Gulf of Maine Seabird Working Group (GOMSWG)
37th Annual Summer Meeting Report

Meeting held virtually via Zoom
August 12, 2021

Visit the website: gomswg.org

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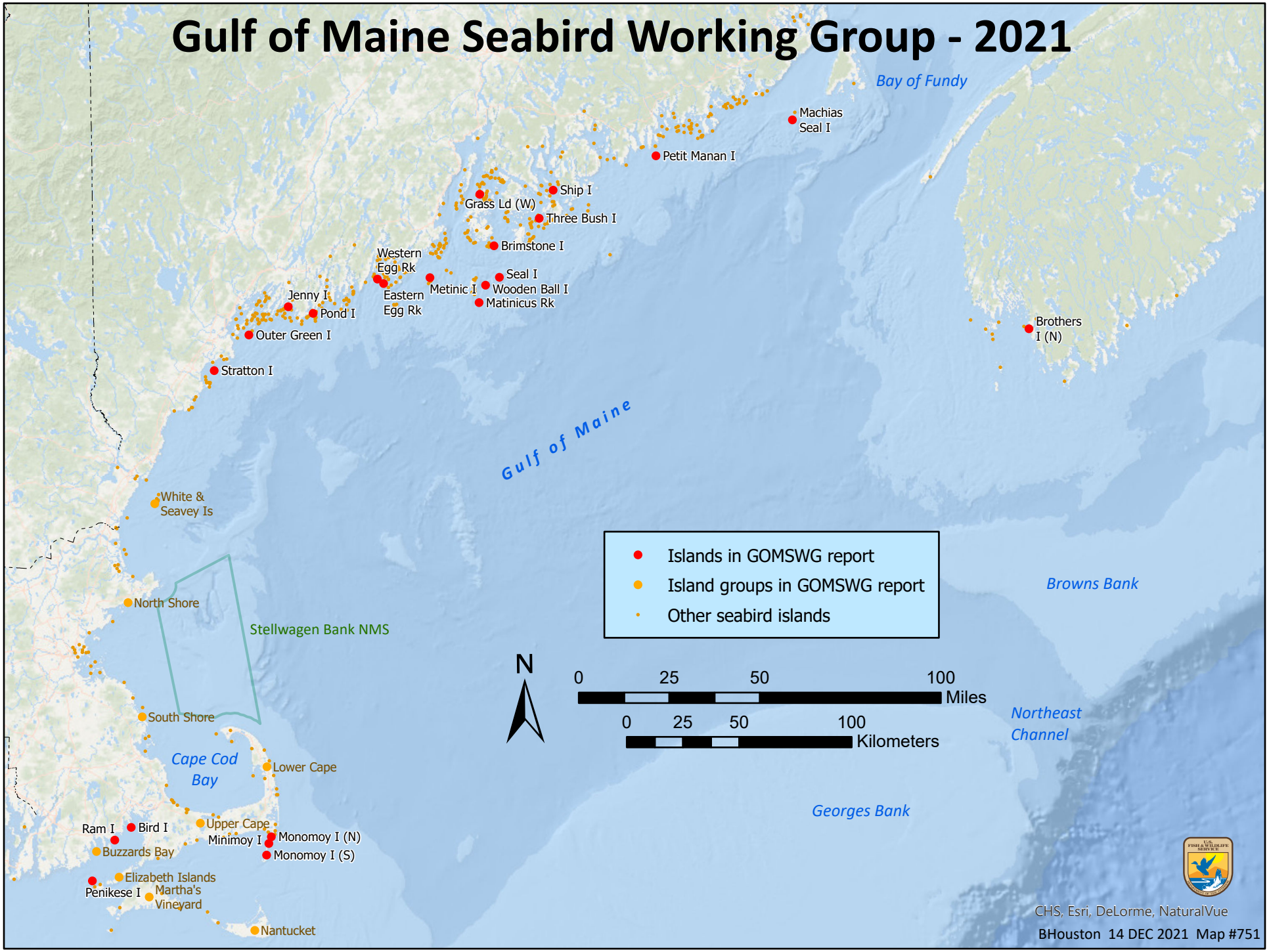
Compiled by, and maps by Bob Houston
USFWS Gulf of Maine Coastal Program
Falmouth, ME 04105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Introduction

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

The 2021 seabird breeding season, similar to 2020, encountered additional challenges due to the COVID-19 pandemic. Through creativity and flexibility, colony managers were still able to protect colonies and collect data at a majority of traditionally managed sites.

Due to the pandemic, the 2021 GOMSWG meeting was held virtually, via Zoom. Meeting activities included summaries of island activities, reported in geographical order from Massachusetts north to Canada. A table with 2021 GOMSWG census results will be distributed concurrently with this report and/or made available at the GOMSWG website (gomswg.org).

Island and Site Reports

Massachusetts

Massachusetts Seabird Islands

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

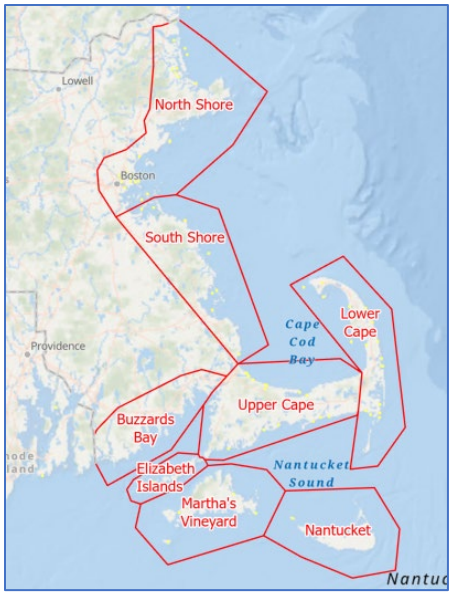
Census

Preliminary data indicate record numbers for ROST, LETE, and BLSK. South Monomoy I was not censused this year, so COTE and LAGU numbers for Lower Cape and statewide are unknown.

Preliminary MA seabird numbers (by region and statewide).

- Gulf of Maine would include North Shore, South Shore, Lower Cape, and some of the Upper Cape region.

2021	Roseate Tern	Common Tern	Arctic Tern	Least Tern	Black Skimmer	Laughing Gull
North Shore	0	260	0	476	0	0
South Shore	0	1	0	574	0	0
Upper Cape	0	62	0	854	0	0
Lower Cape	8	abundant	0	1,595	0	abundant
Buzzards Bay	3,111	7,338	0	358	0	0
Elizabeth Is.	3	1,539	1	15	0	0
Martha's Vineyard	0	538	0	280	19	0
Nantucket	24	96	0	970	0	0
2021 TOTAL	*3,146*	*abundant (>9574)*	*1*	*5,122*	*19*	*abundant*



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

Main Buzzards Bay/Elizabeth Islands colonies **(Bird, Ram, Penikese)**.

- For **Bird, Ram, Penikese** combined:
  - Highest number of COTE recorded in modern times (for 3 sites combined and at Bird and Penikese individually)
  - Highest number of ROST recorded in modern times (for 3 sites combined and at Bird since 1982)
- Food availability was exceedingly bad in Buzzards Bay, especially at Bird and Ram where very few COTE chicks survived to fledging and ROST chick survival was much worse than usual. Gull predation at Penikese was the most intense observed, despite significant control efforts.

	COTE	ROST	ARTE
Bird Island	3,154 P	1,778 F	0
Ram Island, Mattapoisett	4,108 P	1,333 F	0
Penikese Island	1,507 F-P	3 E	1

Productivity codes: E=excellent F=fair P=poor

Other Notes

Preliminary data indicate record numbers for PIPL, total count (adjusted) = 956. Total count (adjusted) for 2020 was 794.5.

Ian Nisbet *(retired tern researcher) notes below:*

First pure pair of ARTE on Penikese for many years (1 bird has been interbreeding with a common tern for 14 years).

Productivity

Productivities were low due to food issues. Roseate productivity was <1.0 for only the 2nd time in 50 years.

Other Notes

In Massachusetts as a whole, several other species reached record numbers in 2021: least tern, 5,122 pairs; piping plover, 956 pairs; black skimmer, 19 pairs; American oystercatcher, (184 pairs) were near record high numbers. Some GOMSWGers may know about the habitat restoration program at Bird Island in 2015-2018. The island was reconstructed to combat erosion and prepared for sea level rise. The surrounding wall was raised 2-3 m and rebuilt to absorb incoming waves; the entire island was raised 2-3 m by filling with gravel; the tern nesting area was increased by ~75% and the substrate improved; the invasive vegetation was removed and replanted with natives. Total numbers of common and roseate terns increased from ~3,000 pairs before the project to ~4,900 pairs in 2021, so the project has paid off.

Monomoy Islands

Eileen McGourty, Fish and Wildlife Biologist - USFWS
Morgan Bennett and Patrick Carr, Biological Interns – Northwoods Stewardship Center for USFWS

Minimoy Island

Tern Census

In 2021, two visits were made to the island. The first visit on June 9 had a count of 17 common tern nests with eggs. This was not a complete survey of the area. In conjunction with a nest count an aerial count was also done with 35 adults flying. With a correction factor of .8 this equates to 28 pairs. The island was visited again on June 17th and a significant increase was seen in the number of common terns nesting on the island. An estimate of 100 common terns were flushed up. With the 0.8 correction factor it is believed that there were approximately 80 pairs nesting. No black skimmers, roseate terns, least terns. One pair of greater black-backed gulls attempted to nest on the island, but we removed by staff. No productivity data was collected for terns on Minimoy.

Table 1. Number of tern nests found during census window on Minimoy from 2017-2021. Numbers in parentheses reflect nests found outside of the census window.

Year	COTE	ROST	LETE
2017	0	0	0
2018	0 (1)	0	0
2019	1	0	0
2020	2	0	0
2021	80*	0	0

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

North Monomoy Island

Tern Census

In 2021, a census was conducted on North Monomoy Island on June 10th. No terns or skimmers were noted nesting on the island.

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

Year	COTE	ROST	LETE
2017	0	0	0
2018	0	0	0
2019	No census	No census	No census
2020	No census*	No census*	No census*
2021	0	0	0

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

Gull Census

In 2021, though great black-backed gulls and herring gulls were observed nesting on North Monomoy, gull nests were not counted this field season. Gull census is conducted every five years and the most recent census was completed in 2018. The nest gull census is anticipated to be in 2023.

Wading Bird Census

In 2021, though many wading birds were observed nesting on North Monomoy Island, a wading bird census was not conducted due to staffing limitations related to the pandemic.

Table 3. Number of wading bird nests found on North Monomoy from 2017-2021 during census window.

Year	BCNH	GREG	SNEG	GLIB
2017	185	25	99	3
2018	225	27	94	1
2019	252	48	94	0
2020	No census*	No census*	No census*	No census*
2021	No census*	No census*	No census*	No census*

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

South Monomoy Island

Tern Census

Common Terns

In 2021, though plenty of common tern and laughing gull nests were observed, the annual South Monomoy Island tern and gull census was not conducted due to the COVID-19 pandemic and staff shortages. This is the second time since 2003 that the tern census was not conducted on South Monomoy Island. The first time was in 2020, also due to the COVID-19 pandemic. Productivity is thought to be poor in the colony this year based on few large chicks seen within the colony and the number of tern chick carcasses observed during the few visits that occurred to the colony during the season.

Roseate Terns

A full census was not conducted on South Monomoy Island. Numbers reported are minimal numbers observed during two visits, one on June 17th and the second on June 24th. Visits into the colony were limited to a few hours and only a small portion of the colony was covered. During the first visit 4 Roseate tern nests were found, 3 nests had 2 eggs and one had 1 egg. During the subsequent visit on June 24th another 6 Roseate tern nests were found, egg numbers ranged between one and three. Nests checks were conducted on the original 4 nests found, 3 had chicks, one still had only one egg. The four nests found during the June 17th visit are considered A-period nests along with the 3 egg nest found on June 24th as this nest was likely there prior to June 20th. All other nests will be considered B-period nesters as we were unable to follow the nests to determine when the eggs were laid based on chick hatching. Productivity data on the nesting roseate terns was not collected this year due to COVID-19 pandemic staff shortages.

Least Terns

In 2021, a least tern census was completed by plover monitors over several days. A total of 619 nesting least terns were counted in 4 separate colonies this year. The largest colony was at the connection area at the northeastern end of the island with a total of 502 incubating adults counted on June 19th. The south tip of the island had a count of 87 incubating adults on June 17th. Two smaller colonies were found on the south west side of the island, one just north of the lighthouse landing with 20 incubating adults on June 6th, and the other north of Powder Hole with 10 incubating adults on June 10th. Productivity of least terns was not monitored but qualitative observations show poor productivity again this year. Predation and/or over wash from storm events significantly impacted each colony. No B-period census was conducted.

Table 4. Number of tern nests and laughing gull nests found on South Monomoy from 2017-2021. Numbers in parentheses reflect nests found outside the census window.

Year	COTE *	ROST	LETE	LAGU
2017	11723	11 (7)	773	2714
2018	13472	30	499	3272
2019	14343	4 (8)	12**	3659
2020	No census***	0(4)***	39***	No census***
2021	No census***	5 (5)****	619	No census***

*Adjusted estimate based on Lincoln Index.
**It is estimated that there were 268-285 pairs of terns present during the census window prior to the official June 20th count but abandoned most nesting attempts due to predator activity.
***Full census not conducted due to COVID-19 pandemic. Numbers are minimal numbers.
****A full census was not conducted, this data represents what was observed in a small portion of the COTE colony on SMNY during 2 site visits.

Productivity

In 2021, tern productivity data was not recorded due to the COVID-19 pandemic and staff shortages. Productivity is estimated to be poor for both common and least terns based on casual observations. Predation and over wash events are thought to be the main reasons for the poor productivity. Productivity for Roseate terns is unknown. No large mortality events were noted this year.

Table 5. Breeding parameters for common and roseate terns on South Monomoy Island in 2021. Data for 2020 shown in parentheses.

