44

Tern Provisioning

We completed 24 hours of COTE feeding watches on 3 nests, and 63 hours of ARTE feeding watches on 7 total nests in two separate plots. Both tern species relied heavily on hake; ARTE provisioning included krill and larval fish, while COTE diets were supplemented with herring and stickleback. Throughout July, insects, primarily moths and dragonflies, made up much of the chick diet for both species.

Table 3. Diet (% by number, not biomass) for terns on MSI

	n	Herring	Hake	Krill	Insect/Moth	Larval fish	Stickleback	Other
ARTE	277	0.4	42	32	4	9.4	3.2	9
COTE	35	9	51	0	17	0	9	14

*Does not include unidentified prey items; COTE feeds from video footage

Predator Control

Non-lethal gull control was continued this year, using paintball guns and hazing of loafing individuals. Lethal gull control was again conducted by a contracted predator control specialist on June 10. A total of 6 adults were removed, 5 HERG and 1 GBBG. All removed individuals were known nest predators, and we did not have to conduct any additional rounds of lethal gull control. Tern nests were not heavily depredated initially, as gulls seemed focused on RAZO and COMU egg depredation, but in July we estimate 8 tern chicks were depredated from productivity nests. Tern egg predation rate was 10%, down from 14% in 2014-2015.

Gull Rock, an adjacent island home to a persistent breeding colony of HERG and GBBG, was visited twice during the season, June 11 and July 5. A total of 17 gull nests, 16 HERG and 1 GBBG, were found and destroyed by shaking and poking eggs. No gull nests were found on MSI this year.

Alcids

We conducted an ATPU census June 10-11. The extrapolated findings suggest between 5400 and 6100 ATPU pairs breeding on the island, a 10% increase from 2015. Two Masters students collected samples from ATPU throughout the season for their Masters projects. Angelika Aleksieva, from McGill University, collected foot web tissue biopsies, as well as blood, from adult and chick ATPU of known ages for a study on molecular methods of age determination. Lucy Smith, from University of New Brunswick, collected feather samples from breeding adults and will use genetic analysis to look at ATPU dispersal between islands in the North Atlantic. In late June, we re-sighted 3 prospecting ATPU, all banded as fledges on Matinicus Rock between 2011- 2013. During the first part of chick rearing the majority of bill-loads were ~7 cm hake, but in July larger fish prey were replaced with euphuasiids and very small hake and stickleback, leading to severely depressed growth rates, and chick mortality throughout July and increasing into August. The linear growth rate this season was 1.8 g/day, well below the previous lows of 3.4 g/day in 2000, and 3.3 g/day in 2005. We completed 148 hours of feeding watches for ATPU this season. We successfully recovered 10 of 17 ATPU GLS tags deployed in 2015, and 1 ATPU tag deployed in 2014, which had logged 2 years of data.

We conducted a RAZO census June 9, and census results suggest about 2825 RAZO pairs breeding on MSI this season, as compared to 3290 breeding pairs in 2015. The decrease of about 14% since last year is focused on the most densely-populated area, where gull predation of eggs and chicks was high. As with ATPU, hake dominated the diet of RAZO during chick provisioning, but as hake became less abundant, RAZO chick feedings dropped precipitously. We completed just 10 fewer hours of feeding watch for RAZO this season (61 hours), but had >750 fewer prey items recorded. We observed attempted kleptoparasitism of ATPU bill-loads by RAZO throughout the season, and becoming more frequent in July. We successfully recovered 7 of 10 RAZO GLS tags deployed in 2015.

The Common murre nesting on MSI continue to increase in number and area occupied, including 22 large 'caves' and many individual burrows among the RAZO colony. We estimate 350-500 breeding pairs present this season, and ~400 chicks hatched. There was intense COMU egg depredation by gulls and ravens in May and early June, but a second wave of nesting seems to have taken place, and COMU chick fledging continued through the entire month of July. We banded 5 adult and 50 fledgling COMU this season. We completed 49 hours of feeding watches for COMU.

Table 4. Breeding Success of alcids on MSI in 2016

	Monitored Burrows	Mean Lay	Mean Hatch	Burrow Occupancy	Hatching Success (hatch/ active nest)	Nest Success (fledge/ active nest)	Linear Growth Rate (mass)
ATPU	87	May 17	June 26	0.79	0.71	N/A	1.8
RAZO	85	May 14	June 18	0.75	0.55	0.41	4.34

Table 5. Diet (% by number, not biomass) for ATPU and RAZO on MSI

	n	Herring	Hake	Euphausiid	Butterfish	Sandlance	Larval	Other
ATPU	1053	1.2	55.3	15	4.8	12.1	1.1	10.4
RAZO	339	16.5	52.8	2.9	0.3	13.3	9.4	4.7

*Does not include unidentified prey items

Table 6. Diet (% by number, not biomass) for COMU on MSI

	n	Herring	Hake	Gadoid	Butterfish	Squid	Rock Gummel	Other
COMU	175	30.3	7.4	13	14.3	19.4	13.1	2.4

*Does not include unidentified prey items

Other Species

Northern Gannets were present on MSI throughout the season, constructing nests in 2 separate locations. At least 3 pairs were seen nest building, courting and copulating on a ledge at the southwest corner of the island, though none of these nests were active. Another pair constructed a nest within 15 m of an observation blind, within the RAZO colony, and laid an egg on June 15. The pair continued to add nesting material and incubate for the next several days, but both were prone to abandon the nest unprovoked, leaving the egg unattended. Though many steps were taken to avoid disturbing the NOGA pair, the egg disappeared on June 20, and is presumed to have been depredated by a gull. This nest site was abandoned after June 20, but NOGA continued to occupy the SW edge until late July.

We had a high count of 186 adult COEI this season (126 males, 130 females), and 39 ducklings. We banded 5 female COEI this season and encountered 20 active nests on MSI and 2 active nests on Gull Rock. Ducklings were first seen during the second week of June. At least 13 ducklings have been seen in August, and we predict at least 5 of these will successfully fledge.

In June an Ancient Murrelet was photographed just offshore of MSI by a passenger on a tourist boat.

MAINE

Eastern Brothers Island

Nathan Jaenecke and Dawson Carter - Island Technicians

This was the 10th year of efforts to establish a new tern and alcid breeding colony on Eastern Brothers Island in Jonesport, Maine. The 17 acre island is currently utilized by black guillemots, common eiders, common terns, Leach's storm-petrels, razorbills, and Atlantic puffins. Due to the consistent presence of mink on Eastern Brothers Island, the Refuge has decided to discontinue restoration efforts at Eastern and Western Brothers islands in 2017. While predator control has been successful, the annual influx of mink is not sustainable for a thriving tern and alcid colony.

Black Guillemots

We observed a season high count of 229 guillemots on both islands and in the surrounding waters on July 25th with an average of 128 guillemots during our morning counts. Guillemots experienced little predation in 2016; no mink predation was observed, only two adult guillemot wing spreads were found (peregrine falcon predation), and ravens predated eggs from only one burrow. Many burrows are out of reach, but the crew found 87 burrows, with a peak of

78 active at one time and regularly checked them all. Hatch success was significantly higher than all previous years at 77.4% (total eggs hatched/total eggs, see Table 3). At the end of the season 81.1% of the burrows monitored had chicks. While many the chicks had not fledged before the crew left, laying and hatching occurred 9 days earlier than the 10 year average which allowed for a more reliable productivity estimate. Of the chicks that were still alive and healthy at the time of the crews departure, we estimate guillemots fledged 1.32 chicks per pair (N=73 nests). The minimum age of these chicks was 10 days and average age of chicks at last check was 27 days (N=93 chicks).

Table 1. Average number and high counts of black guillemot counts during morning surveys on Eastern and Western Brothers Island from 2007-2015.

Year	Daily Count Avg.	High Count and Date	Active Burrows E. Brothers	Active Burrows W. Brothers	Maximum # Breeding Pairs*	Minimum # Breeding Pairs
2007	500	725 May 31	88	10		160
2008	482	733 Jun 6	95	12		250-300
2009	410	658 May 21	111	14		200-225
2010	480	625 May 16	61	11	227	114**
2011	244	380 Jun 1	70	1	357	179**
2012	234	340 Jul 14	65	6	310	155**
2013	202	380 May 28	82	5	339	169**
2014	166	260 Aug 3	69	7	243	122**
2015	234	493 May 29	83	4	336	168**
2016	128	229 July 25	75	12	200	100**

*Average of the monthly high counts
 **Estimated by calculating half of the average monthly high count. Other estimates represent island supervisor's best judgment.

Table 2. Nesting chronology of black guillemots at Eastern Brothers Island 2007-2016

Year	First BLGU Egg	First BLGU Hatch	Avg. Lay Date*	Avg. Hatch Date	Avg. Fledge Date*
2007	8-Jun	5-Jul	13-Jun	11-Jul	13-Aug
2008	9-Jun	5-Jul	20-Jun	18-Jul	20-Aug
2009	8-Jun	5-Jul	18-Jun	16-Jul	18-Aug
2010	8-Jun	7-Jul	15-Jun	13-Jul	15-Aug
2011	25-May	16-Jul	17-Jun	14-Jul	13-Aug
2012	26-May	23-Jun	7-Jun	5-Jul	6-Aug
2013	25-May	24-Jun	19-Jun	12-Jul	14-Aug
2014	31-May	30-Jun	12-Jun	10-Jul	12-Aug
2015	31-May	2-Jul	14-Jun	11-Jul	14-Aug
2016	26-May	20-Jun	4-Jun	2-Jul	4-Aug
Average	1--Jun	1-Jul	13-Jun	11-Jul	12-Aug

*used date found or hatched to calculate avg. lay (-28 days from hatch) and fledge dates (+33days)

Table 3. Black guillemot nest fate, The Brothers Islands 2007-2015.

Year	# Nests	Hatch Success	Nest Fate (at the end of the season)				
			Chicks Alive	Nests with surviving chicks (N)	Abandoned Nests	Predated Nests	Failed

2007	88	25%	93.3% (24 of 26)	-	-	-	-	-
2008	82?	28%	90.0% (36 of 40)	30.5% (25)	42.7% (35)	2.4% (2)	6.1% (5)	18.3% (15)
2009	82	39%	85.9% (49 of 88)	-	-	-	-	-
2010	19	26%	100% (9 of 9)	-	-	-	-	-
2011	68	34.2%	94.5% (35 of 37)	30.9% (22)	11.8% (8)	27.9% (14)	0%	29.4% (20)
2012	60	54.1%	85.0% (51 of 60)	48.3% (29)	21.7% (13)	25.0% (15)	1.7% (1)	5.0% (3)
2013	63	32.1%	82.3% (28 of 34)	30.2% (19)	22.2% (14)	22.2% (14)	12.7% (8)	17.5% (11)
2014	46	39.2%	64.5% (20 of 31)	30.4% (14)	28.2% (13)	41.3% (19)	0%	0%
2015	87	57.5%	89.0% (76-86 chicks)	58.6% (51)	29.9% (26)	3.4% (3)	1.1% (1)	6.9% (6)
2016	74	77.4%	91.2% (93 of 102)	77% (57)	5.4% (4)	0%	13.5% (10)	4% (3)

Predator Control

Mink trapping was expanded from the Brothers in 2015 and 2016 to surrounding islands (Anguilla, Doubleshot, and Halifax) in an attempt to prevent them from swimming to the Brothers during the nesting season. In total, the Refuge lethally trapped 6 mink and 1 muskrat from February 23 to August 29, 2016 using snares and conibear traps. A female mink was removed from Western Brothers in late April and a muskrat in late May. The remaining mink were caught throughout the spring and summer on surrounding islands and included an adult male, female, and at least two young of the year. Bald eagles, merlins, northern harriers, and a peregrine falcon frequented the island. To deter gulls, we destroyed 15 nests on Eastern Brothers (11 HERG, 1 GBBG, and 3 species unknown) and destroyed 2 nests on “Little Brothers” (2 GBBG)

Terns

A tern sound system and 76 tern decoys were deployed on (May 4th, 2016). Although 7 COTE were residents of the island throughout the breeding season, their numbers increased to an average of 9 in mid-July with a high count of 13 on July 24rd. Three pairs of COTE nested on Eastern Brothers Island, with two pairs having three chicks successfully hatch, while one pair only had 2 out of 3 eggs hatch. Tern productivity was 2.6 chicks per pair. The chicks from every nest all fledged and were seen in flight. The dominate fish species in the four chicks diet was herring (44%) and sandlance (33%)

Atlantic Puffins and Razorbills

Refuge staff deployed over 100 alcid decoys on March 31, for a total of 63 puffins and 69 razorbills (132 decoys). Two alcid sound systems were deployed (February 23rd, 2016). Beginning mid-June, we routinely observed razorbills around Eastern and Western Brothers Islands until mid-July. Many times they were observed near the two sets of floating decoys. Atlantic puffins were a common visitor to Eastern Brothers and the waters surrounding the island, with 1-3 observed almost daily.