Species	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	No data* (No data*)	No data* (No data*)	No data* (No data*)	No data* (No data*)
ROST	No data* (No data*)	No data* (No data*)	No data* (No data*)	No data* (No data*)

*Data not recorded due to the COVID-19 pandemic and staff shortages.

Table 6. Common and roseate tern productivity on South Monomoy Island from 2017 - 2021.

Year	COTE Hatch Success	COTE Reproductive Success (fledglings/pair)	ROST Hatch Success	ROST Reproductive Success (fledglings/pair)
2017	87.5	1.53	72.22	1.36
2018	82.6	1.10	62.16	0.73
2019	89.2	1.01	88.9	0.83
2020	No data*	No data*	No data*	No data*
2021	No data*	No data*	No data*	No data*

*Data not recorded due to the COVID-19 pandemic and staff shortages.

Tern Provisioning

No provisioning data was conducted during the 2021 field season.

Predator Activities and Control Efforts

Predators that were present during the 2021 field season included coyote, northern harrier, greater black-backed gull, laughing gull, herring gull, crow, grackle, black-crowned night heron and bald eagle. Several sets of coyote tracks were continually seen throughout the season along the beach. A coyote was also seen within the tern colony. It is believed that at least 4-5 coyotes were on island with at least one pair denning. Early season removal of coyotes was completed between April 29 and May 3rd. A total of 4 coyotes were removed and an additional male was found dead on the island. On July 29th 1adult male coyote was removed from North Monomoy Island and second coyote was seen. Additional predator control activities were conducted during the nesting season by APHIS from June 7-12. Five grackles, 1 crow and 1 coyote were removed at that time. Predator monitoring did not occur during the 2021 season due to staff shortages related to the COVID-19 pandemic.

New Hampshire

White and Seavey islands

Liz Craig – Program Manager / co-PI, Shoals Marine Laboratory
Jenn Seavey – Program co-PI / SML Executive Director, Shoals Marine Laboratory
Beckley Stearns & Olivia Smith – Seabird Technicians, Shoals Marine Laboratory

Tern Census

Common Terns

- COTE census was conducted on June 16th through 18th, 2021
- Unadjusted census:

    - 750 nests on White Island
    - 2,479 nests on Seavey Island
    - Lincoln Indices were calculated for White Island and Seavey Island (divided into sections with indices ranging from 1.07 to 1.14 on White and 1.00 to 1.25 on Seavey)
- Adjusted census:
    - 777.3 nests on White Island
    - 2635.1 nests on Seavey Island
    - **Total estimated population was 3,412.** Highest census count for COTE since program began in 1997 (up from 3,280 in 2020, the previous max).

Roseate Terns

- 112 ROST nests were established on Seavey Island within the census window (before 20 June 2021) Highest census count for ROST since program began in 1997 (up from 96 in 2020).
- B-wave ROST nests brought season total to 115 (up from 108 in 2020).

Arctic Terns

- 1 ARTE nest was established by 20 June 2021 on White Island.

Table 1. Number of tern nests found on White and Seavey islands from 2015-2020

Year	COTE	ROST	ARTE
2016	2,985	83	3
2017	3,210	92	2
2018	2,175	55	1
2019	2,900	61	1
2020	3,280	96	1
2021	3,412	112	1

Productivity

Common Terns

- 11 fenced plots (~10x12 ft) plus 4 unfenced diet-monitoring areas containing 110 nests total.
- Nests were monitored until chicks reached “fledge” age (15 days)
- Productivity was low in comparison to previous years likely due to frequent storms, high diversity of fish provisioned (indicating poor availability of high-quality prey items), and stress due to regular peregrine falcon predation events.

Roseate and Arctic terns

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

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on White and Seavey islands from 2016-2021. Only nests with known outcomes were used for ROST & ARTE calculations.

Species	Year	Clutch size	Hatching success	Fledging success	Nests monitored
COTE	2016	2.25	1.56	0.80	247
	2017	2.00	1.81	0.35	62
	2018	1.84	1.38	0.45	45
	2019	2.11	1.61	0.85	66
	2020	2.19	1.86	0.57	70

	2021	2.16	1.01	0.33	116
ROST	2016	1.69	1.23	0.94	83
	2017	1.60	1.23	0.91	87
	2018	1.18	0.86	0.82	64
	2019	1.72	1.36	1.02	61
	2020	1.64	1.43	0.91	94
	2021	1.78	1.05	0.65	82
ARTE	2016	2.00	1.00	0.50	2
	2017	2.00	1.50	1.00	2
	2018	1.00	1.00	1.00	1
	2019	1.00	1.00	0.00	1
	2020	1.00	0.00	0.00	1
	2021	1.00	0.00	0.00	1

Tern Provisioning

- COTE nests were monitored for diet.
- A remote observation camera was used to record video of each nest every 1-2 days from 17 June 2021 onwards. GoPros were used to monitor ROST nests starting on 4 July 2021. Complementary provisioning data were collected by observers in blinds to compare to camera observations. Data from camera recordings will be collected in fall 2021.
- Diet items included herring, hake, sand lance, butterfish, cunner, mummichog, lumpfish, goosefish, Acadian redfish, mackerel, stickleback, silverside, Atlantic moonfish, pollock, pufferfish, squid, shrimp, euphausiid, amphipod, flying ant, grasshopper, dragonfly, beetle, and moth.
- Partnering with a genetics lab at Cornell Lab of O (Dr. Gemma Clucas) to conduct DNA metabarcoding of feces to determine diet to species level.

Predator Activities and Control Efforts

PEFA:

- Regular visits from 1-year-old PEFA starting in early May and ending in late June. Estimated to have consumed 2-4 adult terns per day.
- Managed predation with pyrotechnics, lasers, and attempted trapping using a baited Dho-Gazza net.
- Predation events stopped after observing an adult PEFA on the island, assumed to have displaced the younger falcon. Adult PEFA seen infrequently through July, but no predation events were observed.

Gulls:

- Destroyed one GBBG gull nest found on Seavey (first nesting attempt observed in the last 6 years when SML began monitoring).
- Used human presence as well as pyrotechnics and lasers to dissuade gulls from lingering and predating.
- Lethal control: removed 1 GBBG (injured from fishing gear and loafing on colony)
- Found remains of approximately 21 COTE chicks on Little Seavey that had been predated by gulls.

Other Avian:

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

Muskrats:

- Due to predation issues in previous years, muskrats were trapped near their den on Seavey using havahart traps. 1 successfully trapped in 2021.

Other Nesting Species

- Common Eider: at least 35 nests (2 on White and 33 on Seavey; up from 34 in 2020)
- Spotted Sandpipers: at least 10 nests (3 on White and 7 on Seavey; up from 5 in 2020)
- Song Sparrow
- Black Guillemot: 6 nests confirmed on Appledore and 8 nests confirmed on Smuttynose
- Used eBird for daily bird list to share bird diversity data from White and Seavey

Research:

- Collected GPS locations for all censused nests in the ArcCollector app. Evaluating spatial distribution of birds and nest site selection wrt habitat characteristics.
- Continued application and evaluation of hypersaline spray for habitat management.
- Tern fecal collection (for DNA metabarcoding) and visual diet observations conducted to determine diet.
- Exploration of historic tern diet data and reproductive success/growth wrt fisheries data.
- Exploration of butterfish implications for growth/survival of chicks with undergraduate student/technician Olivia Smith.
- Exploration of microplastic ingestion by terns via fecal and forage fish analysis.
- Deployed 20 GPS tags to pair provisioning data with foraging. Data to be applied to boat-based fish sampling with graduate student Aliya Caldwell.

Maine

Least Terns

On June 8th and 10th a coordinated least tern census documented a minimum of 281 least tern pairs within the state of Maine. During the census window, 18 nests were counted at Laudholm Farm, 116 nests were at Crescent Surf, 63 nests were at Stratton Island, 71 nests were at Higgins Beach, and 13 nests were at Seawall Beach. On June 30th, outside of the census window, 10 nests were observed at Goose Rocks Beach. Together, Laudholm and Crescent Surf produced a minimum of 81 fledglings, Stratton Island produced 0 fledglings, Higgins Beach produced a minimum of 17 fledglings, Seawall Beach produced 39 fledglings, and Goose Rocks beach produced 0 fledglings. State productivity was estimated to be about 0.5 fledglings per pair. Overall, least terns had a successful year despite multiple challenges. Our pair count was the second highest recorded behind 2019 when there were 296 pairs. The state productivity was the highest it has been since 2015.

Estimate of Least Tern Pairs/Nests

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

[ ] colony partially or fully abandoned. () number fledged.
***** simultaneous count at all occupied nesting sites during window count, not a site specific high nest count, only these numbers used in total. In 2017, after window count, colonies moved around substantially due to predation issues, in 2018 a synchronized count was not possible as the CS colony was disrupted and colonies never really synched up.
**** nesting outside of the window count and not included in state total**
*** Productivity at Crescent Surf and Laudholm Farm should be calculated by combining number of nests and fledglings from the two beaches and be considered one "Little River colony" as LETE were moving back and forth between beaches after fledgling making it impossible to know which birds fledged from which beach.

Laudholm Farm Beach, Wells

Helen Manning, Kate O'Brien, and Kristen Johnson - Rachel Carson NWR

Population Estimate: 18 pairs were nesting during the walking nest count census conducted on June 10th. Two fledgling counts were conducted on July 19th and August 3rd where a minimum of 41 fledglings were observed. It is unknown how many of the fledglings actually fledged from Laudholm and how many fledged from Crescent Surf as the two beaches are only separated by the Little River and they were observed going back and forth between beaches. Fledgling counts were conducted simultaneously on both beaches. Productivity is more accurately calculated by combining the two beaches for 81 fledglings/134 nests and calling it the "Little River colony". Laudholm experienced some overwash and weather events that caused nest loss and chick mortality.

Comparison: 21 pairs nested at Laudholm in 2018 but all nests were predated by a fox after the electric net fence failed. There were no pairs nesting at Laudholm in 2019 or 2020.

Predator Control: Predator control was not conducted at Laudholm Farm Beach. An electric net fence was set up around the colony.

Crescent Surf Beach, Kennebunk

Helen Manning, Kate O'Brien, and Kristen Johnson - Rachel Carson NWR

Population Estimate: 116 pairs were nesting during the walking nest count census conducted on June 10th. Three fledgling counts were conducted on July 19th, August 3rd, and August 19th where a minimum of 40 fledglings were observed. It is unknown how many of the fledglings fledged from Crescent Surf and how many fledged from Laudholm as the two beaches are only separated by the Little River and they were observed going back and forth between beaches. Fledgling counts were conducted simultaneously on both beaches. Productivity is more accurately calculated by combining the two beaches for 81 fledglings/134 nests and calling it the "Little River colony". Crescent Surf experienced multiple overwash and weather events that caused nest loss and chick mortality. In addition, at least one adult and two fledglings were predated by a great horned owl, at least two adults were predated by a peregrine falcon, and two adults were found dead with no outward sign of injury or predation.

Comparison: Crescent Surf Beach saw its most successful years in 2015, 2013, and 2012 with productivity of 1.04, 0.76, and 0.79 respectively. 2020, 2011, 2009, and 2008 were decent years with productivities between 0.5-0.6. Productivity was poor in 2017, 2016, and 2014, and was also poor from 2003-2007.

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

Goose Rocks Beach, Kennebunkport

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns appeared courting on Goose Rocks Beach in early June and a small colony formed by late June after the window count time period. As many as ten nests were observed at once on June 30th. The colony abandoned for unknown reasons in late July and no chicks fledged.

Comparison: Least Terns did not attempt to nest on Goose Rocks in 2020. Some were observed engaging in courtship in 2019 but did not nest. Two pairs attempted to nest in 2018. At least seven pairs attempted to nest in 2017 but all were unsuccessful. Ten pairs of Least Terns made nest attempts on Goose Rocks Beach in 2016 fledging at least seven chicks. No Least Terns attempted to nest at Goose Rocks Beach from 2012-2015. In 2011 a season high of 46 birds were documented and produced a minimum of 12 fledglings. In 2010, a small colony set up after failures at Crescent Surf Beach and Stratton Island, however no chicks survived.

Predator Control: None.

Western/Ferry Beach, Scarborough

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns did not attempt to nest on Western Beach in 2021.

Comparison: Least Terns were often observed flying and foraging near Western Beach but did not attempt to nest in 2020. In 2019, 35 Least Tern nests were observed on Western, but after a predation event, none survived, and no chicks remained. There were a minimum of five Least Tern nests in 2018 that fledged no chicks. There were 48 Least Tern nest attempts on Western Beach in 2017, and these fledged at least five birds. In 2016, there were at least four nest attempts on Western Beach, with no fledglings produced. Before this, terns had not nested on Western Beach since 2008, and the site had not fledged chicks since 2005, when there was a total of 40 active nests. Prior to 2005, Least Terns had not nested at the site since 1981.

Predator Control: None.

Stratton Island

National Audubon Society

Population Estimate: 63 pairs were nesting during the census conducted on June 10th. After two rounds of overnight predation by black-crowned night herons in early July, the colony effectively abandoned. There were 65 nests present at max count, including 7 that were lost to high tide the previous week. There were around a dozen nests still present after the predation events but there did not appear to be adults tending to them. What did remain was then lost to tropical storm Elsa. No chicks survived this season.

Comparison: Least terns did not nest on Stratton Island in 2020, but this site had historically been the second largest colony in the state before that.

Predator Control:

Higgins Beach, Scarborough

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: 71 pairs were nesting during the walking nest count census conducted on June 10th. Four fledgling counts were conducted on July 14th, July 22nd, August 5th, and August 12th. A minimum of 17 chicks fledged from Higgins Beach. An electric fence surrounded most of the colony and there was little evidence of predator issues. Higgins Beach is a popular tourist beach with many beach-walkers wandering near the colony, disrupting roosting birds and making it a challenging place for fledgling birds. We believe that many fledglings leave earlier than the standard 2-week residency period, and as a result our fledgling estimates are particularly low for this site.