In the 2016 season we saw 1-3 puffins almost daily from mid-June through the beginning of August for a total of 23 sightings (32 birds). Puffins were seen perched on the island on 2 different days with an average of 1 bird/day. Razorbill sightings were much more frequent with 41 total sightings (92 birds) but were seen perched on the rocks on only 1 day (1 bird/day).

Petit Manan Island

Jill Tengeres, Island Supervisor – USFWS

Morgan O’Connor, James Welch and Shelby Fortier, Island Interns - USFWS

Census

The GOMSWG census was conducted on June 16 and 17, 2016 and 879 tern nests were counted and corrected with a 1.018% Lincoln Index to 958 tern nests. Tern census results in 2016 were 19.3% lower than 2015 (1187 nests). To calculate species ratio, we identified 467 tern nests to species, 51% of all tern nests on the island. In 2016, the colony consisted of 61% Common Terns and 39% Arctic Terns. We estimate of 574 Common Tern nests and 384 Arctic Tern pairs nested on PMI in 2016. Pairs were calculated by applying the species ratio to the corrected nest count and adding this to productivity plot nests (with known species). No Roseate pairs nested this year. Additionally, 60 Common Eider nests and 543 (7.5% correction factor) Laughing gull nests were counted during the census.

Table 1. Number of tern nests found on Petit Manan Island from 2007-2016

Year	COTE	ROST	ARTE	LETE
2007	1343	5	1038	0
2008	1307	4	1255	0
2009	1374	4	1268	0
2010	912	2	688	0
2011	1138	0	558	0
2012	1186	2	758	0
2013	817	2	616	0
2014	670	0	533	0
2015	706	0	481	0
2016	574	0	384	0

Tern Productivity

Reproductive success for both tern species was lower than last season; overall numbers are continuing to decline. Common tern productivity was 1.04 chicks fledged per nest and Arctic tern productivity was 0.71 chicks fledged per nest. Food availability appeared to be an issue for the terns this season. The weather was mild, with no major storms occurring during the entirety of the season.

Table 2. Breeding parameters for seabirds nesting on Petit Manan Island in 2016.

Petit Manan Island										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
COTE										
# of Nests	1343	1307	1374	912	1138	1186	817	670	706	574
Mean Clutch Size	1.70	1.83	1.93	1.7	1.72	1.90	1.77	1.94	2.09	2.04
Mean Hatch Success	64.8%	85.3%	85%	47.9%	72.3%	78.8%	62%	61.4%	85.1%	92.7%
Mean Fledge Success	76.7%	71.6%	56%	31.0%	36.1%	65.1%	48%	45.2%	68.4%	54.9%
Mean Chicks Fledged/Nest	0.76	1.12	0.90	0.43	0.40	0.98	0.51	0.54	1.22	1.04
ARTE										
# of Nests	1038	1255	1268	688	558	758	616	533	481	384
Mean Clutch Size	1.53	1.55	1.68	1.6	1.46	1.73	1.49	1.70	1.87	1.53
Mean Hatch Success	51.9%	75.3%	78%	21.6%	56.8%	73.7%	66%	30.9%	81.7%	71.4%
Mean Fledge Success	62.8%	81.3%	54%	20%	24.5%	70%	30%	63.3%	62.1%	64.4%
Mean Chicks Fledged/Nest	0.45	0.95	0.70	0.21	0.22	0.89	0.35	0.33	0.94	0.71
ROST										
# of Nests	5	4	4	2	0	2	2	0	0	0
Mean Chicks Fledged/Nest	0.20	1.00	0.20	0.00	0	0.25	0	0	0	0
LAGU nests*	1350	1363	1171	270	735	811	750	560	620	543
ATPU nests	53	93	104	88	46	63	47	73	77	55
COEI nests	49	105	101	56	35	67	55	54	62	60

*7.5 % correction factor applied to LAGU nest counts

Arctic Tern Metapopulation Project

As part of the Arctic Tern metapopulation project we re-sighted 114 adult Arctic Terns. Additionally, we banded 20 new adults, 181 chicks, and recaptured 17 Arctic Tern adults.

Tern and Puffin Provisioning

We conducted provisioning observations for 27 Common Tern nests and 14 Arctic Tern nests for a total of 920.6 hours and observed 1,525 prey deliveries. Various species of invertebrates were the primary prey delivered to Arctic

Tern chicks (49.41%) while hake was the primary prey items of Common Tern chicks (31.06%). On average, Common Tern adults delivered 1.01 prey items per nest per hour while Arctic Tern nests delivered 2.78 items per nest per hour.

This season we continued the puffin provisioning study initiated last season. Unfortunately we did not have the ideal camera needed for capturing a high quality picture to identify the fish being brought back for chicks. This limited the amount of useful data we were able to collect. In total, the crew spent 80.7 hours in blinds observing 60 prey deliveries. Hake made up the majority (39.3%) of prey items fed to puffin chicks, however our sample size was small and a lot of feedings consisted of unidentified bill loads.

Table 3. Principal prey items (percent) in tern and puffin chick diet on Petit Manan Island in 2016.

2016	ARTE	COTE	ATPU
Bluefish	0.11	0.51	--
Butterfish	0.64	0.34	--
Smelt	--	0.85	--
Cunner	--	0.17	--
Haddock	--	--	11.48
Hake	15.44	31.06	39.34
Atl. Herring	2.56	14.51	3.28
Invert*	49.41	21.67	--
Larval Fish	18.21	1.37	--
Lumpfish	6.82	4.10	--
Pollock	0.21	2.56	--
Plant Material	--	1.02	--
Sand lance	0.64	9.39	4.92
Stickleback	3.19	3.75	--
Snipefish	0.11	0.17	--
Unknown Fish	1.81	8.36	16.39
Unknown	0.85	0.17	24.59

Predator Control

Peregrine Falcons were the most frequent non-gull visitors to the colony throughout the season. During the field season we discouraged the Peregrine Falcons and other avian predators from perching on the island using bird deterrents. In July the Peregrine Falcon became a recurring predator preying mostly on tern fledglings, coming multiple times per day. We found the remains of 6 tern adults and fledglings that were taken by the Peregrine, but the actual number taken is significantly higher. One specialist Great Black-back Gull preyed opportunistically on tern chicks, eating young and fledgling chicks, often without landing. At his nest site on adjacent Green Island we discovered the remains of at least 25 tern fledglings, two black guillemot chicks, one common eider duckling, and the skull of an adult puffin. Bald Eagles were a regular visitor to the island but mainly preyed on the Laughing gull colony. During the census, we oiled the eggs of 404 Laughing Gull nests and destroyed 64 Laughing Gull nests. Lethal removal of avian predators thought to be tern or kleptoparasitism specialists also occurred and included: 9 adult Laughing Gulls, 1 Herring Gulls and 3 Great Black-back Gulls. On June 13th a Herring Gull with a broken wing as well as a Great Black-back Gull with a lame wing were removed. In addition, we performed 20 hours of night stints from 1 June to 22 June to observe predator activity at night during tern hatch. No owls or mammalian predators were observed this season on Petit Manan.

Alcids

The highest alcid counts for the season were 149 Atlantic Puffins (21 May), 35 Razorbills (3 June), 8 Common Murres (9 July) and 311 Black Guillemots (20 May). We estimated the breeding population of Atlantic Puffins to be at least 55 pairs based on the number of active burrows (i.e. burrows with either an adult, egg or a chick). This estimate is lower than 2015 (77 burrows), which may be related to warmer waters in the Gulf of Maine this summer. Colony-wide puffin hatch success was 78.%, fledge success in selected productivity burrows was 47.6% and number

of fledged birds/nest was 0.48. We documented 3 active Razorbill burrows in 2016 which produced 2 chicks, only one which we are confident reached fledging. 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 94 burrows, a slight increase from last year's 88 burrows. We monitored a subset of the Black Guillemot population (29 nests) for productivity—weighing and measuring wing cord of chicks every 5 days. For these birds, average clutch size was 1.97, average hatch success was 1.31, and average number of chicks per pair was 1.14.

In addition to daily counts and productivity monitoring, we spent time reading Alcid bands. We re-sighted 93 individual Atlantic Puffins and 2 Razorbills this field season. As well as re-sighting, we recaptured adult puffins by grubbing burrows and setting box and noose traps. We banded 29 puffins this season (9 adults and 20 chicks), and recaptured 7 adults. We banded one Razorbill adult and chick. Finally, we banded 105 Black Guillemots (11 adults and 94 chicks) and recaptured 11 adults.

Other Research

This season we initiated a more thorough protocol for monitoring Leach's storm-petrel productivity. In the past seasons, very little has been done to determine the number of storm-petrels breeding on the island. We conducted three sweeps of the island, during the last week of May, June and July. A recording of the chatter call of storm-petrels was played at the entrance of each burrow, in an attempt to elicit a response from an adult. All burrows we also grubbed to assess the contents. During the June sweep, 43% of active burrows contained an adult storm-petrel respond to playback. There were many burrows where we could not physically reach the nest cavity of the burrow, but playback enabled us to know the burrow was active. At the end of the season, we documented 23 burrows containing chicks, 10 burrows with eggs, and 14 ungrubbable burrows containing at least an adult. We banded 16 adults and 11 chicks.

Ship Island

Meredith Miles – Island Supervisor

Kelby Leary – Island Technician

Census

Ship Island was monitored by a two-person crew from May 12-July 26, 2016. During the GOMSWG census on June 15, we counted 664 common tern nests for a total of 684 nests after applying a Lincoln Index of 1.03.

	Ship Island					
Common Terns	2011	2012	2013	2014	2015	2016
# of Active Nests	105	251	436	405	680	684
Mean Clutch Size	2.16	2.20	2.44	2.26	2.16	2.35
Mean Hatch Success	55.6%	57.1%	72.5%	81%	72.3%	85.6%
Mean Fledge Success	24.9%	63.9%	46.4%	72.8%	87.7%	55.4%
Chicks Fledged/Nest	0.53	0.82	0.80	1.44	1.45	1.32

Nesting and Productivity

The first nest was observed on May 24 and terns were continuing to copulate as of July 18. New nests were found throughout the season. Fair weather coincided with the majority of the hatching and critical rearing stages, allowing chicks to have an excellent start. However, the arrival of a great-horned owl in the colony on July 10 (two weeks after the initial sighting) prompted partial abandonment of the colony by adults rearing older chicks, and many chicks and fledglings were left starving. This may have also coincided with limited tern prey availability in the region. The owl visited the colony at least three nights and was captured and relocated on July 20. Following removal of the owl, some adult terns did return and resumed chick feeding. Several chicks were found covered in ants, and bites appeared to cause eye and joint inflammation. Healthy chicks recovered and were able to avoid ants

as they became more mobile. Ants caused the death of at least one chick during pipping and likely one young chick, age 0-3days. Ant samples were sent to Amy Arnett, Unity College for identification.

Tern Provisioning

We observed 45 common tern nests for a total of 57.4 hours, during which we observed 738 feedings. Provisioning effort was lower than usual this year, because the crew shifted blind stint efforts to midnight owl watches in July. A high rate of nest visibility turnover also resulted in a high number of nests observed. Average feeding rate was 1.19 feedings per hour. Atlantic Herring composed 77.2% of the feedings, hake 6.6%, larval fish 5.2%, sandlance 4.6%, pollock 1.1%, and 3% unknown. Few invertebrates and stickleback, and no butterflyfish were observed this year.