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

Predator Control: An electric net fence was set up surrounding most of the colony.

Seawall Beach, Phippsburg

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: 13 pairs were nesting during the walking nest count census conducted on June 8th. The colony was a continuous wave of new nests over a month-long period and we estimate had over 60 nesting pair. No conclusive walking counts occurred after the walking nest window count due to chick rearing. Five fledgling counts were conducted on July 21st, July 28th, August 4th, August 9th, and August 18th. At least 39 chicks fledged from

Seawall Beach. Although the predators like fox and coyote and gulls frequent this site, no notable predation events took place, although dog tracks were found throughout the colony on two separate visits in late July.

Comparison: A small colony of Least Terns nested on the Morse end of Seawall Beach in 2020. There were seven nests that fledged at least one chick. One Least Tern nest was found in 2016 on Seawall, but otherwise terns have not attempted to nest on Seawall Beach since 2005. That year a 17-nest colony was decimated by a fox or coyote.

Predator Control: None.

Popham Beach State Park, Phippsburg

Laura Zitske and Laura Williams - Maine Audubon

Population Estimate: Least Terns were observed flying and foraging above the Morse River between Popham Beach and Seawall Beach but no terns nested on Popham Beach in 2021.

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

Predator Control: None.

Stratton Island

Michael Rickershauser – Island Supervisor, National Audubon Society Seabird Institute

Tern Census

An island-wide Common Tern nest count was conducted on June 11. Arctic and Roseate Tern nests were found and counted throughout the season. Roseate Terns increased from previous years to a total of 140 nests during the GOMSWG census. Arctic Terns had 10 active nests during the GOMSWG census. 2 nest were found and predated prior to census and thus not counted, and 3 nest were found after census closed, bringing the total number of Arctic nests on Stratton in 2020 to 15 nests. The Common Tern nest count of 1,212 nests was corrected with a Lincoln index of 1.02 to 1,236 nests, and the addition of 79 productivity and feeding study nests brought the total count to 1,315 nests. The Least Tern census was performed on June 10, with 63 nests found. 2 additional nests were found afterwards, bringing the 2021 total to 65 nests.

Table 1. GOMSWG census results on Stratton Island, 2016-2021.

Year	COTE	ARTE	ROST	LETE
2016	825	4	86	69
2017	1127	2	119	93
2018	1206	8	128	122
2019	1244	9	125	96
2020	1159	5	114	0
2021	1315	10	140	63

Tern Productivity

Tern productivity was determined from both fenced and unfenced plots. The 79 nests in the Common Tern plots fledged 0.66 chicks per nest. Roseate Tern productivity was 1.02 chicks fledged per nest for the 95 nests followed. From the 15 Arctic Tern nests followed, no chicks were seen after 15 days so productivity was not estimated. Least Terns chicks succumbed to heavy BCNH predation as well as exposure/abandonment. No Least Tern chicks survived to 15 days.

Table 2. Tern productivity on Stratton Island, 2016-2021.

	2016	2017	2018	2019	2020	2021
COTE						
Mean clutch	2.40	2.32	2.20	2.01	2.41	2.6
Mean hatch	2.25	1.98	1.92	1.59	1.93	2.46
Productivity	1.0	0.63	0.53	1.13	0.76	0.66
ROST						
Mean clutch	1.88	1.88	1.96	1.68	1.57	1.83
Mean hatch	1.28	1.59	1.70	1.42	1.36	1.24
Productivity	1.01	1.03	1.29	1.28	1.16	1.02
ARTE						
Mean clutch	-	2.00	2.00	1.82	1.58	1.69
Mean hatch	-	1.00	0.25	1.18	1.08	0.55
Productivity	0	0.5	0.13	0.73	-	-
LETE						
Mean clutch	-	-	1.82	1.89	-	-
Mean hatch	-	-	-	0.96	-	-
Productivity	0.2	~0.02	-	-	-	0.0

Tern chick provisioning

13 Common Tern nests were observed with a total of 943 feedings. Chick diet primarily consisted of herring, hake, and sandlance, comprising 18.4%, 15.1%, and 12.6% of deliveries, respectively. 19.1% of prey items were not identified to species. 10 Roseate Tern nests were observed with a total of 579 feedings. Diet primarily consisted of sandlance and hake, at 52.2% and 19.7%, respectively. 28.0% of prey items were not identified to species.

Predation

As part of an effort to reduce Herring and Great Black-backed Gull populations on Stratton and Bluff Islands, eggs in all gull nests found on Bluff Island were poked early in the season. 88 Herring Gull nests totaling 215 eggs and 42 Great Black-backed Gull nests totaling 110 eggs were poked on Bluff Island. These nest counts are a significant increase in what was a steady year-over-year decline. In 2019, nesting had reached a low of 26 Herring Gull and 28 Great Black-backed Gull nests. 1 Great Black-backed Gull nest was found on each of Stratton and Little Stratton. Both nests were removed.

Night-heron disturbance was significant in 2021. Between 23 June and 27 the majority of Least Tern chicks were predated. Towards the end of the season, characteristic “egg-slashing” was seen in old and re-laid COTE nests throughout the colony and both adult and juvenile BCNH were flushed by researchers responding to colony disturbance.

Wading Birds

The 2021 wading bird census was conducted on May 18-19. Researchers use mirror poles to view nest contents and egg templates to identify nests to species. 199 Glossy Ibis, 61 Snowy Egret, 49 Great Egret, and 3 Black-crowned Night-heron nests were identified.

Common Eiders

Common Eider census was conducted May 18 through May 24. 423 nests were located on Stratton with another 51 on Bluff Island for a total of 474 nests. Clutch size was determined for 305 nests, averaging 4.48 eggs per nest.

American Oystercatchers

In early May, 2 American Oystercatcher nests were found on Little Stratton. Both nests were gone when checked at a later date and it is believed they succumbed to gull predation as Little Stratton is frequently occupied by both

Great Black-backed and Herring Gulls. On June 4 a 3-egg nest was located on the southeast side of Gull meadow. On July 12 two mature oystercatcher chicks were seen with adults on the north shore of Gull Meadow.

Black Guillemots
6 active Black Guillemot burrows were confirmed in 2021, with 5 on Stratton Island and 1 on Bluff Island. 3 additional nests were located on Stratton but were washed out due to proximity to the tide line. A high count of 56 adult Black Guillemots was recorded on August 2.

Double-crested Cormorants
Double-crested Cormorant nest census was conducted on June 5. An average was determined from three observers counting all nests seen via boat. An estimate of 145 DCCO nests were found on Bluff Island.

Visitors
Stratton Island was closed to visitors this year due to COVID-19 and staffing restrictions. Approximately 20 visitors landed on Stratton and Little Stratton, mostly recreationists on paddleboards and kayaks, and all left after being informed that the island was closed this summer.

Notable Birds
- Virginia Rail seen on landing trail May 19
- Tricolored Heron, 2 seen in the rookery several days in early June and late July
- Atlantic Puffin, 2 seen off the eastern shore on June 14
- Razorbill, 1 seen off the eastern shore on July 17
- Horned Lark seen on LETE beach regularly June 20 through June 2

Outer Green Island

Catherine Neal – Island Supervisor, National Audubon Society Seabird Restoration Program

Tern Census
The 2021 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on June 10. 1,570 Common Tern nests were counted. The Lincoln Correction Index was calculated at 1.102 bringing the total to 1,661nests. 2 Roseate Tern nests were counted for census, and an additional nest was laid after census.

Table 1. GOMSWG annual census results on Outer Green Island, 2016-2021

Year	COTE	ROST	ARTE
2016	1367	0[1]	0
2017	1434	0	0
2018	1553	0[2]	0
2019	1717	0	0
2020	1775	0	0
2021	1661	2[1]	0

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

Tern Productivity
The average number of eggs per nest was 2.19 (n=89) of which an average of 1.93 hatched. The first recorded hatch was on June 11, and peak hatch lasted from approximately June 15-18. The average number of chicks fledged per nest (productivity) was 0.48. This is the lowest productivity since 2008 and the lowest in the history of the island.

Table 2. Outer Green Island annual Common Tern productivity, 2015-2021

Year	Mean Clutch	Mean Hatch	Productivity
2016	2.40	2.12	1.26
2017	2.13	1.93	1.45
2018	2.16	1.87	1.14

2019	2.12	1.81	1.32
2020	2.12	1.93	0.74
2021	2.19	1.93	0.48

Tern Provisioning

Chick provisioning was observed at a total 24 Common Tern nests. A total 1394 feedings were recorded over a period of 1044.5 nest-hours with an average feed rate of 1.33 items per nest-hour. The most frequently observed prey item was herring which made up 22.7% of the observed diet, followed by hake, which made up 22.4% of the observed diet. Interestingly, chicks were fed a surprisingly large numbers of flying ants on several occasions. Some chicks took readily to the food item, where others left the item discarded at the nest.

Predation

A Black-Crowned Night Heron was suspected early in the season where two areas of the island suffered significant damage to eggs by scissoring. Second nesting attempts were initiated, but most chicks were found dead within one week of hatching. Throughout the season, Greater Black-backed and Herring Gulls were present, but were not estimated to be a significant threat until chicks began fledging. Herring Gulls were observed with fledgers in their bills, and on two occasions flew directly into the colony to successfully take a chick. Loud noises such as clapping, yelling, and screamer sirens were used consistently towards the end of the season as negative re-enforcement techniques to scare off all predators, with mixed results.

A Peregrine Falcon visited the colony on June 1, but was chased off and not seen again until July 7. It proved to be a problem later in the season where evidence of predation on fledgers was a daily occurrence. Efforts to scare off the falcon were mostly unsuccessful. The use of a cap gun was reasonably effective if the bird was within close range where it would swerve away from the island.

Table 3. Outer Green Island predator control efforts, 2021

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

Weather Events

There were several notable weather events that occurred this season. The main event was a storm that occurred on July 1-5. Also, Hurricane Elsa brought a total of 3 inches of rain in less than two hours. Both of these events proved fatal to many chicks throughout the island and several drowned nests were also evident.

Black Guillemots (*Cepphus grylle)*

There are currently 22 numbered guillemot burrow sites that are still usable on the island. 15 of them were monitored for productivity. The average clutch size was 1.87 and the average number of eggs hatched per nest was 1.33. On the last check of the season 16 of the 23 hatched chicks had fledged. The remaining 3 were extremely probable to fledge as weight gains were steady and significant. Estimated productivity was 1.13 chicks fledged per pair.

Jenny Island

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

Tern Census

The annual Gulf of Maine Seabird Working Group (GOMSWG) census was conducted on June 11. A total of 1,891 Common Tern nests were counted, with clutches ranging between 1 and 4 eggs, and one nest numbering 5. A Lincoln index mark/recapture correction of 1.028 was applied to the uncorrected count. The addition of 76 productivity nests and 24 marked feeding study nests brought the total to 2044 nests (Table 1). This count is the highest ever recorded on Jenny, notably larger than the previous record in 2019, with 1,618 nests (Table 1). Seventeen Roseate Tern nests were also active during the GOMSWG census window. No additional B-wave nests

were laid after the census window. One Arctic Tern adult was present all season; however no mate or nest was ever identified.

Table 1. GOMSWG census results on Jenny Island, 2017-2021.

Year	COTE	ROST
2017	1,298	22
2018	1,426	24
2019	1,618	21
2020	1,433	21
2021	2,044	17

Tern Hatch and Fledging

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

Tern Productivity

For Common Terns, five productivity plots containing 76 nests and three feeding study plots with 18 nests were monitored to determine productivity. 17 Roseate Tern nests were monitored for productivity. Common Tern productivity was 0.54 chicks fledged per nest, which was a decrease from 2020, when it was 0.68 (Table 2). This decrease is likely attributed to a scarcity in high-quality food throughout the breeding season, severe weather events, and overcrowding or high chick density. Important to note that while sample sizes were similar, mean clutch size and mean hatch were both significantly higher than in 2020 (Table 2). Intense Peregrine Falcon predation likely contributed to a decrease in productivity, directly and indirectly, as frequent dreading may affect attention time given to incubating eggs or provisioning chicks. Roseate Tern productivity was 1.35, an increase from 2020, although with fewer nests (Table 2).

Table 2. Tern productivity on Jenny Island in 2021. Data for 2020 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.62 (2.16)	2.28 (1.88)	0.54 (0.68)	94 (93)
ROST	1.94 (1.81)	1.71 (1.38)	1.35 (0.99)	17 (21)

Tern Provisioning

Tern chick provisioning was monitored at three feeding study plots with 18 Common Tern nests. A total of 1125 feedings were observed during 178 observation hours. Atlantic herring constituted the majority of observed feedings (42.7%; Table 3). Hake (including white hake and four-bearded rockling) made up another 14.3% of the feedings.

Table 3. Principal prey items in COTE chick diet on Jenny Island in 2021.

Prey item	Number of Items	% of Diet
Herring	480	42.7
Hake	161	14.3
Euphausiid	53	4.7

One feeding study plot with 4 Roseate Tern nests was monitored. A total of 144 feedings were observed during 48 observation hours. Sandlance constituted the majority of observed feedings at 41.7% (Table 4), which is an increase from 2020 (33.1%). Herring and hake (including white hake and four-bearded rockling) tied for the second most common item at 21.5%.

Table 4. Principal prey items in ROST chick diet on Jenny Island in 2021.

Prey item	Number of Items	% of Diet
Sandlance	60	41.7
Herring	31	21.5
Hake	31	21.5

Predator Activities and Control Efforts

Large gulls were not a significant problem in the 2021 field season. Though many Herring and Great Black-backed Gulls were seen following lobster boats around the island, only a limited number were typically seen loafing on the northern sand spit and southern intertidal zone, with increased presence towards the end. No Gull species nested on the island.

Though Laughing Gulls have nested on Jenny Island in the past, no signs of nesting were found on the island this season. Laughing Gulls were a significant nuisance to the nesting terns in 2020, but in 2021, were a minor presence. Numbers rarely exceeded 3 individuals. No chicks or eggs were seen to have been predated by Laughing Gulls.

Great Horned Owl predation contributed to tern mortality in 2020 and 2019, but in 2021, no signs of owl predation were witnessed.

Peregrine Falcon predation was very apparent during the 2021 season. Two individuals were identified based on rates of appearance during the majority of the season (one would leave with prey and another would appear separately), and a juvenile or immature made appearances towards the end of the season (based on plumage). Throughout the incubation and chick-rearing parts of the season, adults and chicks would be caught and carried away, while multiple disembodied wings and heads of fledged and unfledged chicks, characteristics of falcon kills, were discovered regularly.

Black-crowned Night-Herons were seen and heard on occasion throughout the season; however no signs of predation or presence beyond flyovers were witnessed.

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

Other Birds

Four Common Eider nests were found during the 2021 GOMSWG census, compared to nine in 2020. One Mallard or American Black Duck nest was also discovered, but no breeding adults or chicks were witnessed.

Pond Island

Adam DiNuovo – Island Supervisor, National Audubon Society Seabird Restoration Program

Tern Census

Tern census was conducted on June 20. The unadjusted count for Common Terns (COTE) was 607 nests. An additional 45 COTE study nests were being followed at the time of census and the Lincoln Index was 1.09. The adjusted count of 706 nests, which includes study nests, is the lowest number of nests recorded on Pond Island since 2015 and 747 fewer nests than last year (Table 1). The reason for this decline is referenced in the predator discussion below.

At the time of census, there were 0 Arctic Tern (ARTE) nests and 0 Roseate Tern (ROST) nests. Over the course of the season there were a total of 3 ARTE nests, 1 of which failed before the census date and 2 identified post census. No ROST nests were found this season.

Table 1. Number of tern nests on Pond Island NWR from 2015-2021.

Year	COTE	ROST	ARTE
2015	685	0	6
2016	773	1	6
2017	942	0	8
2018	1,065	2	11
2019	1,159	0	7
2020	1,453	2	3
2021	706	0	0

Productivity

COTE productivity was determined by following 63 nests in fenced and unfenced study plots. These nests were followed from egg stage until fledging (fledging determined at 15 days unless later found deceased). Mean clutch size for COTE was 1.86 with a mean hatch of 0.82 and 0.28 fledged per nest. Three ARTE nests were monitored. ARTE mean clutch size was 1.00, with a mean hatch of 0.33, and productivity of 0.33 chicks fledged per nest. (Table 2)

Table 2. Breeding parameters for Common and Arctic terns on Pond Island in 2021. Data for 2020 shown in parentheses.

Species	Clutch size	Hatched per nest	Fledged per nest	Nests monitored
COTE	1.86 (2.03)	0.82 (1.71)	0.28 (0.76)	63 (62)
ARTE	1.00 (1.56)	0.33 (0.56)	0.33 (0.45)	3 (9)

Tern Chick Provisioning

Chick provisioning studies were conducted by observing 16 COTE nests from hatching through fledging or failure. There were 1225 total feedings observed during 416 nest hours, resulting in a feeding rate of 2.94 feedings per hour. General chick diet observations were added due to a chick provisioning study plot failing, bringing total feedings observed to 1723. The principal prey species delivered were herring (49.21%) and sandlance (41.78%). Euphausiid was the third most abundant prey species compromising 4.99% of diet. (Table 3)

Table 3. Principal prey items in COTE chick diet on Pond Island in 2021.
Data for 2020 shown in parentheses.

Prey item	Number of Items	% of diet
Herring	848 (557)	49.21 (38.24)
Sandlance	720 (634)	41.78 (33.59)
Euphausiid	86 (89)	4.99 (5.37)

Predator Activities and Control Efforts

Pond Island was subjected to several predators during the 2021 season. Upon opening the island on June 1 (a week late due to weather), signs of Great Horned Owl (GHOW) predation were observed and an owl was caught the first night. Traps were set nightly due to the terns' continued nocturnal abandonment. A second GHOW was caught the night of June 9. Nocturnal abandonment continued until June 20. Owl traps were set nightly through the end of June with no other sign of owls observed. The presence of owls and the late opening resulted in approximately half the colony abandoning the site. The owl presence and late opening set the table for the low productivity on Pond Island in 2021.

Evidence of predation by American Crow was also seen on opening day with dozens of depredated eggs seen throughout the colony. In the early morning of June 2 five crows were seen landing on the island taking Common Tern and Common Eider eggs. Island staff did daily predawn stints to deter crows and the island supervisor was able to remove 3 crows in the month of June. Harassment by crows stopped in early July due to staff efforts.

A Peregrine Falcon (PEFA) started visiting the island several times a week in early June. In early July the PEFA was accompanied by a juvenile and visited several times a day and was seen taking adult terns daily. Late July

brought a third PEFA and the 3 were seen multiple times a day hunting together. The PEFA were also seen landing in the colony and taking chicks on several occasions. PEFA came daily before sunrise and at sunset resulting in terns abandoning colony from 0400-0530 and 2000 and 2130 every day. The presence of the PEFA also made the colony very jumpy with the colony flushing approximately 30 times per hour throughout the entire day. The early and late abandonment along with the constant flushing happened no matter the weather, leaving young or hatching chicks subjected to heavy rain on 2 occasions. This constant pressure from the PEFA no doubt played a role in the low hatch success and productivity on Pond Island in 2021.

Depredation from Great Black-backed Gulls (GBBG) and Herring Gulls (HERG) was sporadic with 1 GBBG and 3 HERG seen harassing the terns at different times during the season. All 4 of these gulls were removed by the island supervisor.

Western Egg Rock

Paula Shannon – National Audubon

Visited island on 24 June and estimated 10 or fewer LAGU nests from Visual Estimate of Birds (VE). We didn't do a complete walk-through census since there was little activity - just one nest was actually found on the ground, and about 20 individuals were observed around the area.

Eastern Egg Rock

Kay Garlick-Ott – Island Supervisor, National Audubon Society Seabird Institute

Census

An island-wide Common Tern and Laughing Gull nest count was conducted on June 13, 2021. During census, 1235 COTE nests were counted. The addition of productivity nests, feeding study nests, and a Lincoln index of 1.0392 brought the total to 1359 nests. 251 Laughing Gull nests were located during census. Arctic and Roseate Tern nests were identified between June 1 and June 22. The census count of Roseate Terns was 85. 74 Arctic Tern nests were identified.

Table 1. GOMSWG census results on Eastern Egg Rock, 2016-2021.

Year	COTE	ARTE	ROST	LAGU
2016	852	76	78	1973
2017	886	76	104	1729
2018	1021	86	82	1
2019	1067	70	73	333
2020	1156	77	80	1174
2021	1359	74	85	251

Tern Productivity

Common Tern productivity was calculated from 76 nests in both fenced productivity plots and unfenced feeding study plots. Productivity measured 0.53. This value remains much lower than COTE productivity estimates for the last fifteen years. Roseate Tern productivity was calculated from a sample of 79 unfenced nests. Roseate Terns fledged 0.95 chicks per nest. Arctic Tern hatching success was monitored at 73 nests. Arctic Tern hatch success was low this year at 0.58, likely due to a combination of bad weather events and predation from Laughing Gulls and Mallards.

Table 2. Tern productivity on Eastern Egg Rock in 2021. Data for 2020 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	2.28 (2.28)	2.01 (1.81)	0.53 (0.27-0.56)	76 (79)
ARTE	1.28 (1.67)	1.06 (0.60)	-	73 (42)

ROST	1.66 (1.83)	1.45 (1.68)	0.95 (1.60)	79 (72)

Tern Provisioning

Thirteen Common Tern nests were observed over a total of 551 nest-hours. Herring was the most frequently fed prey item, comprising 32.5% of feedings, followed by hake at 26.3%. Five Arctic Tern nests were observed for 99 nest-hours. Euphausiids comprised most of the diet at 33.8%, followed by amphipods at 27.3%. Seven Roseate Tern nests were observed over 336 nest-hours. Herring was the most frequently observed prey item at 30.2% followed by hake at 24.4%, and sandlance at 15.8%.

Table 3. Principal prey items in tern chick diet on Eastern Egg Rock in 2021.

COTE		ROST		ARTE	
Prey Item	**%**	**Prey Item**	**%**	**Prey Item**	**%**
Herring	32.5	Herring	30.2	Euphausiid	33.8
Hake	26.3	Hake	24.4	Amphipod	27.3
		Sandlance	15.8		

Common Tern provisioning was also monitored during the courtship period. Common Terns were observed for a total of 72 observer hours. Courtship feedings were comprised primarily of herring at 38.8%, and hake at 20.0%.

Table 4. Principal prey items in observed adult courtship feedings on Eastern Egg Rock in 2021.

COTE	
Prey item	**%**
Herring	32.5
Hake	26.3

Predator Activities and Control Efforts

Herring Gulls continued to predate the tern colony this season. One Herring Gull was lethally removed. Other avian predators, including Peregrine Falcons and Bald Eagles, were observed flying by the colony on multiple occasions. A Peregrine Falcon was witnessed taking an adult tern and a tern fledger on separate days, but no other kills were observed.

The team continued efforts to manage Laughing Gulls through a rotating barrage of behavioral harassment, including playing bongo drums, clapping, carcass walks, bullhorn, and athletic whistle. Laughing Gull effigies were strung up around the island prior the crew's arrival on May 7. All nests counted during census were oiled. The reduced number of nesting LAGU at census can be attributed to the efficacy of this strategy; however, the effort involved in coordinating this deterrence is not advisable for future years. After census LAGU nested in large numbers, and it is likely the delay in LAGU breeding may have resulted in a high number productive nests later in the season.

A family of Mallards was again observed predating common tern nests. As there were several mallards raising chicks on Eastern Egg Rock, it is unclear whether one or multiple broods were responsible for predation events. Future attempts to dissuade mallard nesting should be considered.

Table 5. Gull control measures at Eastern Egg Rock in 2021.

	GBBG	HERG	LAGU
Gulls Shot	0	1	8
Nests Destroyed	0	0	324

Atlantic Puffins

There were a minimum of 140 active puffin burrows on the island, likely an underestimate that can be attributed to reduced observation coverage. Hake comprised most of the puffin diet at 65.1%. Haddock was the second most

prevalent prey species observed at 22.2%. A notable influx of rough Scad (5.5%) was seen in 2021. The first chick feeding was observed on June 8 from Tower Blind.

Black Guillemots
Productivity was monitored for Black Guillemots at 31 nests. Mean clutch size was 1.96 and productivity was 0.83 chicks fledged per nest, higher than the 2020 productivity of 0.71.

Leach's Storm-petrels
Leach's Storm-petrels productivity was monitored at 91 nests across three plots. Hatching success was 0.67, which is lower than the 0.72 hatching success reported in 2020.

Visitors
The number of visitors to Eastern Egg Rock in 2021 was limited due to the threat that coronavirus transmission could pose to the field crew. Notable visitors included Dr. Steve Kress for several nights in mid-July, as well as photographers Jean Hall and Derrick Z. Jackson, and a crew from National Geographic.

Metinic Island

Emma Paton – Island Supervisor, USFWS

Tern Census
On June 18, we counted 1,006 tern nests during the Gulf of Maine Seabird Working Group (GOMSWG) census. After applying a Lincoln Index Correction Factor of 1.04 to the raw count and adding 65 productivity plot nests, we estimated a corrected total of 1,111 tern pairs at Metinic in 2021. This is the largest nesting population since restoration began in 1998. We identified the species of 28% of the nests (n=315) and calculated a species ratio of 62% common terns (690 pairs) and 38% Arctic terns (421 pairs).

Table 1. Estimated number of tern pairs counted during the GOMSWG census at Metinic Island, 2017-2021.

Year	COTE	ARTE
2017	331	295
2018	522*	320*
2019	515*	316*
2020	630*	389*
2021	690*	421*
*new species ratio method used		

Productivity
Productivity was much lower than in recent years for both Arctic and common terns. We suspect that productivity was lower due to poor weather conditions in early July and less food available than in 2020.

Table 2. Tern reproductive success at Metinic Island, 2017-2021.

	2017	2018	2019	2020	2021
Common Tern					
# of Nests	23	41	40	45	44
Mean Clutch Size	2.35	2.24	2.25	1.96	2.20
Mean Hatch Success	90.7%	88%	90%	81.8%	89.7%
Mean Fledge Success	69.4%	42%	46%	50.0%	19.6%
Chicks fledged/pair	1.48	0.83	0.93	0.80	0.43
Arctic Tern					
# of Nests	48	26	24	24	28
Mean Clutch Size	1.90	1.69	1.71	1.63	1.82
Mean Hatch Success	89.0%	93.2%	85.4%	92.3%	88.2%
Mean Fledge Success	93.8%	61%	91.4%	63.9%	35.3%
Chicks fledged/pair	1.58	0.96	1.33	0.96	0.64

Tern Provisioning

During chick provisioning observations, we watched eight common tern nests for 185 hours and recorded 150 feedings (0.81 feedings/hour/per nest) and observed 13 Arctic tern nests for 339 hours and saw 392 feedings (1.16 feedings/hour/per nest). Dominant food items delivered to common tern chicks were hake (24.0%) and herring (22.7%). The most abundant food brought to Arctic terns were unidentified fish (21.7%) followed by unknown (21.4%) and hake (20.7%). Feeding rates for Arctic terns increased slightly compared to 2020, and the average size of prey items increased for all species except hake and herring. Common tern feeding rates also increased slightly from 2020 but overall average prey size decreased, except for butterfish and inverts. Common tern diet averaged 82% fish and Arctic tern diet averaged 64% fish. We observed a higher percentage of butterfish delivered to chicks in the beginning of July. Linear growth rates were much lower than previous years (2.8g/day) for Arctic terns and (3.1g/day) for common terns. The average linear growth from 2017-2021 was 5.1g/day for Arctic terns and 5.3g/day for common terns.