Diet Item	% of COTE Diet					
	2011	2012	2013	2014	2015	2016
Atlantic Herring	24.4	79.4	45.6	60.8	53.1	77.2
Sandlance	17.3	0.9	20.9	1.0	21.4	4.6
Crustaceans	--	--	10.5	--	0.9	1.1
Pollock	18.1	--	4.3	10.0	4.1	1.1
Invertebrates	1.7	1.6	5.7	0.7	0.7	0.7
Butterfish	0.4	--	1.7	--	--	--
Stickleback	10.7	0.2	1.5	--	0.5	0.3
Hake	--	--	1.1	6.6	2.5	6.6
Unknown	20.5	7.2	--	1.0	16.3	3.1
Other						

Predator Control

The most significant predators observed during the 2016 season were peregrine falcons, great-horned owl, great black-backed gull, and bald eagle. Falcon activity on Ship Island increased on 2016, with 28 successful attempts observed and evidence of at least 3 falcon kills outside of the observed successful attempts. Despite the peregrine falcon visitation, their presence did not seem to disrupt the overall stability of the colony. Gulls were seldom observed flying low or landing in the colony, and only once was predation of a chick observed. A great-horned owl visited the colony on three separate nights (June 23, July 10, and July 19), killing mostly fledglings, and was trapped and relocated to LaGrange, ME, about 80 miles North of Ship.

Species	Minimum # of Visits	Minimum # Terns Taken
Peregrine Falcon	44	32
Merlin	6	0
Sharp-shinned Hawk	1	0
Bald Eagle	24	0
Great Black-backed Gull	2	1
Great-horned Owl	3	6

Mink traps were set early in the season with an average of 15.14 traps maintained throughout the season, but no definitive signs of mink were observed. Gulls were deterred from loafing on any part of the island. Two herring gulls were shot in the early season. Trapping began in early April and included nearby Bar Island where two raccoon were removed and mink sign was observed.

Habitat Management

The Refuge created new tern nesting habitat in the spring of 2016 by moving 76 cubic yards of sand and gravel from the intertidal zone to the island's interior. Six inches of material was placed on top of landscape fabric. Terns primarily nest on a narrow sandy beach where they are vulnerable to high tides and storms. Gravel areas were installed in 2014 (283m²) and 2016 (425m²) to immediately provide safe and suitable habitat. Though numbers are lower than expected, a total of 70 common tern pairs nested in gravel areas and densities are increasing each year in older plots. Despite weeding in May and June, lambsquarters, ragweed, and black bindweed became abundant in gravel plots during chick rearing in July. These annuals can't be controlled using herbicide when terns are present, so plants, so plots were hand-pulled at the end of the nesting season. Either tall vegetation or owl presence caused the abandonment of 24 tern nests in the gravel areas.

In other areas, we burned 4.9 acres this spring, treated thistle, raspberry, and cow parsnip with herbicide, and continue to battle invasive garlic mustard and garden valerian. The Refuge is considering using sheep and a rotational grazing strategy to control vegetation.

Metinic Island

Mark Baran (Island Supervisor)

Helen Manning (Technician)

Common and Arctic Tern Census Results

The Metinic Island GOMSWG census was conducted on June 16, 2016. A total of 550 tern nests were found. A Lincoln Index Correction Factor of 1.008 was applied to the raw count resulting in a total of 554 pairs. After adding nests in productivity plots, we estimate 607 tern pairs were actively nesting during the 2016 GOMSWG census. To determine species ratio, 152 nests were flagged based on the incubating adult. The species ratio was found to be 48.7% Common Terns and 51.3% Arctic Terns. After applying the ratio to the corrected tern census total and adding productivity plot nests, we estimate 290 common tern and 317 arctic tern pairs nested on Metinic in 2016.

Metinic Island					
	2012	2013	2014	2015	2016
COTE					
# of Nests	0	209	214	343	290
Mean Clutch Size	0	2.8	2.67	2.26	2.43
Mean Hatch Success	0	78.6%	84.5%	77.36%	88.24%
Mean Fledge Success	0	27.1%	78.51%	85.37%	42.22%
Chicks fledged/Pair	0	0.76	1.68	1.52	0.90

ARTE					
# of Nests	0	142	257	260	317
Mean Clutch Size	0	2.1	1.90	1.94	1.89
Mean Hatch Success	0	89.5%	89.8%	94.74%	89.39%
Mean Fledge Success	0	52.4%	81.1%	86.11%	44.07%
Chicks fledged/Pair	0	1.1	1.39	1.63	0.74

ROST					
# of Nests	0	0	0	0	0
Chicks fledged/Pair	-	-	-	-	-

Provisioning

Six arctic tern and nine common tern nests were followed for provisioning studies. 151 feedings occurred during 45 hours of watches for common terns (0.86 feedings/hour per nest), and 448 feedings occurred during 45 hours of

arctic tern watches (1.15 feedings/hour per nest). The primary prey item for both species was hake, which made up 51% of common tern and 44% of arctic tern diets. Small unknown invertebrates (likely amphipods or isopods) were the second most abundant prey item for arctic terns.

	Total Nests	Feedings/ Hour	Herring	Hake	Sandlance	Pollock	Butterfish	Other & Unknown
COTE	9	0.89	7.95%	50.99%	3.31%	5.30%	8.61%	23.84%
ARTE	6	1.82	1.34%	43.53%	0.45%	0.22%	2.01%	52.46%

Predators

- Gull predation was the greatest threat to tern eggs and chicks. At least three nests with eggs were depredated before the census and several large chicks were taken by both great black-backed and herring gulls. Laughing gulls were observed kleptoparasiting terns on several occasions. One herring gull with a broken wing was dispatched and two laughing gulls were shot.
- Peregrine falcons are known to have taken at least four adult terns. They are not believed to be residents on the island.
- Thirteen garter snakes were removed from the island this year. They have been observed preying upon small chicks in prior years.
- Several crows and ravens were seen near the colony periodically, but were never observed in the colony and were typically chased away when they approached.
- A pair of bald eagles nested on the island and an immature eagle was seen throughout the latter part of the season. None of the eagles were seen pursuing terns.

Black Guillemots

We monitored 12 guillemot burrows and recorded a hatching success of 70%. Fledging rates are estimated to be 0.7 chicks/nest based on the number of chicks present at their last weighing. 26 chicks were banded, including 14 in productivity burrows. 7 adults were also banded.

Leach's Storm Petrels

We were able to locate at least 11 active Leach's storm-petrel burrows towards the end of the season. The burrows were not accessible enough to be checked for productivity.

Common Eider

We found the first eider eggs on May 18 and the first eider ducklings were observed on May 22. The high count was 57 ducklings in one crèche on June 9, which was also the largest combined hen and duckling count with 32 hens observed. Crèches containing large ducklings continued to be seen through the end of the field season in late July.

Incidental Sightings

A total of 97 live bird species were identified on Metinic Island in 2016, including 18 shorebird species and numerous migrant songbirds. An additional two species (Common Gallinule and Northern Fulmar) were found dead on the island. Several tern fledglings were found buried in the dirt by burying beetles in late July. One carcass was collected for observation. White larvae nearly an inch long were found within one week, and a fully developed adult was collected for identification.

Sheep

Sheep are allowed to graze entire north end of Metinic outside of the nesting season, but are herded south of an electric fence for the duration of the breeding season. Sixteen sheep remained north of the fence throughout the season and were often present on the tern colony, despite repeated harassment efforts. Egg loss to trampling is believed to have been minimal.

Geocator and Three-Adult Nest

We successfully recaptured an arctic tern equipped with a geocator deployed in 2010. The data is being recovered to be analyzed. The two egg nest appeared to be attended by three adults: the geocator bird, an unbanded bird, and a field readable banded bird.

Seal Island National Wildlife Refuge, Maine

Keenan Yakola & Isabel Brofsky Island Supervisors – National Audubon Society Seabird Restoration Program

Tern Census

A partial tern census was conducted on June 14, where 14 of the 30 census grid squares were surveyed, as in the 2009-2015 censuses, due to safety concerns on the island. The censused area has been determined to represent, on average, 57% of the total nest number of the colony over the last eleven years in which a complete census was performed (1996-2006). The extrapolated total was 2,234 nests on Seal Island (after a Lincoln Index of 1.038 was applied). On June 15, the species ratio of the colony was determined by marking a 16 meter radius around nine blinds and identifying as many nests to species as possible within each circle. With this, in addition to the composition of four productivity plots on the island, the species ratio was estimated at 42% Arctic Terns and 58% Common Terns (n=572). These data suggest that the colony was similar in size and composition as the 2015 season

(Table 1). **Table 1. Adjusted number of tern nests found on Seal Island from 2012-2016.**

Year	COTE	ARTE
2012	1,837	959
2013	1,448	1,039
2014	1,383	855
2015	1,345	902
2016	1,295	939

Tern Productivity

The average clutch size for both Common and Arctic Terns increased from 2015. However, even considering the increase in average clutch size, mean productivity was one of the least successful years for Common Terns to date (Table 2). Roseate Terns were observed performing courtship displays and exploring possible nesting sites at the end of June and beginning of July, but no nesting attempts were made.

Table 2. Tern productivity on Seal Island in 2016. Data for 2015 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.06(1.78)	1.82(1.55)	0.52(1.17)	72(64)
ARTE	1.82(1.73)	1.62(1.35)	0.79(1.08)	34(37)

Tern Provisioning

12 Arctic Tern nests were observed for 498 cumulative hours. The average feeding rate was 1.67 feedings per nest per hour. 14 Common Tern nests were observed for 531 cumulative hours and the average feeding rate was 1.10 feedings per nest per hour. The primary prey items in the diets of both Arctic and Common Tern chicks were white hake and euphausiid (Table 3). During the month of June as well as the beginning of July many euphausiid feeding frenzies were observed around the island.

Table 3. Principal prey items (percent of diet) in tern chick diet on Seal Island in 2016.

Total number of prey items observed n=833 for ARTE and n=585 for COTE.

Prey item	ARTE	COTE
Hake	33.49	41.20
Euphausiid	34.57	30.26
Amphipod	5.52	2.10
Butterfish	2.16	2.56
Stickleback	2.64	2.22

Predator Activities and Control Efforts

Gull predation was a threat to the tern colony in 2016. A few individuals began to regularly enter the colony after tern hatching began. After fledging began, Herring and Great Black-backed Gulls were observed in the colony almost every day taking tern chicks. Efforts to remove predatory gulls were unsuccessful. Gull control efforts also included poking eggs in all gull nests found in accessible areas of the island (Table 4). The first gull nest census/control effort showed an increase in both Herring Gull and Great Black-backed Gull nests compared to 2015. Overall, 81 GBBG eggs from 32 nests and 540 HERG eggs from 203 nests were destroyed. Laughing Gulls were observed daily and at least one pair attempted to nest in the Area 4 meadow, but the majority arrived around the beginning of July, perhaps too late to attempt breeding. The season high count of 116 occurred on July 27. LAGU were observed occasionally kleptoparasitizing terns and puffins throughout the season. In addition, terns, razorbills, and guillemots were observed attempting to kleptoparasitize Atlantic Puffins in July and August. Other predators included Peregrine Falcons, Merlins, and Bald Eagles, which were largely observed in the colony towards the end of the season.

Table 4. Gull control measures by species on Seal Island in 2016.

Species	# Nests destroyed	# Shot
Herring Gull	203	0
Great Black-backed Gull	32	0
Laughing Gull	1	0

Atlantic Puffin

While hatching success in 2016 was relatively high at 0.88 chicks hatched/nest, productivity was well below average at 0.57 chicks fledged/nest (Table 5). Additionally, many chicks were significantly underweight and likely starved soon after fledging. It was not unusual for a 40+ day old puffling to weigh less than 200 grams. Many chicks were still being fed through much of August and were growing relatively slowly. In fact, some chicks remained in their burrows for over 60 days. An extrapolated census of breeding pairs was performed by determining the activity at burrows in 15 circular plots within the main colony and at all burrows outside of the main colony. From observations of incubating adults, eggs, chicks, and feedings, it is estimated that there were a minimum of 510 active burrows this year. One of the six adults deployed with geolocators in 2014 was recaptured this season.

Table 5. Atlantic Puffin hatch success and productivity on Seal Island from 2012-2016.

	# Burrows monitored	Hatch Success	Productivity
2012	78	0.74	0.31
2013	69	0.55	0.09
2014	71	0.83	0.75
2015	62	0.94	0.81
2016	67	0.88	0.57

Puffin chick diet was monitored for approximately 70 hours throughout the season. The dominant prey species this season was white hake at 76% of the diet (Table 6). Most hake were observed in full bill loads and were relatively small, around one bill length. Haddock, *Sebastes* sp., and euphausiid were the next most common food items. Most of the haddock observed in puffin feedings were relatively large, around 2-3 bill lengths.

Table 6. Principal prey items in Atlantic Puffin chick diet on Seal Island in 2016. Total prey items n=1,412

Prey item	% of diet
White hake	76.56
Haddock	5.45
Sebastes sp.	5.45
Euphausiid	4.67
Stickleback	2.83

Black Guillemot

Productivity was monitored at 34 burrows. Mean clutch size was 1.85, hatch success was 1.46 chicks hatched/nest and productivity was 0.74 chicks fledged/nest, which is near average for recent years. On June 28, a raccoon was observed in close proximity to some monitored BLGU burrows, and it is likely that four monitored burrows lost eggs or chicks to the raccoon. The season high count was 1,189 individuals.

Razorbill

An expanding colony of Razorbills is present on Seal Island. A high count of 103 individuals was observed this season compared to 102 individuals in 2015. A total of 26 active Razorbill burrows were located on the island, however, it is likely many went undetected (32 active burrows were located in 2015). An increase of burrows amongst the puffins in Area 1 was observed this year with at least 7 active burrows.

Common Eider

On May 31, 106 Common Eider nests were counted in the areas censused for gulls, though there are likely many more nests. Common Eider nest across the island and a large portion nest in high grasses where there is potential unexploded ordinance. Many large crèches were observed throughout the season. Predation from gulls was high, however many older chicks were observed into the beginning of August.

Cormorants

Both Great and Double-crested Cormorants nest on the western head of Seal Island. Visual estimates of the colony in May confirmed 23 Great Cormorant nests and at least 9 Double-crested Cormorant nests. The field crew attempted to walk the length of the island to the Area 4/5 boundary to deter lurking Eagles away from the colony on a regular basis. Eagles were observed on 4 days throughout the field season. When observed they were pursued until they had left the island. On July 28, 37 Great Cormorant chicks were counted with John Drury via boat.

Northern Gannet

A single Northern Gannet was observed landing on the Northeast Point of the island on the several days during the end of July. In addition, on August 7, an adult gannet was observed preening and loafing with the cormorant colony in Area 5. On August 9, presumably the same adult was observed loafing with cormorants on the east side of Area 3.

Bird Sightings

A regular season, record-breaking, 157 bird species were observed on Seal Island from the beginning of May to the beginning of August. Highlights included Maine's first state records of both Ancient Murrelet and Great Knot, Upland Sandpiper, Turkey Vulture, Hooded Warbler, Olive-sided Flycatcher, King Eider, Royal Tern, and good numbers of Cory's Shearwaters. In addition, the resident Red-billed Tropicbird was seen again this year, for the twelfth year since first being observed on the island in 2005. For the second year in a row there were no recorded jaegers of any kind.

Matinicus Rock, Maine

Jess Steketee Island Supervisor – National Audubon Society Seabird Restoration Program

Tern and Laughing Gull Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on 15 and 16 June. A total of 694 Common Tern and Arctic Tern nests were counted, with clutches ranging between 1 and 5. A Lincoln index mark/recapture correction of 1.023 was applied to the uncorrected count, yielding 710 total nests. The addition of tern productivity and feeding plots yielded a total of 788 nests on the island. A direct count of Common Tern nests yielded 167 nests, including productivity and feeding plots. These nests were subtracted from the total corrected count leaving 621 Arctic Tern nests. We counted 30 Laughing Gull nests this year, an increase from last year although still very low for the island.

Table 1. GOMSWG census results on Matinicus Rock, 2009-2015.

Year	ARTE	COTE	LAGU
2009	1,278	359	1,161
2010	674	253	958
2011	859	258	778
2012	711	268	557
2013	519	171	579
2014	564	223	689
2015	808	206	0
2016	621	167	30

Tern Productivity

Arctic Terns fledged 0.88 young per nest. Mean clutch was 1.90 for 42 nests. This is the highest mean clutch since 2002, and while the productivity was lower than the past 2 years it was still relatively high for the island. Common Terns fledged 1.03 young per nest, which while lower than in the previous 4 years, was still high for the island.

Mean clutch was 2.66 for 29 nests. The COTE mean clutch was the highest since the study began in 2002.

Table 2. Tern productivity on Matinicus Rock in 2016. Data for 2015 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
ARTE	1.90 (1.68)	1.57 (1.38)	0.88 (0.19)	42 (47)
COTE	2.66 (1.79)	2.34 (1.5)	1.03 (1.32)	29 (28)

Tern Provisioning

The most common food item in the Arctic Tern chick diet was white hake at 59.2%, and amphipods at 9.33% of their total diet. The average feeding rate per nest was 1.25 feeds per hour, which was lower, than last year's feeding rate of 1.32. The most common food item in the Common Tern chick diet was also white hake, which constituted 52% of the diet, followed by butterfish at 13.41% and pollock at 2.13%. Amphipods were the most common invertebrate and comprised 2.13% of Common Terns diet. The average COTE feeding rate was 1.18 deliveries per hour which was also lower than last year's 1.5 feeding rate.

Predator Activities and Control Efforts

A Peregrine Falcon was seen on 11 days from 13 May until 5 August, and Merlins were observed on 16 days throughout the summer. Both were seen eating adult terns at least once during the summer. We also found several

piles of feathers from tern fledglings that were presumably eaten, but this did not seem to have a large effect on the tern colony overall.

Predation of tern chicks by gulls as well as kleptoparasitism was observed on several occasions this year. No large gulls were found nesting on the island this year. While Laughing Gulls were not observed taking tern eggs or chicks (in fact no productivity plot eggs went missing before the hatching period), kleptoparasitism from Laughing Gulls was seen on several occasions late in the season. Only a handful of Laughing Gulls nested near the terns and those nests were destroyed soon after laying. During census, 30 Laughing Gull nests were found and destroyed. After the census a total of 44 Laughing Gull nests were found and destroyed, for a total of 74 nests destroyed over the entire season. 21 adult Laughing Gulls were shot from 21 May to 14 July. One juvenile Great Black-backed Gull was shot and no Herring Gulls were shot.

A conspiracy of ravens was seen in Area III on a total of 36 days between 12 May and 7 August. Throughout the season we found many cached RAZO eggs as well as old shells throughout the island, including on the southern side in the tern colony. If the ravens came out of Area III (where most Razorbills nest) we made an effort to scare them away from the island, however they more often remained in the Razorbill area and nothing was done to deter them because of Razorbill disturbance concerns. In early June a dead raven was displayed in the RAZO area but did not appear to have much effect. In addition to the Common Ravens, many large gulls were seen walking around in the Razorbill area after the hatching period.

Atlantic Puffins

Puffin hatch success was 0.79 hatched per nest (n= 81) and productivity was 0.75 chicks fledged per nest (n=64; the productivity study is still ongoing and numbers are subject to change). Puffin bill loads delivered to chicks in 2016 consisted mostly of redfish (42.63%), hake (35.17%), haddock (9.43%) butterfish (4.72%), and sand lance (1.96%). No herring were observed during puffin feeding studies, or anecdotally noted in puffin diet, throughout the summer.

Razorbills

Razorbill hatch success was 0.75 (n = 61), and productivity was 0.48 chicks fledged per nest (n = 46). The first Razorbill chick was seen on 9 June. Razorbill chick diet consisted of white hake (31.59%), butterfish (29.56%), herring (13.68%), sand lance (6.93%), and pollock (3.04%).

Black Guillemots

Mean clutch size was 1.74 (n=46) and productivity was 0.68 chicks fledged per nest (n=46). This study is also still ongoing and numbers are subject to change.

Common Murres

The high count for Common Murres in 2016 was 41. This year, the decoys and sound system were not put in place for the first time since 1992 (although the sound system has not worked properly in several years). On only one occasion on 1 July, a COMU was seen carrying fish in Area III compared to three occasions in 2015. In 2016, for the first time since 2009, two COMU eggs were found, both in Area III. On 1 June the first egg was discovered in Area III, however on 2 June it was found rolled and cracked. On 4 July a second COMU egg was discovered nearby in a Razorbill burrow a few feet from the original rolled egg. One adult was seen under rocks near the egg, and vocalizations were also heard from the area. On 7 July the second COMU egg was missing, and days later the broken shell was found 15 feet away from nest area in the open.

Leach's Storm Petrels

Hatching success was 0.72 (n=58).

Manx Shearwaters

Manx Shearwaters were seen on the water regularly throughout the season in groups of as many as 10, and were heard calling from the northwest, west central, and southwest areas of the island. We banded two large, fat, and

happy chicks from the original burrow near the cannon wheel on the Sunset Strip and from the area below Texas blind. We also pulled out two adults from separate burrows in the area below Texas that did not contain chicks or eggs. A third chick was heard and felt, but we were unable to remove it from its burrow.

Unusual Fish

On 16 August, a Common Tern was photographed carrying a black ruff to its chick at Eom’s feeding study. The fish was not fed to the chick because the chick was too small.

Notable Birds

We saw two male Bobolink on 14 May, a Cattle Egret on 18 May, a Mourning Warbler on 28-30 May, and a Yellow Crowned Night Heron on 31 July through 2 August.

Eastern Egg Rock, Maine

Kelsey Navarre, Island Supervisor – National Audubon Society Seabird Restoration Program

Census

Arctic and Roseate Tern nests were identified between May 31 and June 18, with Roseate Terns increasing from 77 nests in 2015 to 78 nests and Arctic Terns increasing from 75 to 76 nests. No B-wave Roseate Tern nest were located after the census period. An island-wide Common Tern and Laughing Gull nest count was conducted from June 12 to June 14. Common Tern numbers were slightly down from 2015. During census, 746 common tern nests were counted. The addition of the productivity nests, feeding nests and a Lincoln index of 1.0542 brought the total to 852 nests. The number of Laughing Gull nests remained high, at 1769 nests, which is 174 less nest than the 2015 season.

Table 1. GOMSWG census results on Eastern Egg Rock, 2010-2016.

Year	COTE	ARTE	ROST	LAGU
2010	714	83	82	1553
2011	829	77	90	2051
2012	817	57	71	2065
2013	831	68	83	2083
2014	698	62	65	1934
2015	894	75	77	1943
2016	852	76	78	1769

Larid Productivity

Common Tern productivity was calculated from 62 nests in both fenced productivity plots and unfenced feeding study plots. Productivity was 1.22 chicks fledged per nest. Arctic and Roseate Tern productivity was calculated from unfenced nests. Roseate Terns fledged 1.24 chicks per nest and Arctic Terns fledged 0.62 chicks per nest. Productivity of Arctic Terns was affected heavily by flooding after large rain events. Productivity of Laughing Gulls was not determined on Eastern Egg Rock this season.

Table 2. Tern productivity on Eastern Egg Rock in 2016.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.44	2.10	1.22	62
ARTE	1.91	1.66	0.62	35
ROST	1.88	1.48	1.24	73

Tern Provisioning

Fifteen Common Tern nests were observed over a total of 618 hours with an average feed rate of 0.95 feedings per hour. Hake was the most frequently fed prey item, comprising 43.9% of feedings, followed by unknown fish at 11.6% and herring at 7.4%. Seven Arctic Tern nests were observed for a total of 281 hours with an average feed rate of 1.10; hake were the most frequently fed item comprising 39.1% of diet followed by amphipods at 19.2% and Euphasiid at 11.7%. Six Roseate Tern nests were observed over 295 hours, averaging 2.19 feedings per hour; Hake was the most frequently fed item at 51.9%, followed by unknown fish at 14.2%, and Herring at 10.2%.

Table 3. Principal prey items (percent) in tern chick diet on Eastern Egg Rock in 2016.