Table 3. Principal prey items (percent) of tern chick diets on Metinic Island in 2021.

Prey Item	COTE	ARTE
Herring	22.7%	7.9%
Hake	24.0%	20.7%
Invert	6.7%	14.3%
Sand Lance	5.3%	1.3%
Butterfish	2.7%	6.4%
Pollock	3.3%	1.0%
Hake/herring	5.3%	1.8%
Unknown Fish	18.7%	21.7%

Predator Activities and Control Efforts

The rate of predation on tern eggs (4.4% of 91 nests monitored) prior to the GOMSWG census was slightly higher than 2020 but lower than previous years. A peregrine falcon visited the colony three times but was not successful. A single merlin was observed hunting in and around the tern colony throughout the season and is known to have taken at least 20 tern chicks. The merlin visited the colony from late June to late July but most visits occurred at the end of June. It was observed successfully hunting on multiple occasions and signs of merlin predation were found in the intertidal area. Laughing gulls did not breed on Metinic in 2021, but small groups were observed throughout the season and they were observed kleptoparasiting terns in July. We lethally controlled three herring gulls in 2021. We oiled six great black-backed and 181 herring gull nests this season. A great horned owl was heard near the forest six times in May but is not believed to have predated any terns. We removed 53 eastern garter snakes from the tern colony this season.

Black Guillemots

We located 73 active guillemot burrows on USFWS property and determined an 80% hatch rate for eggs with known fates from 64 burrows checked by July 26th. Out of the 23 burrows we routinely monitored, two burrows completely failed due to predation or chick mortality. We found the first chick on June 17th. As of the last burrow check on July 26th, 72% of chicks from monitored burrows (n=26 chicks) and 65% of chicks island wide (n=54 chicks) were at least 10 days old and still alive. We banded 39 chicks.

Leach's Storm-Petrels

We completed a petrel census in the forested section of the island on May 20th and found very few burrows in the forest interior. We located 104 active burrows on the north end of the island using callback or a burrow scope and we confirmed eggs in 15 burrows. As of our last burrow check, 67% of eggs had hatched (n=10 chicks). We found one dead chick on July 22nd.

Common Eiders

We conducted a common eider census in conjunction with the gull census on the north end of Metinic Island on May 24th, 25th, and 28th. We identified 44 nests during the census by finding a nest, finding an incubating female, or flushing a female out of a patch of dense vegetation. The census did not include the forest interior, but we observed several hens frequenting this area throughout the season. We observed the first eider ducklings on May 28th, and we

continued to see ducklings throughout the season as they approached adult size. The largest crèche was observed in North Cove on June 23rd and included 46 ducklings and 38 hens.

Incidental Sightings
We documented 113 species of birds on Metinic in 2021 and confirmed breeding for 15 species.

Sheep
Sheep graze Metinic from September through May and are kept on the south side of the island during the seabird breeding season. When the round up was conducted on May 14th, at least two sheep remained on FWS property. By the end of June, at least 10 sheep were on FWS property. We suspect that they navigated around the edge of the fence at low tide and there was no way to prevent this. We counted 14 sheep by early July, but no damage to the fence was observed during routine checks. In July, the sheep made almost daily attempts to enter the colony and were successful eight times either before dawn or in foggy conditions. We did not find crushed eggs or chicks after the sheep were in the colony but think that a minimal amount of damage is likely due to the high frequency of events. The energy expenditure of adults attempting to dive at the sheep may have also affected productivity.

Matinicus Rock

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

Tern and Laughing Gull Census
The GOMSWG census was conducted on June 16. We estimated a total of 854 Arctic Tern nests after adjusting the raw count with a Lincoln Index correction factor. We directly counted a total of 395 Common Tern nests, or 33% of the total colony. During the GOMSWG census we counted and destroyed 121 Laughing Gull nests.

Table 1. GOMSWG census results on Matinicus Rock, 2016-2021

Year	ARTE	COTE	LAGU
2016	621	167	30
2017	600	166	3
2018	717	268	1
2019	764	327	4
2020	No Data	No Data	No Data
2021	854	395	121

Tern Productivity
Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots. Arctic Terns fledged 0.23 young per nest. Mean clutch was 1.71. Common Terns fledged 0.29 young per nest. Mean clutch was 1.81 for 32 nests. Both Arctic and Common terns had the lowest productivity since monitoring began, due to a combination of weather events and poor food availability.

Table 2. Tern productivity on Matinicus Rock in 2021

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
ARTE	1.71	0.88	0.23	48
COTE	1.88	0.88	0.29	32

Tern Chick Provisioning
We conducted Common and Artic tern feeding studies. The most common food items provisioned by Arctic terns were amphipods (38.4%) and hake (29.4%). The most common food item in the Common tern chick diet was hake (29.6%), followed by amphipods (23.7%).

Predator Activities and Control Efforts
Peregrine Falcons and Merlins were observed several times throughout the season, though they were never seen taking a tern chick or adult. Two Herring Gulls persistently predated younger chicks and fledglings throughout the season. Predation increased in intensity as the tern colony began to disperse earlier than in prior years, with many

nests failed by mid-July. No large gulls were shot. Laughing Gulls attempted to nest in all areas of sod and tall vegetation along the western side of the island. 4 adults were shot and displayed on tall poles in two of the densest nesting areas. Laughing Gull counts decreased significantly after we displayed carcasses, and after tern census, during which we destroyed 121 nests. We shot and displayed two additional breeding adults. A total of 266 nests were destroyed over the course of the season, and approximately 10-15 chicks hatched. Several instances of successful kleptoparasitism of terns, guillemots, and puffins were observed.

Atlantic Puffins
Puffin hatch success was 0.71 hatched per nest (n= 78). Productivity checks are still continuing, but it appears that it will likely be a very poor year for puffin productivity. Chick diet has consisted primarily of hake, rough scad, haddock, and butterfish.

Razorbills
A Razorbill census was conducted in 2021, by systematically checking all existing and new burrows in Area 3, and known Razorbill nesting sites in smaller clusters around the island. 345 eggs were found, and a high count of 1,575 adults was obtained when the main Area 3 colony flushed. There are likely more active burrows that were not observed, due to the difficulty of definitively determining burrow contents. Razorbill hatch success was 0.5 (n = 39), and productivity was 0.15 chicks fledged per nest. This is the lowest reported Razorbill productivity since productivity checks began in 2007. The first Razorbill chick was seen on June 3. Low food availability, along with raven predation, accounts for low productivity.

Black Guillemots
Mean clutch size was 1.73 (n=30), hatch success was 0.72, and productivity was 0.77 chicks fledged per nest. Black Guillemots were incidentally observed provisioning chicks with pollock, haddock, and cusk on several occasions, in addition to the typical rock eels and other bottom-feeding intertidal fishes.

Common Murres
The high count for Common Murres in 2021 was 89. A minimum of 18 murre eggs were observed in June, and at least 7 chicks hatched and fledged by the middle of July. Incidental diet observations indicate that chicks were primarily provisioned with haddock.

Leach's Storm Petrels
Hatching success was 0.84 (n=83), and productivity checks are ongoing. Overall burrow density is 0.68/m2, and the occupancy rate across our two adult survival plots and three productivity plots was 0.91.

Manx Shearwaters
We were able to confirm seven active Manx Shearwater burrows. To assess potential activity at the end of June, we played mixed female and male calls at burrow entrances and listened for responses at the six sod burrows. Adults responded at 5 out of the 6. The seventh burrow is visible, and was flooded in a late July storm, resulting in a dead egg. In mid-July, we grubbed or used an endoscope to confirm the presence of chicks in all six remaining burrows.

Other Breeding Birds
2021 is potentially a record year for species diversity on Matinicus Rock, with the confirmed breeding of Common Ravens, American Black Ducks, Common Eiders, Savannah Sparrows, Song Sparrows, Barn Swallows, and Herring Gulls, in addition to the above-mentioned species. A Common Raven nest was discovered upon arrival to the island on May 18, with three chicks close to fledge. The chicks were removed from the island. Chicks had been provisioned with adult puffins, guillemots, razorbills, and storm petrels.

Seal Island

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

Tern Census
The 2021 Gulf of Maine Seabird Working Group (GOMSWG) tern census was conducted on June 13. As not all areas of the tern colony are cleared to walk through, a partial direct count of the colony was conducted, across 14

grid squares. A Lincoln Index of 1.0084 was applied to the direct count, and an extrapolated total was derived from this number. We calculated a combined total of 2,081 Arctic and Common Tern nests. A species ratio was determined through identifying a sub-sample of nests to species, then used to calculate an estimated count of Common and Arctic Tern nests. The number of Common Tern nests has continued to increase since 2017, while the number of Arctic Tern nests has continued to decrease since 2018.

Table 1. Adjusted number of tern nests found on Seal Island NWR from 2017-2021.

Year	COTE	ARTE
2017	1,064	733
2018	1,204	829
2019	1,293	776
2020	No census	No census
2021	1,422	659

Tern Productivity

Tern productivity was monitored in both fenced productivity plots and unfenced feeding study plots (Table 2). This year had the lowest Arctic Tern productivity recorded since monitoring began in 1991, and the second-lowest Common Tern productivity recorded.

Table 2. Tern productivity on Seal Island NWR in 2021. Data for 2020 shown in parentheses.

Species	Mean clutch size	Mean hatch	Productivity	Nests monitored
COTE	1.73 (1.81)	0.72 (1.42)	0.31 (0.72)	70 (78)
ARTE	1.74 (1.68)	0.62 (1.38)	0.23 (0.72)	49 (53)

Tern Provisioning

Arctic Tern nests were observed for 605 cumulative nest-hours, with an average feeding rate of 2.68 feedings per nest per hour. Common Tern nests were observed for 1,012 cumulative nest-hours, with an average feeding rate of 0.79 feedings per nest per hour. Amphipods and hake were the most common prey items fed to Arctic Tern chicks, while herring and hake were the most common prey items for Common Tern chicks (Table 3). Though pollock and haddock made up a low percentage of Common Tern diet, they were observed much more frequently than in previous years.

Table 4. Principal prey items (percent of diet by prey item) in tern chick diet on Seal Island NWR in 2020. Total number of prey items observed n= 1624 for ARTE and n= 803 for COTE.

Prey item	ARTE %	COTE %
Herring	**1.2**	**33.6**
Hake	**30.1**	**27.3**
Amphipod	**35.6**	**2.6**
Pollock	**0.9**	**6.2**
Sandlance/Larval Sandlance	**1.3**	**4.7**
Stickleback	**3.5**	**3.4**
Haddock/Larval Haddock	**0.2**	**2.6**

Predator Activities and Gull Control Efforts

Gull predation was observed regularly. On June 1, a single predation event occurred in the largest productivity plot, resulting in 10 fully or partially predated nests; small, isolated areas throughout the colony also appeared to be affected. Gull control efforts included poking eggs in all gull nests found during a gull census conducted in early and late June, as well as the culling of individual predatory gulls. Control efforts are summarized in Table 4. Low numbers of Laughing Gulls were observed daily. Two one-egg Laughing Gull nests, possibly laid by the same pair, were found on the edges of the tern colony and destroyed upon discovery.

As in 2020, this year saw regular visits by one and sometimes two Peregrine Falcons throughout the entirety of the tern nesting period. They often made multiple passes through the colony in a single day, particularly at dawn and dusk, though were not observed consistently catching terns.

Table 4. Gull control measures by species at Seal Island NWR in 2020.

Species	# Nests destroyed	# Shot
Herring Gull	293	5
Great Black-backed Gull	43	0
Laughing Gull	2	0

Atlantic Puffins
Puffin productivity was monitored at 77 burrows. Hatching success was 0.79 chicks hatched per egg. Burrows are still being monitored for productivity (Table 5). We anticipate that 2021 will be a poor year for productivity.

Table 5. Atlantic Puffin hatch success and productivity at Seal Island NWR from 2017-2020.

	# Burrows monitored	Hatch Success	Productivity
2017	68	0.91	0.89
2018	63	0.92	0.60
2019	71	0.89	0.85
2020	73	0.88	0.76
2021	77	0.79	TBD

Chick diet has largely consisted of hake, squid, haddock, butterfish, and rough scad.

Black Guillemots
Black Guillemot productivity was monitored at 44 burrows. Average clutch size was 1.82 and average hatch success was 0.8. Burrows are still being monitored to calculate productivity.

Razorbills
Over the course of the nesting season we identified a minimum of 84 active burrows. 59 burrows were monitored for productivity. Hatch success was 0.68 and productivity was 0.31.

Cormorants
There were a minimum of 47 Great Cormorant nests and 36 Double-crested Cormorant nests. This is an increase of 20 and 10 nests, respectively, from the number of nests observed in 2020. Counts of chicks of both species are still being conducted to determine an estimated productivity.

Penobscot Bay - East

Brad Allen – ME Department of Inland Fisheries and Wildlife
Kelsey Sullivan – ME Department of Inland Fisheries and Wildlife

No report submitted. See data table.

Penobscot Bay – Outer

John Drury – Vinalhaven; johnbdrury@gmail.com

Great Cormorants:
Total of 46 nests counted at two sites.

There were 40 great Cormorant nests counted at Seal Island at the end of May.
One partially white chick last seen September 4.

There were 6 Great Cormorant nests counted at Brimstone ledge on June 5.
One chick of the year seen near Brimstone ledge on September 5,
4 eagles on Brimstone ledge that day.

There were no Great Cormorants at 11 other former nesting sites.

A gain of 15 nests or 30 birds to the breeding population, 1/2 the total last year, the second gain in this population during the last 30 years.

Terns:
40 Common Terns at Three Bush Island June 5, count of individuals from the boat.
There were three fledgling terns seen in the area on September 5, a month after any had been seen near Seal Island.

Wooden Ball:
25 Arctic tern nests, estimate from the boat.
I saw no fledglings near the island.