Prey item	COTE	ARTE	ROST
Herring	7	3	10
Hake	49	39	52
Unknown Fish	12	4	14
Hake or Herring	7	8	13
Invertebrates	13	35	0

Atlantic Puffins

This year there was a minimum of 150 active puffin burrows on the island, which is the same number of active burrows as in 2015. The fledging success was not estimated for Atlantic Puffins this summer. Redfish comprised the majority of puffin diet at 49.7%. This species was never observed in 2015. Hake was second most prevalent prey species at 34.1% and Hake or Herring at 3.9% and Haddock at 3.7%. Butterfish was also present, but in a much lower percentage than 2015 at 1.9% of the diet.

Table 4. Active burrow count and fledge success for Atlantic Puffins on Eastern Egg Rock, 2010-2016.

ATPU	2010	2011	2012	2013	2014	2015	2016
Active Burrows	123	123	104	112	148	150	150
Fledge success*	0.86	0.92	0.74	0.91	0.94	0.92	-

*estimated using the 21-day feeding method

Predator Activities and Control Efforts

Herring and Great Black-backed Gulls were the predominant tern predators, though neither species attempted to nest. Two Herring Gulls were shot over the course of the season and one with a broken wing was removed by cervical dislocation. No Great Black-backed Gulls were shot as they only took chicks on foggy days. Four Laughing Gulls were shot in the early season in attempts to deter nesting, a procedure which was successful on Matinicus Rock in 2015. However, our removal did not deter nesting. We expect more individuals need to be removed earlier in the season to be successful at deterring nesting. All Laughing Gull eggs were oiled during census to prevent hatching. In addition, a buffer zone was maintained within 10 meters of tern habitat in which all Laughing Gull nests were destroyed periodically throughout laying. During the week prior to census 204 Laughing Gull nests were destroyed in the buffer zone. Laughing Gulls still appeared to be a source of predation on Arctic and Common Tern eggs and young chicks.

Table 5. Gull control measures at Eastern Egg Rock in 2016.

	GBBG	HERG	LAGU
Gulls Shot	0	2	4
Nests Destroyed	0	0	1769

Other Notes

Productivity was monitored for Black Guillemots for the fourth year. Thirty nests were followed with a mean clutch size of 1.93 and productivity of 0.60 chicks fledged per nest, a lower fledge rate than the 0.92 chicks fledged per nest in 2015.

Leach's Storm-petrels were monitored for the second season this year. 31 nests were followed with a hatching success of 0.64.

This summer, Egg Rock welcomed 90 visitors, primarily media personnel, donors, and teen campers from the Hog Island Camp.

Pond Island National Wildlife Refuge, Maine

Ravin Thomasson, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

Tern census was conducted on June 14. The unadjusted nest count for Common Terns (COTE) was 708 (not including study nests). The Lincoln Index was 1.01. The adjusted count, including study nests, was 773. This is 88 nests higher than 2015 (see Table 1).

There were six confirmed Arctic Tern (ARTE) nests on Pond Island in 2016 and all of them were found within the GOMSWG census window. There were a total of three Roseate Tern (ROST) nests identified this season but only one nest that was included in the GOMSWG census.

Table 1. GOMSWG census results on Pond Island, 2009-2016.

Year	COTE	ROST	ARTE
2009	438	0	3
2010	590	0	3
2011	586	2	0
2012	596	0	0
2013	692	0	0
2014	612	0	4
2015	685	0	6
2016	773	1	6

Tern Productivity

COTE productivity was measured by following 58 nests in both fenced productivity plots and unfenced feeding study plots. All nests were monitored from egg until fail/fledge. Mean clutch size for COTE was 2.66 with a mean hatch of 2.50 and productivity of 1.50. All six ARTE nests were monitored; mean clutch size was 2.17, mean hatch 2.00 and productivity was 1.33 chicks fledged per pair. Two of three ROST nests were followed and mean clutch size was 3.0, though no eggs hatched and productivity was 0.0 (see Table 2).

Table 2. Tern productivity on Pond Island in 2016. Data for 2015 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.66 (2.39)	2.50 (1.98)	1.50 (1.54)	58 (56)
ARTE	2.17 (2.00)	2.00 (1.17)	1.33 (0.83)	6 (6)
ROST	2.33 (0.00)*	0.00 (0.00)	0.00 (0.00)	2 (0)*

*Mean clutch was calculated with a third nest that is not included in mean hatch or productivity because its nest fate was unknown.

Tern Provisioning

A COTE chick provisioning study was conducted by observing 15 nests from hatching through fledging. There were a total of 1562 feedings observed during 589.0 nest observation hours, producing a feeding rate of 2.65 feedings per hour. The primary prey items delivered were sand lance, herring, sand/shore shrimp and hake (see Table 3). Butterfish made up a small proportion of observed feedings (0.64%).

Table 3. Principal prey items in Common Tern chick diet on Pond Island in 2016 (2015 in parentheses)

Prey item	Number of items	% of diet
Sand lance	474 (1455)	30.35 (59.28)
Unknown fish	295 (399)	18.89 (16.06)
Herring	247 (144)	15.81 (5.88)
Sand/shore Shrimp	176 (51)	11.27 (2.05)
Hake	142 (146)	9.09 (5.9)

Predator Activities and Control Efforts

For the first year since the tern restoration project was established on Pond Island, there was no evidence of Great-horned Owl predation on the island. American Crows were a serious problem for Common Eiders (COEI) and were observed on several occasions depredating eggs. Great Black-backed Gulls (GBBG) were seen depredating COEI chicks, and during dense fog periods both GBBG and Herring Gulls (HERG) were also seen taking COTE eggs and chicks. GBBG became a greater problem later in the season when they began catching tern fledglings near the landing. Bald Eagles were also seen on many occasions depredating eider chicks and seen taking one tern fledgling. A Peregrine Falcon (PEFA) was a regular visitor to the colony starting in mid-July and was observed taking adult and fledgling terns from the air. A Merlin visited the island on several occasions and attempted to catch a large COTE chick on one visit but was unsuccessful.

Jenny Island, Maine

Aspen Ellis, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 12. A total of 1,033 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs. A Lincoln index mark/recapture correction of 1.0194 was applied to the uncorrected count. The addition of 69 productivity and feeding study nests brought the total to 1,122 nests (Table 1).

Thirteen Roseate Tern nests were also presumed active during the GOMSWG census window. A total of 21 nests were found during the early season, however between mink predation and bad weather, eight failed before Roseate

Tern census. Three 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. Prior to this year, Arctic Terns have only nested on Jenny twice, in 2004 and 2006.

Table 1. GOMSWG census results on Jenny Island, 2009-2016.

Year	COTE	ROST
2009	578	3
2010	854	32
2011	753	8
2012	948	11
2013	946	7
2014	1,120	12
2015	1,268	15
2016	1,122	13

Tern Productivity

For Common Terns, five productivity plots containing 50 nests and three feeding study plots with 21 nests were used to determine productivity, and 23 of the 24 Roseate Tern nests were monitored for productivity, a summary of which follows in Table 2.

Table 2. Tern productivity on Jenny Island in 2016. Data for 2015 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.23 (2.05)	1.83 (1.87)	1.24 (1.35)	72 (60)
ROST	1.83 (1.92)	0.78 (1.17)	0.54 (0.88)	23 (13)

Tern Provisioning

Three feeding study plots with 18 Common Tern nests were monitored in 2016. A total of 1351 feedings were observed during 726 nest-observation hours, producing an average feeding rate of 1.86 deliveries per hour (compared with 1.76 deliveries per hour in 2015). Average prey size was 48.06 mm. Atlantic herring constituted the majority of observed feedings (37.5%; Table 3). Hake (including white hake and four-bearded rockling) made up another 20.8% of the feedings. In 2015, sand lance and silverside were seen in much greater numbers than is usual for Jenny Island, but those numbers seemed to return to normal this season. Butterfish were similarly abundant to last year, at 1.5%. Invertebrates made up a greater proportion of the Common Tern diet in 2016 than is normal for Jenny Island at 7.4% for all invertebrates.

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2016.

Prey item	Number of Items	% of Diet
Herring	507	37.5%
Hake	281	20.8%
Unknown fish	212	15.7%
Sand lance	85	6.3%
Unknown	73	5.4%

One feeding study plot with 6 Roseate Tern nests was monitored in 2016. A total of 504 feedings were observed during 216 nest-observation hours, producing an average feeding rate of 2.33 deliveries per hour. Average prey size was 49.32 mm. Sand lance constituted the majority of observed feedings (51.4%; Table 4). Atlantic herring made up another 16.79% of the feedings. Hake (including white hake and four-bearded rockling) constituted another 10.7% of feedings.

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2016.

Prey item	Number of Items	% of Diet
Sand lance	259	51.4%
Herring	84	16.7%
Unknown fish	84	16.7%
Hake	54	10.7%
Hake or Herring	10	2.0%

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2016 field season. Though many Herring and Great Black-backed Gulls were seen following lobster boats around the island, few were seen loafing on the island, and they were very rarely seen in the tern colony. Great Black-backed Gulls were seen preying on the eider chicks, but few incidences of large gull predation on terns were seen in 2016. No Herring or Great Black-backed Gulls nested on the island in 2016.

Though Laughing Gulls (*Leucophaeus atricilla*) have nested on Jenny Island in the past, no nests were found in 2016. One pair was regularly on the island in early June, but no nest was found. 1-2 Laughing Gulls were regular visitors to the island throughout the season, and though a small number of predated eggs that could have been due to Laughing Gull predation were found, they were not suspected to be significant cause of chick mortality in 2016.

Black-crowned Night Herons were heard and seen on three nights in the 2016 season, but there was only some evidence of limited night heron predation, so no effort was made to remove the individual. Two American Crows landed in the colony one evening in the earlier part of the season, but they were chased off and did not return. There were no signs of further avian predation in 2016.

Two mink were found on Jenny Island in 2016. A large hoverball was seen on May 31, along with several dead and dying adult Common and Roseate Terns, all with head and neck punctures. 38 conibear traps were set across the island, and stints with .22 rifle and 410 shotgun were held daily. On June 5, the first mink was shot with the 410 on the north side of the island. Hoverballs continued after the death of the first mink, and on June 8, more dead adult terns were found. 33 conibear traps were set across the island, and the second mink was found dead in a trap by Northwest Blind on the morning of June 9. It was assumed that the minks' time on the island overlapped. 40-50 dead adult Common Terns were found, as well as six dead adult Roseate Terns. No caches were found, so that is suspected to be a low estimate of the number killed.

Common Eiders

Common Eiders were not counted during the 2016 census, as the majority of the nests on the island hatched before the census window.

Outer Green Island, Maine

SJ Kwiatkowska, Island Supervisor – National Audubon Society Seabird Restoration Program

Tern Census

The 2016 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on Outer Green Island on 13 June. A total of 1289 Common Tern (*Sterna hirundo*) nests were counted. The inclusion of 41 productivity study nests (one clutch was laid post census within the GOMSWG window), 24 feeding study nests, and a Lincoln correction index of 1.01 (n=205) resulted in a corrected total of 1367 nests. This is another new record for Outer Green Island, making it the largest tern colony in Casco Bay, Maine for the second year in a row. There were no known Arctic Tern (*S. paradisaea*) nests on the island this year, but a single pair of three-year old Roseate Terns (*S. dougallii*) laid a single egg in grid #10 on 26 June. This egg hatched on 20 July, and the chick was still alive and well when researchers left the island on 1 August.

Table 1. GOMSWG annual census on Outer Green Island, 2010-2016

Year	COTE	ROST	ARTE
2010	1151	15	0
2011	1067	0	0
2012	1034	0	0
2013	1143	0	0
2014	1139	0	0
2015	1353	0	0
2016	1367	0*	0

*One ROST nest was laid after 20 June

Tern Productivity

The first Common Tern egg was laid on 20 May. The average number of eggs per nest was 2.40 (n=65). The first hatch was on 12 June, and peak hatch lasted approximately from 18-26 June. The average number of eggs hatched per nest was 2.12, and the average number of chicks fledged per nest (productivity) was 1.26.