Bob Houston notes Coastal Island Registry IDs associated with John Drury reports: Brimstone Ledge - 59-479 (east of Marshal Island); Three Bush I - 59-980; Wooden Ball – 63-917; Other GRCO islands: Black Horse I – 63-294, Great Spoon I – 63-287, Green I – 59-446, Green Ld – 63-266, Johns I – 59-483, Little Duck I – 59-439, Little Spoon I – 63-289, Mark I – 63-260, Mason Ld?? – 59-481, Metinic Green I – 63-585, Roberts I (W) – 63-175, Saddleback I – 59-999, Spirit Ld – 59-001, White Horse I – 63-293,

Ship Island

Bethany Spiegel – Island Supervisor, Maine Coastal Islands NWR, USFWS

Tern Census
During an initial GOMSWG census on June 23 we counted 219 Common Tern nests (no Lincoln Index correction factor applied). Due to a weather event a few days prior to this census which included high winds (61mph) and hail, approximately 30% of nests were estimated to have been lost, damaged, and/or abandoned. To assess renesting, a second census was conducted on July 6 and we counted 418 active nests. After applying the Lincoln correction index of 1.163 (excluding productivity nests) we estimate 426 pairs of terns nested on Ship in 2021. This season's estimate is 20% higher (71 pairs) than the 2020 estimate (355pairs).

Table 1. Number of tern nests found on Ship Island during the GOMSWG census window from 2017-2021.

Year	COTE	Notes
2017	620	
2018	519	All nests were abandoned after the census
2019	9 active, 14 abandoned	Total estimated pairs = 427
2020	54 active, 307 abandoned	Second census on July 6= 301 new and active nests Total estimated pairs= 355
2021	6/23 = 219 7/7 = 426	Second census to assess renesting after hail storm

Tern Productivity
Beginning on June 23, we monitored productivity and chick growth rates in 45 nests contained in fenced productivity plots. Due to the late start of COTE nesting activities this season, as well as the renesting effort after the hailstorm, many chicks were still present within the productivity plots at the end of the field season (Aug 11). A volunteer remained on the island is continuing to monitor productivity after the seasonal crew left. For productivity, only chicks that were 15 days or older at the last check were counted as "fledged".

Average clutch size (1.78, N=426) was based on data collected during our July 7 census. Prey availability and feeding rates appeared to be consistent throughout the season. This likely was a significant contributing factor to the fledging success of the chicks this season.

Table 2. Breeding parameters for Common Terns on Ship Island in 2021.

Species	Clutch Size	Hatching success	Fledging success	Productivity	Nests monitored
COTE	1.78	66.2%	63.3%	0.94	45

Tern Provisioning

We conducted provisioning observations for 14 common tern nests for a total of 485 hours and observed 577 prey deliveries. Herring was the primary prey item recorded accounting for 75% of the common tern diet. The second most prevalent prey item was sandlance contributing to 17.68% of the diet. The feed rate was 1.19 feedings per hour.

Table 3. Principal prey items (percent) in tern chick diet on Ship Island in 2021.

Prey item	COTE
Herring	74.0%
Sandlance	17.68%
Hake or Herring	4.33%
Pollock	1.21%
Smelt	0.35%
Larval Fish	0.35%
Invertebrate	0.87%
Hake	0.35%
Cunner	0.17%
Unknown	0.69%

Predator Activities and Control Efforts

The hesitancy shown by the tern colony to begin nesting this season was initially believed to be due to predators visiting the island. Predator control and monitoring efforts were started early and continued throughout most of June. We found seven pellets around the island from mid-May to early June. No owls were observed or trapped despite deploying two Swedish goshawk traps and 11 padded leg hold traps across the island from May through June. We also monitored the colony each evening and early morning. The pellets were the only sign of predation found on the island to indicate possible early season raptor predation, no feather piles or predated tern carcasses were found during this time.

Peregrine falcon and merlin visits, while not as frequent as previous years, were a regular occurrence beginning in mid-July. We recorded three merlin visits between Aug 1-5 and six peregrine falcon visits from July 14- Aug 1. During this time period at least three common terns were found predated around the island. Between Aug 6 and August 9 the crew observed 3 successful predation events by a broad-winged hawk on fledgling terns.

The crew observed one great black-backed gull predation attempt on a tern chick on July 20. To deter gulls from loafing on the beach, we scared them off by waving our hands and yelling as well as using an Agrilaser lite® laser. Bald eagles were frequently observed preying on the gulls, eiders, and cormorants on East and West Barge, and Trumpet Island. American crows were frequently seen on Trumpet Island as well as loafing on the south side of Ship Island. The largest predator of tern eggs was likely American crows, based on the cracked and predated eggs that were found and the frequency of their visits.

Common Eiders

No common eiders nested on Ship Island during the 2021 season. Eiders were frequently observed loafing on Trumpet Island, on the sandbar between Trumpet and Ship, and in waters surrounding Ship throughout the season.

Habitat Management

Gravel tern plots were weeded throughout the summer, and approximately 70-80 nests were located in the plots by July 31. (72 were counted on July 6). The crew also collected vegetation data during COTE incubation. The crew

collected data from random points within the tern management area, common tern nests, and grazing exclosures. The vegetation survey took place from June 28-July 2. The crew also pulled 16 contractor bags of garlic mustard from the island. The invasive brown tailed moth was also documented on the island this season, and Refuge staff spent considerable time trying to remove caterpillars from the cherry trees and rose bushes.

Great Duck Island

No report or data received.

Petit Manan Island

Ryan Potter: Island Supervisor – Maine Coastal Islands NWR, USFWS
Joe Cleaves & Gwendolyn Zeckowski: Island Technicians

Tern Census

During the Gulf of Maine Seabird Working Group (GOMSWG) census on June 17 and 18, 2021. We counted 1,204 active tern nests. We applied a Lincoln Index correction factor of 1.037 to this value, added in the 85 nests contained in our productivity plots, and calculated that 1,333 pairs of terns nested on Petit Manan Island (PMI). This season's estimate is 2.5% higher (32 pairs) than the 2020 estimate (1,301 pairs). During peak incubation, we identified 430 tern nests to species to calculate species ratio. We noted that Common Terns (COTE) dominated shorelines and mixed Arctic Tern (ARTE)/COTE interior habitats were each uniquely calculated. Overall, 426 ARTE pairs and 907 COTE pairs were estimated to have nested in 2021 with a colony-wide ratio of 32% ARTE and 68% COTE. Additionally, 36 Common Eider (COEI) and 763 Laughing Gull (LAGU) nests were documented during the census with a corrected LAGU count of 820 nests after a standardized 7.5% correction factor was applied.

Table 1. Number of nests found on Petit Manan Island during the GOMSWG census window from 2017-2021.

Year	COTE	ARTE	LAGU	COEI
2017	657	431	605	46
2018	906	371	766	47
2019	937	365	656	45
2020	949	352	589	36
2021	907	426	820	36
New species ratio method started and used since 2018.				

Tern Productivity

Within productivity plots, COTE productivity was recorded at 0.12 chicks fledged per nest and ARTE productivity at 0.16 chicks fledged per nest. Prey availability appeared to be consistent throughout much of the season with a diverse array of prey species delivered to chicks. It is unknown whether or not food availability and prey selection were contributing factors to chick mortality whereas poor weather events were clearly detrimental to chick survival throughout the season along with documented gull predation. Several significant rain events were followed by increased chick mortality, likely due to exposure as chicks were unable to thermoregulate after getting saturated by rain.

Table 2. Breeding parameters for Common and Arctic Terns on Petit Manan Island in 2021 (2020 in parenthesis).

Species	Clutch Size	Hatching success	Fledging success	Productivity	Nests monitored
COTE	1.79 (1.96)	50.7% (84.4%)	13.2% (47.7%)	0.12 (0.78)	42 (23)
ARTE	1.72 (1.67)	74.3% (71.7%)	12.7% (55.8%)	0.16 (0.67)	43 (36)

Arctic Tern Metapopulation Project

As part of the Arctic Tern metapopulation project, 36 adult ARTE were re-sighted and two adults were recaptured during island-wide trapping efforts. A total of 19 new birds were banded (two adults and 17 chicks). Additionally, a Common Tern with a field-readable band and listed in Seabird Finder as an ARTE was also observed.

Tern Provisioning

Provisioning observations were conducted on 13 Arctic Tern and 21 Common Tern nests for a total of 480 observation hours (296 ARTE/184 COTE) with 737 prey deliveries (538 ARTE/199 COTE). Overall, hake and herring were the dominate prey items for each species. ARTE chick diet was 28.3% hake, 26.2% herring, and 13.2% hake or herring while COTE chick diet was 36.2% herring, 33.2% hake, and 1.5% hake or herring. Invertebrates also made up a noticeable proportion of prey brought in by both species, contributing to 17.7% of ARTE chick diet and 15.1% COTE chick diet. On average, ARTE adults delivered 1.82 prey items per nest per hour while COTE delivered 1.08 items per nest per hour.

Table 3. Principal prey items (%) in tern chick diets on Petit Manan Island in 2021.

Species	ARTE	COTE
Hake	28.3%	33.2%
Herring	26.2%	36.2%
Hake or Herring	13.2%	1.5%
Invertebrates	17.7%	15.1%
Sandlance	2.4%	3.0%
Haddock	2.0%	0.5%
Pollock	1.1%	3.5%
Butterfish	0.9%	1.0%
Squid	0.6%	0.5%
Larval Fish	0.6%	3.5%
Silverside	0.2%	1.0%
Lumpfish	0.2%	0.0%
Unknown Fish	5.8%	0.5%
Unknown	0.9%	0.5%

Predator Control

Avian predators were discouraged from roosting or perching on the island throughout the season through the use of bird deterrents including pyrotechnics, bird spikes, decoys, and a high-powered laser. Peregrine Falcons (PEFA) were the most frequent avian predator observed, first appearing May 11 and recorded a total of 45 occasions over 28 days throughout the season. PEFA were directly observed having taken five adult terns but are presumed to have killed at least eight more adults based on prey remains. In addition to terns, PEFA killed two Atlantic Puffin, one Black Guillemot, a Hairy Woodpecker, and one unidentified shorebird.

During the GOMSWG census, staff oiled the eggs of 478 Laughing Gull (LAGU) nests and destroyed eggs in 285 additional nests. Lethal removal of gulls thought to be tern or kleptoparasitism specialists included the removal of two adult LAGU and one adult Herring Gull. In addition, Refuge staff removed 43 additional LAGU during the season.

Table 4. Gull control measures by species at Petit Manan Island in 2021.

Species	# Nests destroyed	# Shot
Herring Gull	0	1
Great Black-backed Gull	0	0
Laughing Gull	763 (including 478 oiled)	45

Alcids

Individual high counts for alcids were 378 Atlantic Puffins (July 25), 316 Black Guillemots (June 3), 75 Razorbills (May 27), and 24 Common Murre (June 12). A total of 87 active Atlantic Puffin (ATPU) burrows were recorded but pairs were largely unsuccessful with only 45 hatched chicks and nine considered to have fledged. A majority of chicks were extremely small (weight and body size) at the age when they should have been fledging from the island. We concluded that several chicks that "fledged" likely died once they reached the water. The linear growth rate of 16 ATPU chicks was 3.77 grams/day. There were also five Razorbill (RAZO) nests with a productivity rate of 0.4 chicks fledged/pair (n=2). A total of 69 Black Guillemot (BLGU) nests were recorded and monitored around the perimeter of the island and under the boardwalk. BLGU productivity was 1.03 chicks fledged/pair (n=71). Common Murre were regularly observed on the rocky point beneath the lighthouse and were observed prospecting and performing courtship behavior, however, there was no evidence of any known breeding attempts in 2021.

Table 5. Active alcid nests and reproductive success at PMI, 2021.

Species	Burrows Monitored	Hatch Success	Productivity
ATPU	87	52%	0.10
RAZO	5	60%	0.40
BLGU	69	79%	1.03

In addition to daily counts and productivity monitoring, we read bands on adult puffins (N=65) and captured adults opportunistically during nests checks (N=13). We banded 18 puffins (5 adult/13 chicks). Additionally, three RAZO adults were re-sighted and we banded the two RAZO chicks. We recaptured seven adult BLGU 80 and individuals were banded during the season (8 adults/72 chicks).

Petrels

Leach's Storm-Petrel (LESP) burrows were located and flagged early in the season. Marked burrows were revisited the last week of June. We used a burrow-scope camera to determine burrow status and confirmed a minimum of 32 active burrows. These burrows were again checked the last week of July for the presence of chicks. We observed 19 chicks and six unattended or ejected eggs.

Other Research

Fecal Sampling: A total of 30 fecal samples were collected from COTE, ARTE, ATPU, and BLGU to be used to document diet composition. The Refuge is working with Cornell University to conduct the DNA analysis of the fecal samples.

Microplastic Sampling: Additional fecal samples from alcid, tern, and gull populations were collected for microplastic analysis to assess floating microplastics and associated risks to seabird colonies in Eastern Maine in collaboration with the Shaw Research Institute.

Stable Isotope/Blood Sampling: In partnership with researchers at Gettysburg University, blood samples for stable isotope analysis were collected from 100 individuals; 19 BLGU, 26 ARTE, 26 COTE, and 19 ATPU. Analysis will look at comparing short term and long-term trends in chick diet composition and provisioning strategies by adults during the chick rearing period.

Canada

Machias Seal Island

Sarah Durham – Island Supervisor/PhD student, University of New Brunswick
Quinn Carvey – field technician/PhD student, University of New Brunswick

Tabatha Cormier – field technician/MSc student, University of New Brunswick

Tern Census

No formal tern census was conducted in 2021 due to COVID restrictions limiting the number of crew members on island.