Table 2. Outer Green Island annual Common Tern productivity, 2010-2016

Year	Mean Clutch	Mean Hatch	Productivity
2010	2.81	2.63	2.09
2011	2.43	1.98	1.77
2012	2.81	2.19	1.42
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

Tern Provisioning

Chick provisioning was observed at 23 Common Tern nests (one nest never hatched) this season over 912 nest hours. A total of 1199 feedings to chicks were recorded for an average feeding rate of 1.31 items per hour, which is lower than the 2014 feeding rate of 1.73 items per hour, but higher than the 2015 rate of 0.97 items per hour. The most frequently observed prey item was herring species (*Clupeidae sp.*), which made up 35% of the observed diet. Hake species (*Urophycis sp.*) was the second most frequently observed prey item, at 26% of the observed diet.

Predation

Early and late in the season, Ruddy Turnstones (*Arenaria interpres*) were opportunistically depredating eggs. Two Black-crowned Night Herons (*Nycticorax nycticorax*) landed and depredated at least two nests, a Peregrine Falcon (*Falco peregrinus*) predated one or two fledgling terns, and a Bald Eagle (*Haliaeetus leucocephalus*) landed on the island twice. An American Mink was located and subsequently shot on the island on 16 June 2016 after predated one adult Black Guillemot (*Cepphus grylle*) in its burrow. Throughout the season, Great Black-Backed Gulls (*Larus marinus*) and a few Herring Gulls (*Larus argentatus*) hunted at all times of day in the colony, but increased their predatory activity at dawn and dusk and during poor weather conditions. Deterrence methods included gull walks and lethal control. Two Great Black-Backed Gulls (one adult, one juvenile) were shot. On neighboring Junk of Pork Island, one Great Black-Backed Gull and two Herring Gull nests were destroyed. On Outer Green Island, one Herring Gull nest was destroyed. One Herring Gull was seen with a Common Eider (*Somateria mollissima*) duckling, and an estimate of 3-10 young terns were predated daily by large gulls during the peak predation period (18 June – 10 July).

Weather

The average, high, and low air temperatures and average sea surface temperature (SST) this year are similar to the island averages over the past 15 years. Air temperatures ranged from 42°F to 85°F, with an average temperature of 61.5°F. Sea surface temperatures (SST) ranged from 43°F to 67°F, with an average SST of 55.5°F. Precipitation was recorded on 24 days this season for a season minimum of 9.9 inches (rainfall was not collected in May).

Black Guillemots

This year, one new Black Guillemot burrow was found, raising the island total to 23 burrows. This year, 16 burrows were active, and 10 were followed for growth. Of the 16 active burrows, one burrow had what is considered a supernormal clutch of three eggs. This is the second year in a row of a supernormal clutch size on Outer Green Island. The burrow with three eggs had two eggs for a long period which felt cold, and then a third was found laid in the burrow. None of the eggs hatched, likely due to the disturbance from the American Mink during incubation. Because of the supernormal clutch, the average clutch size was 2.06, the average number of eggs hatched per nest was 1.25, and the estimated productivity (based on healthy chick growth at time of staff departure) was 1.13.

Stratton Island, Maine

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

Tern Census

Roseate Terns decreased from 2015 levels to a total of 86 nests during the GOMSWG census, and 90 nests total for the season. Arctic Terns nests decreased from 12 in 2015 to 4 in 2016. An island-wide Common Tern nest count was conducted on 12 June, about a week after a large swell in conjunction with a very high tide swept away hundreds of low laying tern nests. The Common Tern nest count of 758 nests was corrected with a Lincoln index of 1.035, to 785 nests, and the addition of 40 productivity and feeding study nests brought the total count to 825 nests. This is a decrease from 1395 nests in 2015. A total of 69 Least Terns nests were counted during the official LETE census on 16 June, however many were lost before the count was conducted due to a high tide.

Table 1. GOMSWG census results on Stratton Island, 2010-2015.

Year	COTE	ARTE	ROST	LETE
2010	854	12	35	76
2011	960	11	51	59
2012	1033	0	71	86
2013	1284	3	93	92
2014	1314	8	103	97
2015	1395	12	108	81
2016	825	4	86	69

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 43 nests in the Common Tern plots fledged at a rate of 1.0 chicks per nest. Roseate Tern productivity was 1.0 chicks fledged per nest for the 65 nests followed. Least Terns produced at least 14 fledgling aged chicks in 2016. Black-crowned Night-Herons were not a major factor for the LETEs this year. 4 Arctic Tern nests were found in 2016 compared to 12 in 2015. All of them were washed away during a high tide and high wind event on 5-6 June. Subsequently, 6 ARTE nests were found after the official GOMSWG census period from which 0 chicks fledged.

Table 2. Tern productivity on Stratton Island, 2011-2016.

	2011	2012	2013	2014	2015	2016
COTE						
Mean clutch	2.50	2.60	2.02	1.95	2.09	2.4
Mean hatch	2.23	2.40	1.83	1.69	1.75	2.25
Productivity	1.70	2.04	1.41	1.29	0.89	1.0
ROST						
Mean clutch	1.94	1.80	1.88	1.49	1.83	1.88
Mean hatch	1.82	1.45	1.52	1.10	1.49	1.28
Productivity	1.24	1.32	1.27	0.99	1.38	1.0
ARTE						
Mean clutch	1.91	-	2.00	2.00	1.83	-
Mean hatch	1.45	0	0	1.22	1.08	-
Productivity	0.36	0	0	0.22	0.25	0
LETE						
Mean clutch	1.88	1.96	1.97	1.86	-	-
Mean hatch	1.50	1.48	1.65	1.52	-	-
Productivity	0.38	0.65	0.72	0.38	0	0.2

Tern chick provisioning

Fifteen Common Tern nests were observed in 2016 with a total of 712 feedings. Sand lance was the primary prey item offered to chicks, comprising 51.9% of the diet, with hake following at 15% and herring at 5.6%. Twelve Roseate Tern nests were observed with a total of 457 feedings. Sand lance made up 80.1% of their diet, with hake being the second most common item at 1.9%. The remainder was made of up unidentified fish, a single butterfish, and a single herring. Least Tern feeding studies were conducted by opportunistically identifying fish as they were fed to chicks. No effort was taken to follow specific nests. A total of 746 feeding were observed. Hake was the most common item fed at 30.6% followed by killifish at 20.4% and herring at 8.4%.

Predation

Herring and Great Black-backed Gulls continue to prey on tern eggs and chicks and to have a devastating impact on Common Eider chick success. 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. Five Great Black-backed Gull nests were found on Stratton and destroyed, and 49 Herring Gull and 58 Great Black-backed Gull nests were poked on Bluff Island. One Herring Gull and 4 Great Black-backed Gulls were lethally removed from Stratton Island.

Black-crowned Night Herons were had a small impact on tern productivity this year. One individual was known to have taken nests of ROST and COTE and may have taken a few LETE nests. Attempts were made to remove it from the island but they were not successful.

Wading Birds

A census of the wading bird colony on Stratton Island was conducted on May 19-21. A total of 86 Glossy Ibis, 7 Black-crowned Night Heron, 33 Great Egret, and 80 Snowy Egret nests were found.

Common Eiders

A Common Eider census was not conducted this year.

American Oystercatchers

One pair of American Oystercatchers nested on Bluff and Stratton Islands in 2016. Three fledglings were confirmed.

Black Guillemots

Two active Black Guillemot burrows were confirmed in 2016. Both were near East Beach. A high count of 34 adult Black Guillemots occurred on July 18.

Double-crested Cormorants

On June 4, 151 Double-crested Cormorant nests were counted on Bluff Island by visual estimate from a boat.

Visitors

In 2015, Stratton Island had 149 documented visitors. Visitors included USFWS and National Audubon personnel for research purposes, 3 Maine Audubon Society field trips, a Prout's Neck Audubon Society field trip, A York County Audubon Society field trip, and visiting kayakers and boaters.

Notable Birds

Two Atlantic Puffins were observed about 1 kilometer offshore flying north on 29 July.

Least Terns – Maine

2016 Maine State Synopsis of Nesting Least Terns

On June 16th, a coordinated statewide least tern census documented a minimum of 238 least tern pairs within the State of Maine. An earlier survey was slated to be conducted on the 8th, however high storm tides had already washed out many nests. During the window count on June 16th, 169 least tern pairs nested at Crescent Surf while 69 nested on Stratton Island. Later in the season least terns nested at Higgins Beach, Popham Beach, Seawall, Laudholm, Goose Rocks and Western. Crescent Surf produced a minimum of 15 fledgers, and Stratton Island produced a minimum of 14. Estimation of fledglings was difficult due to mink predation at Crescent Surf over 4th of July weekend. Mink predation continued at the colony sporadically during the rest of July. State productivity was estimated to about .12 fledgers per pair. Overall, productivity was quite low.

Estimate of Least Tern Pairs

	WELLS	LAUDHOLM FARM	CRESCENT SURF	GOOSE ROCKS	WESTERN BEACH	STRATTON ISLAND	HIGGINS	RAM ISLAND	SEAWALL	POPHAM	REID STATE PARK	TOTAL
2003	0	20 (0)	57 (8)	8 (0)	0	-	38 (53)	0	0	0	33 (5)	156 (66)
2004	15 (10)	1 (0)	[50] (3)	0	0	-	45 (54)	0	0	0	50 (2)	146 (69)
2005	0	4 (1)	[52] (7)	0	[40] (3)	18 (9)	[22] (0)	0	[17] (0)	0	0	114 (20)
2006	[1] (0)	0	30 (10)	[25] (1)	0	103 (15)		0	0	0	[1] (0)	134 (26)
2007	1 (1)	0	[37] (1)	[45] (2)	0	113 (10)8	0	0	0	0	0	150* (112)
2008	0	0	92 (52)	2 (0)	[2]	72 (33)	0	0	0	0	0	166* (89)
2009	0	0	102** (62)	[6]** (0)	0	72 (16)	[16] (0)	0	0	0	0	170 (78)
2010	0	[1]**	136** (45)	[18]**	0	76** (5)	0	0	0	0	0	211* (50)
2011	0	0	123* (73)	23* (12)	0	59* (28)	0	0	0	0	0	205* (113)
2012	0	0	99* (78)	0	0	86-92* (72)	0	5 (1)	0	2	0	185-191* (155)
2013	0	0	129* (93)	0	0	92* (79)	0	0	0	3* (0)	0	224* (172)
2014	0	4** (4)	164* (29)	0	0	79* (36)	4* (0)	0	0	2* (?)	0	249* (72)
2015	0	6** (0)	138* (144)	0	0	69* (0)	25* (6)	0	0	14* (3)	0	233* (153)
2016	0	2**(0)	169*(15)	10**(7)	4(0)**	69*(14)	0	0	1(0)* *	22(0) **	0	238*(36)

[] colony deserted

* simultaneous count at all occupied nesting sites during window count, not a site specific high nest count

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

Laudholm Farm Beach, Wells

Katrina Amaral and Kate O'Brien, Rachel Carson NWR

Population Estimate

There were no active nests during the statewide census period. Approximately 2-5 pairs of least terns nested here later in the season. It appears all nests were predated before or immediately after hatch. Crow tracks and mammal tracks were frequently found on this beach.

Comparison

In 2015, Laudholm produced 0 LETE fledglings; prior to 2015, least terns had not nested at Laudholm since 2005.

Predator Control

No predator control was conducted though USDA Wildlife Services removed predators at nearby Crescent Surf Beach.

Crescent Surf Beach, Kennebunk

Katrina Amaral and Kate O'Brien, Rachel Carson NWR

Population Estimate

There were 169 active nests during the statewide least tern census on June 16th.

A mink appeared to predate the majority of the least tern chicks starting in early July and continuing throughout the season. Numerous dead least tern chicks were found during this time, most with bite marks. A skunk had also managed to breach the fence.

A fledgling survey on July 20th counted 15 fledged birds, with 4 chicks. A minimum of 15 fledgers were produced, however it is likely an additional 5 or so birds fledged over the season.

Comparison

In 2015, there were 138 active nests during the statewide least tern census on June 10th. This was likely not a complete count, however, we were unable to do a second survey due to the large numbers of young plover chicks on the beach. Our final estimate is >144 fledglings for a productivity of 1.04.