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

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
175	75	50	90	187	150	175	300	476	500	0

Productivity

No terns successfully fledged chicks from the island for a second year in a row due to a combination of gull predation, exposure, and poor food availability. Upon the crew's arrival on May 28th no terns were present on island and no nests were found. Gulls were regularly seen hunting on all parts of the island. After the crew's efforts at non-lethal gull control (mainly due to our physical presence in the island) small groups of terns were observed landing and scraping. Our first nest was found on June 2nd and mean lay date was June 11th.

We monitored 82 nests for productivity (81 ARTE, 1 COTE) for a total of 122 eggs. The average clutch size was 1.5 (SD 0.5). Of the 122 eggs, 64 eggs were depredated (52.5% predation rate). Of the remaining eggs, 35 chicks hatched for an overall hatch success of 0.29 (SD 0.45). First hatch was June 27th with a mean hatch of July 1st. Of the 35 chicks that hatched, 26 (~75%) were found dead and the other 9 chicks went missing resulting in no fledged chicks for the 2021 season.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on Machias Seal Island in 2021. No data for 2020 shown due to no successful nesting attempts last year.

Species	Clutch Size	Hatching Success	Fledging Success	Nests Monitored
COTE	2	0	0	1
ARTE	1.5 (SD 0.5)	0.29 (SD 0.45)	0	81
ROST	NA	NA	NA	NA

Tern Provisioning

No tern provisioning occurred during the 2021 season.

Table 3. Principal prey items (percent) in tern chick diet on Machias Seal Island in 2021. *n* is the total number of prey items identified. No data for 2020 shown due to no successful nesting attempts last year.

Prey Item	COTE	ARTE	ROST
n	NA	NA	NA
Herring	NA	NA	NA
Hake	NA	NA	NA
Sandlance	NA	NA	NA
Butterfish	NA	NA	NA
Pollock	NA	NA	NA
Stickleback	NA	NA	NA
Euphausiid	NA	NA	NA
Larval fish	NA	NA	NA
Other	NA	NA	NA

Predator Activities and Control Efforts

Non-lethal gull control was continued this year, using paintball guns to deter individuals actively hunting and kleptoparasitizing alcids in the colony. The paintball gun did not prove to be effective as the gulls had already established territories prior to our arrival. A laser pointer (Bird Control Group Handheld 200) could not be used this season again as a nonlethal gull control tool as we were advised it was not legal to do so in Canada. Lethal gull

control could not be carried out for the second year in a row due to COVID regulations restricting access to the island. 13 HERG nests were found on island this season with a total of 29 eggs that were destroyed via the shake and poke method. Despite our efforts gull activity remained high on the island with individuals seen actively hunting in all parts of the colony taking tern, alcid, and eider eggs and chicks.

Common Eiders
Counts were conducted weekly starting on June 1st. Our highest count was a total of 190 individuals (88 males, 102 females, and 0 ducklings) on June 1st. Our highest count of ducklings was on July 23rd with 85 ducklings counted.

Alcids: Atlantic Puffin
A formal ATPU census was not conducted during the 2021 season.

We monitored 103 burrows for productivity, 91 of which were active (occupancy = 0.88).

It became evident early in the season that birds were starting to abandon as many of the active burrows contained cold eggs which were later determined to be dead. Out of our 103 productivity burrows 10 burrows were vacant and never became active, 2 burrows were dropped (1 of which was active), 26 eggs went missing, 36 chicks went missing, 17 eggs were found dead, and 7 chicks were found dead. Out of the 91 active nests only 48 chicks hatched (hatch success = 0.53, first hatch = June 13th, mean hatch = June 22nd). We currently have 5 burrows with chicks, 3 of which have been able to receive a BBL band but are too small for a field readable band, the other 2 are still too small to hold any bands at all. An additional 76 chicks have been banded from non-productivity burrows, 26 of which were large enough to receive field readable bands leaving 50 chicks with BBL only.

A total of 120.95 hours of ATPU chick provisioning stints have been conducted. Food was very poor throughout the season with diet consisting mainly of polychaete worms and euphausiids early in season and then switching to butterfish and squid.

Alcids: Razorbills
A formal RAZO census was not conducted during the 2021 season.

Upon the crew's arrival in late May we determined 84 out of 100 (occupancy = 0.84) productivity burrows to be active. Of the 84 active burrows, 33 eggs were found dead or went missing and 51 hatched (hatch success = 0.61, first hatch = June 9th, mean hatch = June 18th). Out of the 51 chicks 13 went missing, 17 were found dead, and 21 were considered fledged (fledge success = 0.25).

In addition to the productivity chicks, we banded an additional 54 chicks from non-productivity burrows. A total of 69.63 hours of RAZO chick provisioning stints were conducted with diet consisting mainly of herring, hake, and sandlance consistently throughout the season.

Alcids: Common Murre
COMU numbers remain high. From July 6th to July 8th a minimum of 942 active nests were estimated (303 eggs, 607 chicks, and 32 dead chicks). A total of 287 chicks were banded this year and a total of 50.3 hours of COMU chick provisioning stints were conducted with diet consisting mainly of redfish, rock eel, and herring consistently throughout the season.

Table 4. Breeding parameters for Atlantic Puffins and Razorbills on Machias Seal Island in 2021. Data for 2020 shown in parentheses.

	n	**Mean Lay**	**Mean Hatch**	**Burrow Occupancy**	**Hatching Success (hatch/ active nest)**	**Nest Success (fledge/ active nest)**	**Linear Growth Rate (mass)**
ATPU	91 (117)	13-May (NA)	22-June (NA)	0.88 (NA)	0.53 (NA)	0.02 (0.74)	3.6 (NA)
RAZO	84 (56)	14-May (NA)	18-June (NA)	0.84 (NA)	0.61 (NA)	0.25 (0.80)	0.9 (NA)

Table 5. Principal prey items (percent) in alcid chick diet on Machias Seal Island in 2021. *n* is the total number of prey items identified.

Prey Item	ATPU	COMU	RAZO
n	1599	428	248
Euphausid	9.7	0.0	0.4
Fish Scrap	2.4	3.0	4.4
Hake	29.0	0.5	29.0
Hake or Herring	0.3	0.0	0.8
Haddock	12.0	7.5	3.2
Pollock	0.1	0.0	0.4
Larval hake	0.0	0.0	1.6
Larval sandlance	1.1	0.2	0.4
Larval unknown fish	9.5	0.2	3.6
Sculpin	0.0	0.2	0.0
Rock eel	0.1	14.7	0.8
Polychaete	3.4	0.0	0.0
Squid	14.5	7.0	2.4
Herring	1.3	15.9	34.3
Radiated shanny	0.0	4.2	0.4
Red fish	0.0	35.3	0.0
Red hake	0.0	1.4	0.0
Sandlance	1.3	0.7	12.5
Shrimp	0.6	0.5	0.0
Butterfish	9.1	6.1	0.4
Unknown	1.0	0.2	1.2
Unknown fish	3.6	2.1	2.8
Unknown gadoid	0.0	0.2	0.4
Silverside	0.0	0.0	0.8
Isopod	1.3	0.0	0.0

North Brother Island - Lobster Bay, Nova Scotia

Ted D'Eon and Alix d'Entremont – Island stewards
Julie McKnight – ECCC-CWS
Luc Bilodeau, Shawn Craik, Sophie Landry, Alexis Saulnier - Université Sainte-Anne

Tern Census

The tern census was conducted on North Brother Island on 11 June with four observers. We surveyed all suitable nesting habitat by making systematic sweeps through nesting habitat and placed wooden craft sticks in each nest upon discovery to avoid counting individual nests more than once. We report in Table 1 nest total for ROST (census + later initiated nests) and the number of COTE and ARTE nests counted during the survey. A total of 893 tern nests were counted during the nest census, representing the highest nest count recorded for The Brothers since nest monitoring began by Ted D'Eon in 1990.

The first COTE and ARTE eggs were laid during 17-18 May and the first ROST eggs were laid during 20-26 May.

Table 1. Number of tern nests found during survey on North Brother Island from 2015-2021. The survey is conducted during peak nesting.

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

[1] Colony was abandoned post-census due to heavy predation
[2] The count of 49 nests includes a nest attended by a hybrid COTE x ROST pair

Productivity
Fledging success is not measured due to logistical constraints.

Table 2. Breeding parameters for Common, Arctic, and Roseate terns on North Brother Island 2021. Data for 2019 shown in parentheses. Monitoring during 2020 was restricted to ROST.

Species	Mean clutch size	Hatching success	Fledging success	Nests monitored
COTE	2.52 (2.53)	0.94 (0.63)	-	25
ARTE	2.00 (2.00)	0.78 (0.74)	-	23
ROST	1.67 (1.46)	0.92 (0.95)	-	51

Note that in 2020 mean clutch size for ROST was 1.3 and hatching success for ROST was 0.86.

Tern Provisioning
Table 3 shows statistics from observations of ROST provisioning undertaken from blinds on North Brother. Data from video cameras positioned at ROST nests will be analyzed by students in the coming weeks. A DNA barcoding study was initiated and involved obtaining fecal matter from 20 chicks for each of COTE, ROST, and ARTE.

Table 3. Principal prey items (percent) in tern chick diet on North Brother Island in 2021. *n* is the total number of prey items observed.

Prey item	COTE	ROST	ARTE
Herring	-	37%; n = 47	-
Hake	-	1%; n = 1	-
Sand Lance	-	12%; n = 15	-
Unidentified	-	50%; n = 65	-

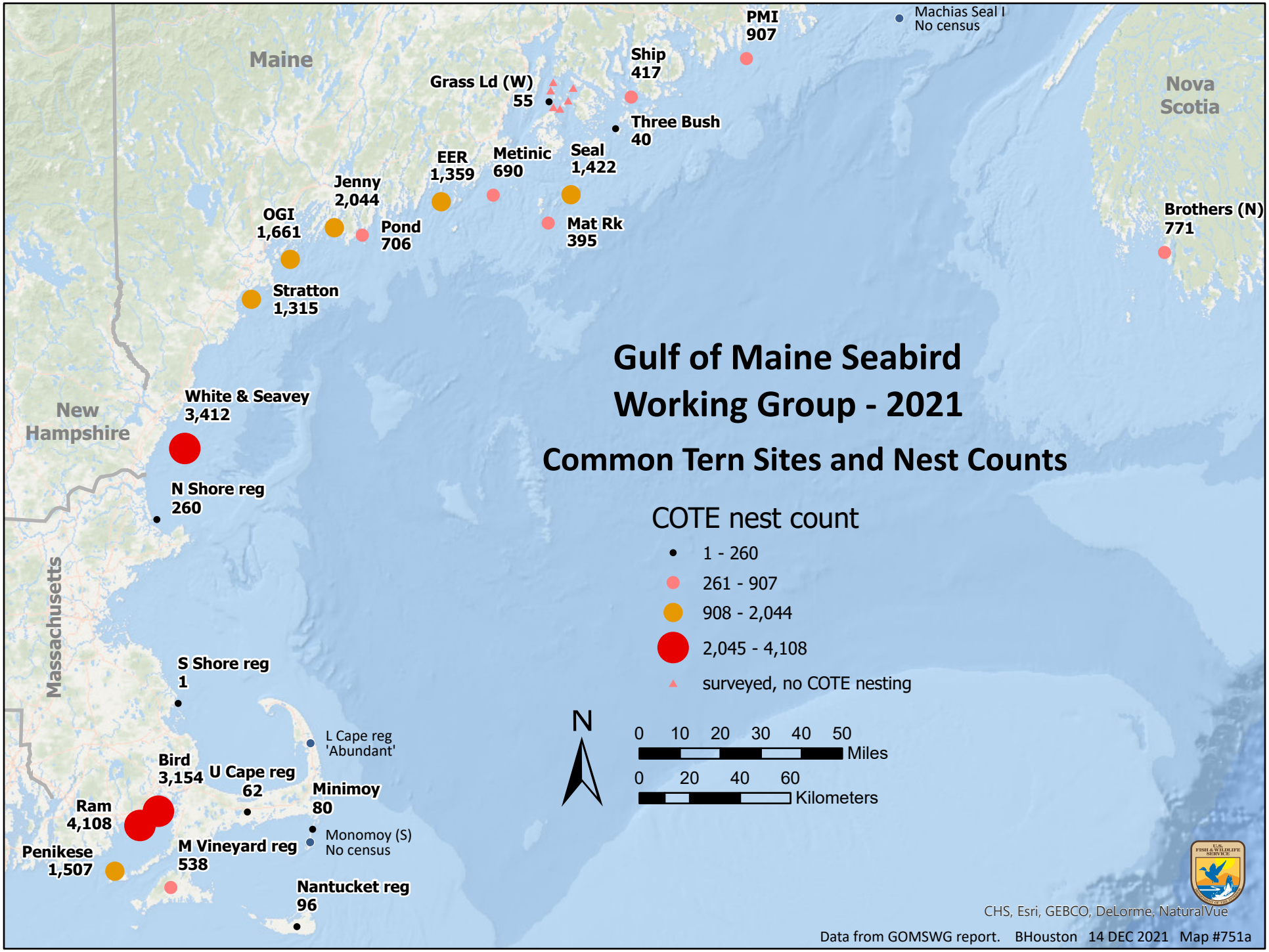
Predator Activities and Control Efforts
No gulls nested on North Brother Island. A survey of South Brother Island on May 17 yielded no gull nests.

Common Eiders
Six incubated eider nests were recorded on North Brother Island. Clutch sizes were 3, 4, 4, 6, and 10. Clutch size of the sixth nest was unknown.

Other Notes
We surveyed islands throughout Lobster Bay during peak tern nesting; no ROST were confirmed nesting elsewhere.

An MSc study of tern foraging ecology will be initiated in 2022. The research will contrast diet and foraging routes of ROST, COTE, and ARTE breeding on North Brother Island, and assess behavioral relationships between terns and their prey (e.g., herring) at a nearby foraging site.