In 2014 there were 138 least tern nests but due to a number of extreme weather events these nests only produced 29 fledglings for a productivity of 0.18. In 2012 and 2013 the productivity was approx. 0.7 on Crescent Surf. Productivity was poor between 2003 and 2007. The steady growth of the least tern population is likely due to the intensive wildlife management actions on these productive mainland beaches and at Stratton Island.

Predator Control USDA

Wildlife Services removed specialist predators from the Crescent Surf beach area throughout the breeding season. An electric net fence was used during the breeding season.

Goose Rocks Beach, Kennebunk

Laura Minich Zitske, Maine Audubon Society

Population Estimate

10 nesting pair produced 7 fledglings. 1 chick appeared to have been killed by domestic cat.

Comparison

Least terns did not nest at Goose Rocks in 2015. In 2011 a high of 23 pairs we observed, however due to predation only 9 pairs nested, and produced at least 12 fledglings.

Predator control

None

Ram Island

Maine Audubon Society

Population Estimate

No least terns nested on Ram Island in 2016.

Stratton Island

Frank Mayer, National Audubon Society

Population Estimate

There were 69 nests recorded during the statewide census on June 16th. A minimum of 14 fledglings were produced.

Comparison

In 2015, the minimum number of pairs was 69, with a zero fledglings.

Predator Control

Yes

Higgins Beach, Scarborough

Laura Minich Zitske, Maine Audubon Society

Population Estimate

0

Comparison

In 2015, there were 25 nests recorded during the census window on June 10th, which is a minimum population estimate. At least 6 fledglings were produced.

2014 marked the first year that least terns had nested on Higgins Beach since 2009 when there were a minimum of 16 nesting pairs; this colony was abandoned due to predation.

Predator Control

Popham Beach, Phippsburg

Laura Minich Zitske, Maine Audubon Society

Population Estimate

In 2016, 22 pairs were documented with zero fledglings produced.

Comparison

In 2015, 14 pairs were documented nesting during the window count on June 10th. 3 chicks surviving to fledge.

In 2014 at least 2 pairs nested at Popham. In 2013, 3 pairs were documented nesting during the census window, with a high count of 4 nesting at any one time. No chicks survived to fledge due to heavy fox predation. In 2012, 2 least tern pairs fledged 3 chicks. Prior to 2012, no nesting had occurred since 1997.

Predator Control

USDA Wildlife Services removed specialist predators from the Popham Beach area throughout the breeding season.

Other beaches

4 pairs nested at Western, 1 pair nested at Seawall and no fledglings were produced.

NEW HAMPSHIRE

Isles of Shoals - Seavey and White Islands

Liz Craig, Program Manager – Shoals Marine Laboratory

Abby Cramer & Elizabeth Ford, Seabird Technicians – Shoals Marine Laboratory

Tern Census

- A-wave COTE census was conducted on June 14 & 15.
- 2,388 COTE nests were counted on Seavey and adjusted with the Lincoln Index to 2,467.
- 264 additional COTE nests were counted on White and adjusted with the Lincoln Index to 270.
- 245 nests were monitored in productivity plots on Seavey and 3 nests were monitored in prod plots on White
- A-wave total is 2989, the highest A-wave census in colony's past nineteen years
- June 20th Seavey Island had 84 ROST nests, 16 more than in 2015
- B-wave ROST nests brought season total to 103
- June 20th, Seavey had 1 ARTE nest, White had 2 ARTE nests. Consistent with the past 5 years.
- A dog on White island, restricted by an electric fence, discouraged nesting within the grassy yard surrounding lighthouse keeper's cottage
- Nests initiated in this area were moved to the perimeter.

1. Number of tern nests found on Seavey and White Island from 2011-2016, A-wave.

Year	COTE	ROST	ARTE
2011	2447	42	3
2012	2044	51	4
2013	2269	51	2
2014	2548	69	3
2015	2686	68	2
2016	2989	83	3

Productivity

- For COTE 15 productivity plots on Seavey containing 247 nests were used to determine productivity.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Seavey Island from 2016. Only nests with known outcomes used for ROST & ARTE calculations. Data for 2015 shown in parentheses.

Species	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2.25 (2.04)	1.56 (1.52)	0.80 (1.10)	247 (188)
ARTE	2.00 (3.00)	1.00 (0.67)	0.50 (0.33)	2 (3)
ROST	1.69 (1.58)	1.23 (1.20)	0.94 (0.93)	83 (74)

Tern Provisioning

Was not done this year

Predator Activities and Control Efforts

Gulls:

- While there were no gull nests found on Seavey or White this year, GBBG and HERGs were present throughout the breeding season (Nearby gull colonies in the Isles of Shoals 0.25 miles Star, 0.75 miles Appledore)
- Early season monitored gull presence through AM and PM gull counts as well as counts while on the colony.
- Used human presence, as well as pyrotechnics to dissuade gulls from lingering and predating. No lethal gull removal was done.
- 37 pyrotechnic screamers used (3 at the end of June, 34 in July)
- Witnessed 10 gull predation events during July (8 by GBBG, 2 by HERG) of 9 fledges and 1 adult.
- Gull interns on Appledore discovered a satellite gull colony which had 41 individual tern wings (largely fledglings) scattered amongst 6 nests

Other Avian:

- Prior to our arrival on May 9 there was a Snowy Owl on Seavey and White. We found 8 owl pellets. It left before the terns had arrived.
- July 29th Peregrine Falcon sited, was heavily mobbed by the terns. Another PEFA was observed 2 days later, same response from the terns.

Mammalian:

- Other patterns of tern chick predation also observed. Including caching and eating of the abdomen (~8) and head removal (~7). One of which was definitely predation and not scavenging.
- Muskrats - caching: possible scavenging of dead chicks
- Other Observed Predation: face chewing + head eating - rats?

Other Nesting Species

Both Common Eider (13 nests on 5/10) and Spotted Sandpipers (9 nests) were found nesting on the islands.

Other Notes

- Coast Guard helicopter visit on 7/21
- Microburst took down all blinds on 7/23
- Vegetation management - herbicide applied by NHFG at peak hatch (6/16) and post fledge (7/9). Planned burn in Sept.
- Outreach: animal planet (6/19) with John Kanter, SML field trips HS, College classes, as well as visiting artists and lighthouse stewards.
- First year overseen by SML= logistics year

MASSACHUSETTS

Monomoy National Wildlife Refuge

Kate Iaquinto – Wildlife Biologist, U.S. Fish & Wildlife Service

Becca Mattson -- Biological Science Technician, U.S. Fish & Wildlife Service

Gina Zanarini – Biological Science Technician, U.S. Fish & Wildlife Service

Minimoy Island

Common Tern Census and Productivity

No common tern nests were found on Minimoy Island this field season. Productivity on Minimoy Island was zero.

Roseate Tern Census and Productivity

No roseate tern nests were found on Minimoy Island this field season. Productivity on Minimoy Island was zero.

Least Tern Census and Productivity

No least tern nests were counted on Minimoy Island during the census window. Three least tern nests were found on 1 June but were no longer present during the next visit to the island on 13 June, likely due to over wash. Productivity on Minimoy Island was zero.

North Monomoy Island

Common Tern Census and Productivity

The North Monomoy Island Tern Census was conducted on 19 June and no common tern nests were counted although two common tern nests were found after the census on 28 June. Productivity was not monitored throughout the season but general observations suggest that no nests hatched or fledged, likely due to predation/abandonment.

Wading Birds

No wading bird census was conducted during 2016 field season.

South Monomoy Island

Common Tern Census and Productivity

The South Monomoy Island tern and gull census was conducted on 10 - 12 June. The nesting area has been delineated into 60m² grids, and all nests were tallied by grid number. The total number of common tern nests counted was 10,075. To compensate for error we performed a Lincoln Index for a final adjusted estimate of 10,505 nests for South Monomoy Island. A B-census was not conducted, however based on the number of nests initiated in productivity plots after June 20th, we estimated there to be an additional 936 nests in the colony during the B-period.

The reproductive success of common terns on South Monomoy Island was excellent based on 258 A-count nests in 36 fenced productivity plots. The reproductive success for the plots monitored was 1.96 chicks fledged per nest. The following calculations are based on A-nests only and reproductive success is measured by chicks fledged per nest attempt.

Table 1. Comparison of Productivity Information for A-Period Nesting Common Terns on South Monomoy Island: 2014 to 2016

	2014	2015	2016	Standard Deviation	Standard Error	Sample Size
Average Clutch Size	2.38 eggs/nest	2.72	2.57	0.58	+/- 0.04	258
Average Eggs Hatched Per Nest	2.17 eggs hatched/nest	2.40	2.33	0.80	+/- 0.05	258
Hatching Success	91.0%	88.3%	90.7%			
Fledging Success	73.0%	61.0%	84.1%			
Reproductive Success	1.58 chicks/nest	1.50	1.96	0.88	+/- 0.04	258

Table 2. Number of Pairs and Reproductive Success of Common Terns on South Monomoy Island 2014 to 2016

	2014	2015	2016
Number of Pairs	8526	9203	10505
Reproductive Success	1.58	1.50	1.96

Common Tern Feeding Stints

Staff conducted twenty-one 1-hour long common tern feeding stints from 21 June - 15 July. Seven nests with small to medium chicks were marked by the observer. Prey item and prey length were recorded during each stint. Observers recorded 122 total feedings during twenty-one hours of stints. Sand lance was the most common prey item (86.9%). Other delivered prey items included herring (7.4%), squid (1.6%), and unknown fish (4.1%). The average prey length was 1.99 culmen-lengths. Prey species observed within the colony but not during feeding stints included butterfish, bluefish, hake, and squid.

Common Tern Trapping and Banding

Fifty-three adult common terns were trapped this season during banding efforts. Of the 53 captured, 39 were previously banded and 14 were affixed with new bands. Of the 39 previously banded adults, 21 were originally banded at Monomoy NWR and the remaining was as follows; Cuttyhunk Island, MA (5), Wareham, MA (2), Mattapoisett, MA (1), Manomet, MA (1), Great Gull Island, NY (3), Punta Rasa, Argentina (5), and Mangue Seco Bahia, Brazil (1). In addition to the trapped birds, 13 adult common terns with plastic field readable (PFR) bands from previous work in 2013 and 2014 were resighted in the colony in 2015.

Roseate Tern Census and Productivity

Twelve roseate tern nests were counted during the A-census window on South Monomoy Island. Two additional nests were found after 20 June, bringing the total to fourteen pairs. This was an increase of three pairs compared to 2015. A total of 19 chicks hatched, 17 of which could be considered fledged by GOMSWG standards. Observational stints to find roseate terns were continued until 2 July but no additional nests were located.

The reproductive success of roseate terns on South Monomoy Island was good with an overall 82.35% fledging success rate. The following calculations are based on the total number of A pair nest attempts and reproductive success is measured by chicks fledged per nest attempt. Included in these calculations are re-nest attempts by two different A pair nesters. One pair lost a 9-day old chick and re-nested on 3 July and the other laid a fourth, fertile egg on 23 June in a three egg infertile nest that was found on 26 May. Not included in these calculations are two B pair nesters.

Table 3. Comparison of Productivity Information for Nesting Roseate Terns on South Monomoy Island: 2014 to 2016

	2014	2015	2016	Standard Deviation	Standard Error	Sample Size
Number of Pairs	8	11	12			
Average Clutch Size	2.13 eggs/nest	2.00	1.71	0.61	+/- 0.16	14
Average Eggs Hatched Per Nest	1.38 eggs hatched/nest	1.27 eggs	1.21	0.87	+/- 0.23	14
Hatching Success	64.71%	63.64%	70.83%			
Fledging Success	100%	100%	82.35%			
Reproductive Success	1.38chicks/nest	1.27	1.00	0.88	+/- 0.23	14

Roseate Tern Attraction Project

A roseate tern attraction project was initiated beginning in 2009 in an effort to attract roseate terns to South Monomoy Island due to the severe loss of habitat on Minimoy Island. This project has been continued annually and

in 2016 two sound systems were placed near the main nesting colony along with artificial nesting structures, which consist of six artificial nest boxes covered by a piece of plywood, and teepee chick shelters (modeled after those used by the Massachusetts Natural Heritage and Endangered Species Program on Ram Island). This year the artificial nesting structures were not used by any of the A census nesting pairs of roseate terns, and only a single teepee was used by one of the B pair nesters. It may be a result of the colony settling earlier this year than usual and the artificial nesting structures being placed later than usual. This behavior is a departure from the three years previous when multiple roseate pairs have nested underneath these artificial structures provided. Two pairs nested within 10 meters of the northern sound system that worked continually throughout the season. The second sound system did not work throughout the duration of the season, although 8 pairs nested within 30 meters of it. The majority of the nesting pairs this year were in the southern end of the colony, with 8 pairs choosing the more spread out area near the southern sound system over the densely populated areas the other 6 pairs chose in the northern main colony. This trend started near this southern sound system with 1 pair in 2014, 3 pairs in 2015, and now 8 pairs in 2016.

Roseate Tern Restoration Project

A Cooperative Recovery Initiative grant funded roseate tern habitat restoration project was initiated on South Monomoy Island in 2014 to increase roseate nesting habitat in and around the colony. In 2014 a total of 2,175 seaside goldenrod seedlings were planted during two planting events. The plantings were focused on three 180 by 60 m² study areas, each containing a different density of nesting common terns. In 2016, we continued to take photos of these plots to evaluate the success of these efforts over time. Twelve of the fourteen pairs of roseate terns nested within the study areas in 2016; however the plantings in the two southern study areas have all but failed in taking root and replenishing themselves.

Roseate Tern Trapping and Banding

Eleven roseate tern adults were captured using Potter traps, six had been previously banded and five were unbanded new captures. Blue PFRs with white lettering were added to 9 of the 11 trapped adults and to 18 of the 20 newly hatched chicks. One PFR was removed during the season that was placed in 2014 due to an injury to the bird's joint between the tibiotarsus and the tarsometatarsus. The cause of the injury could not be determined. The bands were reported to Bird Banding Lab and Jeff Spendelov of USGS. Nine of the twelve adults affixed with PFRs in 2014 and 2015 returned to breed in 2016.

Staging and Re-sighting

Although no re-sighting or staging work was done by refuge staff, Mass Audubon, USGS, and USFWS conducted counts of staging roseate and common terns on the refuge, South Beach, Chatham and North Beach Island, Chatham in addition to re-sighting color banded adult roseate terns. Staging counts were performed on six days between 15 July and 23 Aug.

Least Tern Census and Productivity

Least terns nested in two main areas in several smaller colonies on South Monomoy Island. The A-period census was conducted on 13, 15 and 16 June. A total of 839 nests were counted during the A-period census window. There was no B-period census conducted this year because the number of terns present on the refuge remained relatively consistent throughout the nesting season. Productivity was not quantitatively monitored, but was estimated to be excellent overall. Many fledglings were seen in some of the denser nesting areas at the end of the nesting season.

Black Skimmer Census and Productivity

No black skimmers were seen on the refuge this year although one was seen on neighboring South Beach once but it made no nest attempt.

Laughing Gull Census and Productivity

During the tern census, which took place 10 – 12 June, 2738 active laughing gull nests were counted compared with 1424 in 2015, 983 in 2014, and 974 in 2013. This increase is likely due to an increase in available habitat from the burn in winter 2015, a lack of nest destruction in recent years, and the possible redistribution of laughing gulls throughout the Gulf of Maine from nest destruction efforts at other colonies. Productivity of laughing gulls was not monitored; however it was estimated to be qualitatively excellent based on the number of chicks and fledglings seen throughout the season.

Laughing Gull Kleptoparasitism

Stints were continued this year to monitor the number of kleptoparasitism attempts by laughing gulls on common terns. Seventy-one kleptoparasitism observational stints were conducted this year for a total of 71 hours.

Kleptoparasitism events were observed during 63 of the 71 stints. During stints, a total of 1191 kleptoparasitism attempts were recorded, with an average of 16.77 per hour. Laughing gulls were successful 32.9% of the time, common terns were successful 29.4%, the outcome was unknown 28.2% and prey items were dropped during 9.6%. Laughing gulls retrieved the dropped item 34.2% of the time while terns retrieved the item 1% of the time so they have been added into successes of the respective species. Trends from many years of data collection have shown that the number of laughing gulls involved in a kleptoparasitism event affects the outcome. Typically laughing gulls tend to be more successful as the number of them involved in the chase increases, whereas the tern is more likely to be successful when less laughing gulls are involved.

Great Black-backed Gull and Herring Gull

Prior to the arrival of both nesting terns and staff to South Monomoy Island this year both herring and great black-backed gulls were discovered attempting to nest in the area of the tern colony. To combat these attempts, staff was sent out earlier than in previous years on 7 May to open camp and to harass the gulls in hopes of getting them to re-nest elsewhere. Harassments were conducted two to three times per day in May and then slowed as the numbers of gulls in the colony diminished. Occasional harassments were continued throughout the season whenever a gull was spotted in the tern colony. A total of 13 great black-backed gull nests were destroyed in addition to 28 herring gull nests. A total of ten herring gull adults and three great black-backed gulls were also lethally removed from South Monomoy Island during the 2016 field season. Great black-backed gulls were observed in the colony a total of 158 times and herring gulls were seen a total of 357 times. A total of 76 common tern eggs on South Monomoy and one American oystercatcher nest were found predated by gull species though these estimates are likely lower than the total number actually taken by gulls.

Northern Harrier

A northern harrier was observed at the South Monomoy Island tern colony only once throughout the season in mid-May but another twelve times throughout the rest of South Monomoy Island.

Coyote

A total of 12 coyotes were removed from the refuge in 2016, 4 adults and 8 pups. Scat, tracks and sightings of coyotes were seen in and around the tern colony periodically but the majority of evidence was seen outside the colony as well as throughout the other islands. On 11 July, one coyote ran straight through the colony with a chick in its mouth during midday. During a night stint that night on 12 July the coyote was seen in the colony again; two shots were fired but it got away. Overall there was little obvious predation of terns, plovers, or oystercatchers that could be directly linked coyotes.

American Crow

American crows were observed on South Monomoy Island early on in the season however none were seen within the colony. One crow was removed from the south end of the island.

Common Grackle

Fifty-seven common grackles were removed from South Monomoy Island. Common grackles likely have little to no impact on nesting common terns. However, common grackles are a significant predator of nesting piping plover and potentially least terns on the island.

Wading Birds

No census was conducted on South Monomoy Island this year, because wading birds have not been found nesting on the island since 2007. Staff sighted black-crowned night-herons on South Monomoy Island 5 times throughout the season and a small amount of depredation was observed in the tern colony.

Owls

Six owl pellets were found and dissected. Bird bones and feathers were found in some, but species have not been determined.

Peregrine Falcon

Peregrine falcons were documented flying over the colony four separate days, two of which the peregrine harassed the colony the entire day, and two other times predation events (carcasses) within the colony were attributed to peregrine falcons.

AFTERNOON PRESENTATIONS

EFFECTS OF GPS LOGGER ATTACHMENT ON PUFFINS AND RAZORBILLS - Using fledge success and chick growth rates

Stephanie Symons and Tony Diamond, ALAR, UNB

Previous Knowledge of Effects

- Razorbills equipped with external loggers have been observed to spend less time on site (n=3; Wanless 1988)
- Thick-billed murres equipped with TDRs had significantly lower provisioning rates than control pairs (Paredes *et al* 2005)
- Harris *et al.* (2011) cautioned the use of GPS loggers on Atlantic Puffins on the Isle of May (Scotland):
- Instrumented birds made fewer feeds per day than controls
- Mates of instrumented birds compensated
- Puffins without devices returned without fish significantly less than logger-equipped birds 2

Methods: Foraging Locations

- Ecotone Global Positioning System (GPS) loggers
- Download to base station aerial on the lighthouse when within 300m
- GPS position every 30 minutes for ~4days
- Date, time, latitude, longitude, speed, dive duration

Fledge success of tagged late-chick-rearing adults

At least 75% fledge success of birds tagged at the late-chick-rearing stage

Growth rates: tagged birds vs the colony Controls

- Growth rates from chicks measured as a part of our regular monitoring
- 2014: Puffins (n=38) and Razorbills (n=29)
- 2015 : Puffins (n=41) and Razorbills (n=30)

Procedural Controls

•Growth rates for chicks belonging to adults that were handled to the same extent as logger-equipped birds but no logger was attached

- 2014: Incubating Atlantic Puffins (n=3)
- 2015: Late-chick-rearing Puffins (n=4) and Razorbills (n=5)

Chick Growth Rates

“No significant” difference in Razorbill ($p=0.15$) growth rates but **Puffin** chicks with one tagged parent grew **significantly slower** ($p=0.025$)

Do GPS-derived foraging locations reflect where chick food is coming from?

•Using videos of experimental burrows, identify feeding locations immediately preceding food delivery by tagged parent.

Conclusions

- GPS tags do have negative impacts on chick-feeding by tagged birds (chick receives fewer feeds, grows more slowly)
- Few chick feeds are delivered by tagged adults
- Mate (non-tagged parent) evidently compensates to some extent.

So what now?

- Continue to investigate by looking at nest attendance and provisioning (videos of control burrows)

- Use caution when deploying loggers
- Loggers used here were well under the 3% weight guideline (~1.3%) (Vandenabeele *et al* 2012)
- Hydrodynamics of logger may play an important role
- Puffins spend ~ 78% of time underwater when feeding (Wanless *et al* 1988, Harris & Wanless 2011)
- Improve streamlining of logger
- Await developments of smaller, less bulky loggers

Tern colony collapse at Machias Seal Island: ten years later

Lauren Scopel, University of New Brunswick

Machias Seal Island (MSI), NB, was formerly the largest tern colony in the Gulf of Maine. In 2006, however, the colony collapsed, and ~90% of the terns abandoned. Ten years later, I review changes in population size and reproductive success of five seabird species on MSI. Gull predation was identified as the main driver of low reproductive success and subsequent abandonment by the terns; we identified 25% predation as a threshold that must not be exceeded in order to have successful breeding seasons for terns on MSI. Arctic Tern reproductive success stabilized following the resumption of lethal gull control in 2013, but the population size is still very small. Common Terns represent only ~5% of the breeding terns on the island; we cannot draw firm conclusions about their reproductive success. Common Murres increased greatly in number in spite of high predation from gulls. Razorbills also increased in number, but their hatch success and productivity declined, perhaps because of predation and a reduced tern colony. Atlantic Puffins, which should not be affected by gull predation, also have reduced hatch success and productivity, suggesting that there may be oceanographic influences on these reproductive declines. We will further examine a link between seabird reproduction and bottom-up ecosystem effects in future analyses.

Migrations and Phenology in a changing Climate from the perspective of Forage Fish

Adrian Jordaan and Michelle Staudinger, Department of Ecological Conservation, UMass Amherst

Climate change is causing species to shift their phenology, or the timing of recurring life events, in variable and complex ways. This can potentially result in mismatches or asynchronies in food and habitat resources that impact individual fitness, population dynamics, and ecosystem function. While climate change induced shifts in phenology have been well documented in terrestrial ecosystems, particularly relative to flowering plants and migratory song birds, studies of marine organisms have been limited. This project seeks to improve our understanding of climate-induced shifts in the seasonal timing of migration, spawning or breeding, and development rates in coastal predatory and forage fishes, marine mammals, and migratory shore and seabirds through a synthesis of existing regional datasets. We conducted a literature search using the term “marine phenology” in Web of Science, which yielded 374 studies conducted between 1977-2015. Globally, the greatest number of studies has been conducted on marine plants, followed by seabirds and plankton. Only 3% of all studies were conducted in northeast habitats and the majority (N = 8) focused on lower trophic level species; only 4 considered macro-predators (fish and seabirds). In addition, we have assembled several datasets and conducted preliminary analyses that provide case studies of shifting phenology in several fish, invertebrate and seabird species in the Gulf of Maine and greater New England region. While climate is a likely factor influencing these shifts, we will discuss the influence of other environmental and ecological stressors that raise questions about how best to attribute climate change and disentangle other confounding signals. Results will help characterize the adaptive capacity and vulnerability of individual species and regional populations to changing environmental conditions, identify where potential trophic mismatches may occur, and reveal gaps in monitoring networks intended to detect such responses.

APPENDIX A: List of 2016 Meeting Attendees

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