Editor note: To see more details, visit website http://teddeon.com/tern21.html


Maine
New Hampshire
Massachusetts
Nova Scotia
PMI
907
Machias Seal I
No census
Ship
417
Grass Ld (W)
55
Three Bush
40
EER
1,359
Metinic
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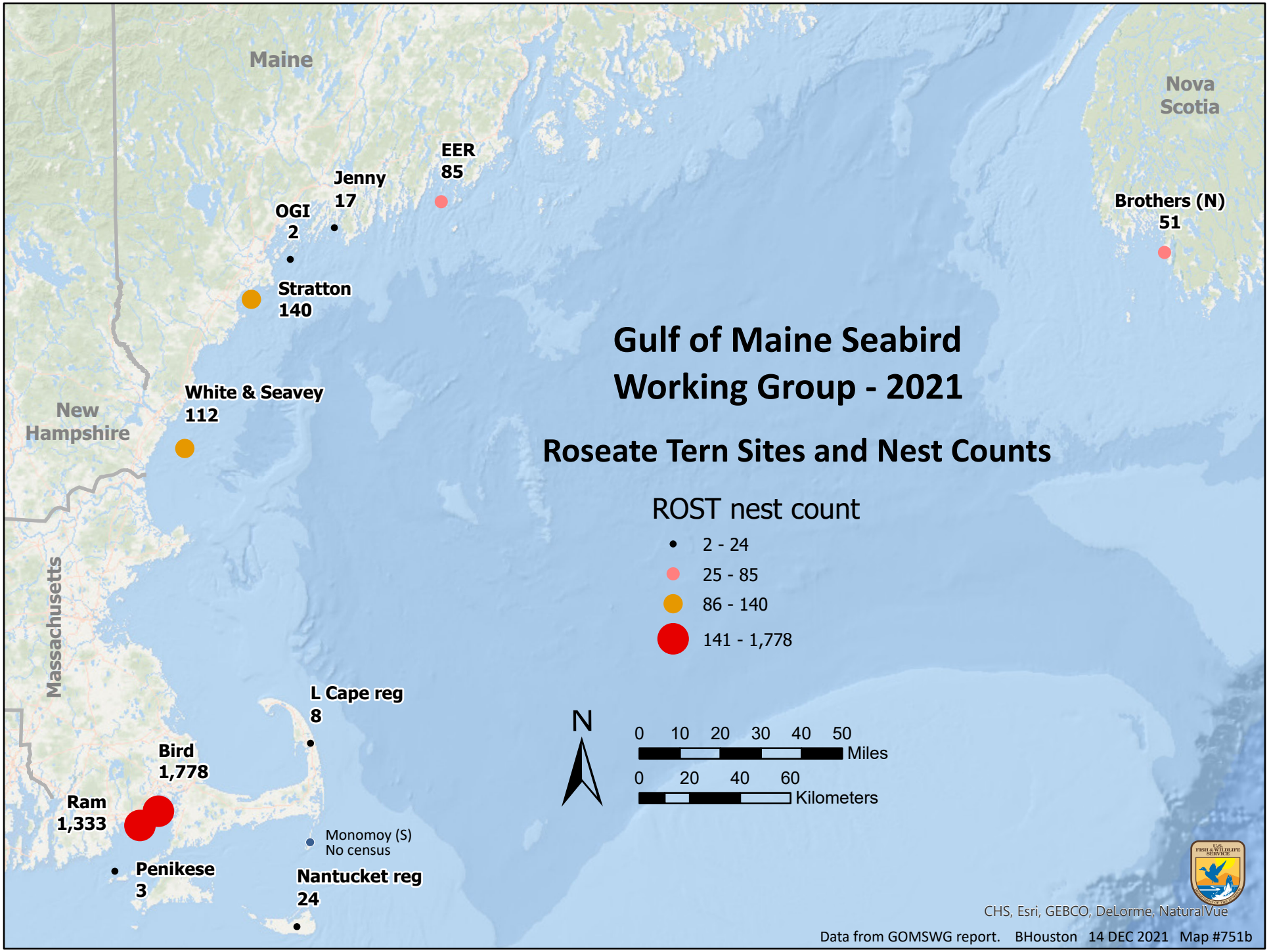
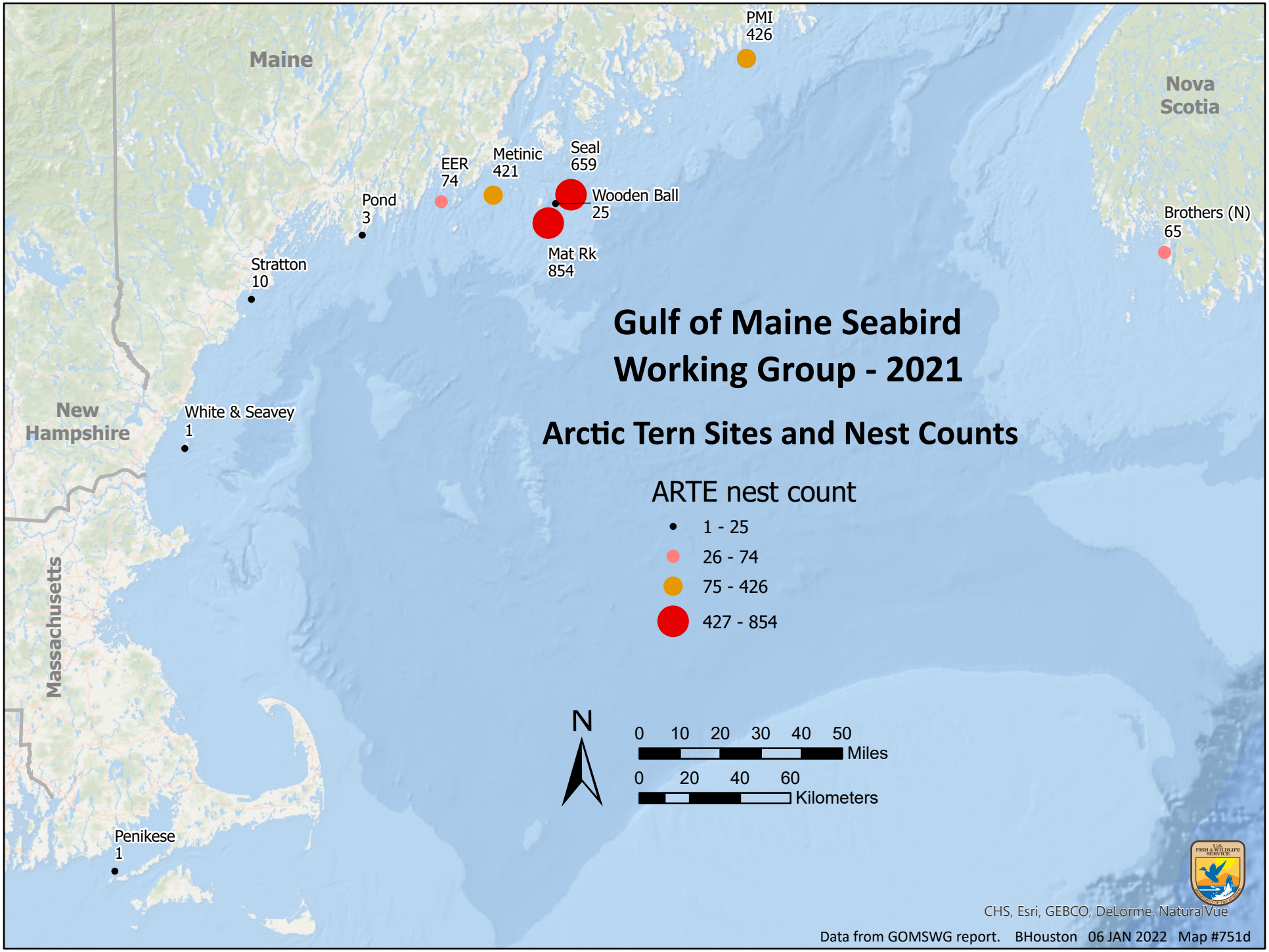
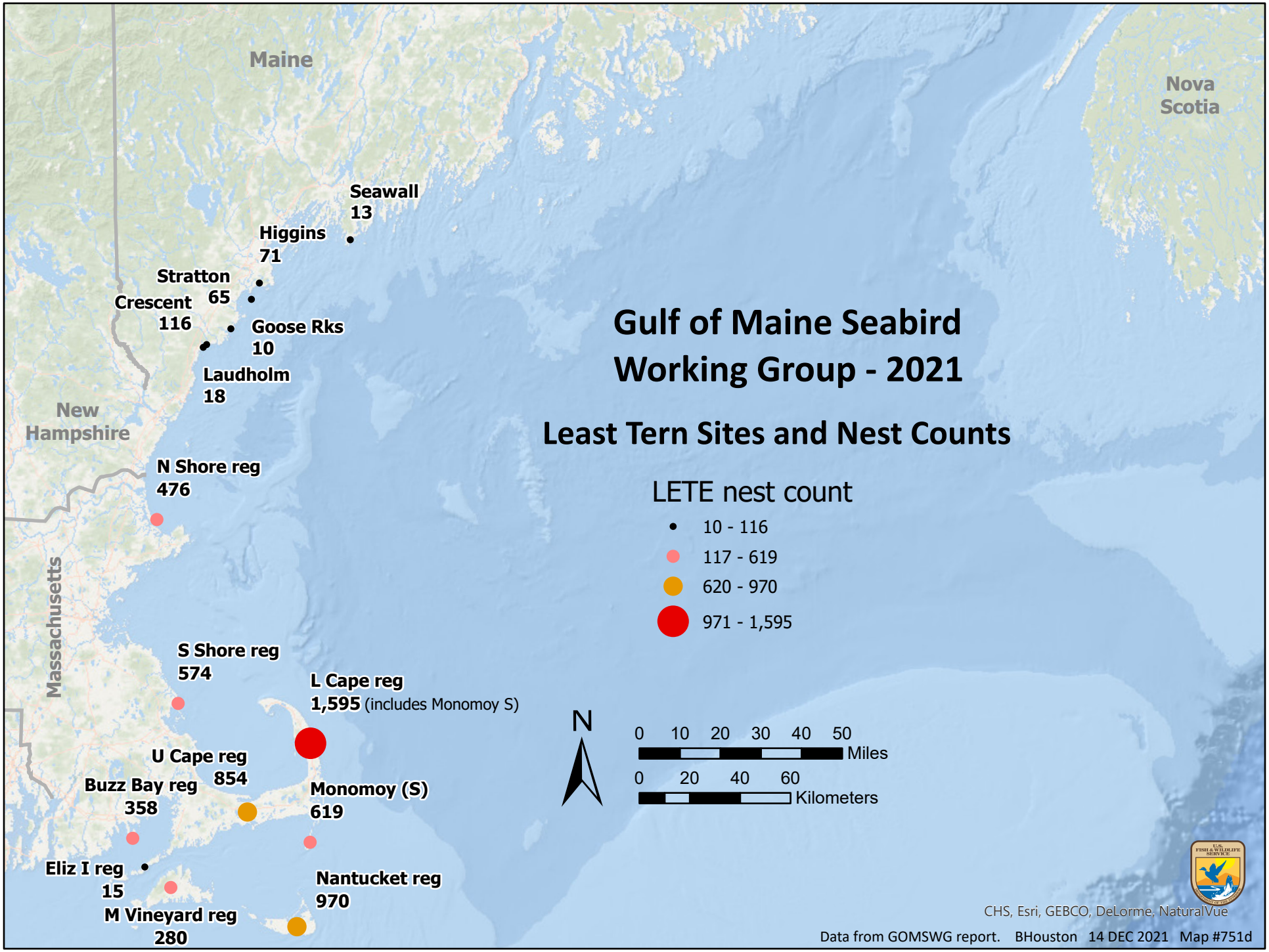
Seal
1,422
Jenny
2,044
OGI
1,661
Pond
706
Mat Rk
395
Brothers (N)
771
Stratton
1,315
White & Seavey
3,412
N Shore reg
260
S Shore reg
1
L Cape reg
'Abundant'
Bird
3,154
U Cape reg
62
Minimoy
80
Ram
4,108
Monomoy (S)
No census
Penikese
1,507
M Vineyard reg
538
Nantucket reg
96
Gulf of Maine Seabird
Working Group - 2021
Common Tern Sites and Nest Counts
COTE nest count
1 - 260
261 - 907
908 - 2,044
2,045 - 4,108
surveyed, no COTE nesting
N
0 10 20 30 40 50
Miles
0 20 40 60
Kilometers
CHS, Esri, GEBCO, DeLorme, NaturalVue
Data from GOMSWG report. BHouston 14 DEC 2021 Map #751a


Maine
Nova Scotia
New Hampshire
Massachusetts
EER
85
Jenny
17
OGI
2
Stratton
140
Brothers (N)
51
White & Seavey
112
Gulf of Maine Seabird Working Group - 2021
Roseate Tern Sites and Nest Counts
ROST nest count
2 - 24
25 - 85
86 - 140
141 - 1,778
L Cape reg
8
Bird
1,778
Ram
1,333
Monomoy (S)
No census
Penikese
3
Nantucket reg
24
N
0 10 20 30 40 50
Miles
0 20 40 60
Kilometers
CHS, Esri, GEBCO, DeLorme, NaturalVue
Data from GOMSWG report. BHouston 14 DEC 2021 Map #751b


Maine
New Hampshire
Massachusetts
Nova Scotia
PMI
426
EER
74
Metinic
421
Seal
659
Wooden Ball
25
Mat Rk
854
Pond
3
Stratton
10
White & Seavey
1
Brothers (N)
65
Penikese
1
Gulf of Maine Seabird Working Group - 2021
Arctic Tern Sites and Nest Counts
ARTE nest count
1 - 25
26 - 74
75 - 426
427 - 854
N
0 10 20 30 40 50
Miles
0 20 40 60
Kilometers
CHS, Esri, GEBCO, DeLorme, NaturalVue
Data from GOMSWG report. BHouston 06 JAN 2022 Map #751d


Maine
Nova Scotia
New Hampshire
Massachusetts
Seawall
13
Higgins
71
Stratton
65
Crescent
116
Goose Rks
10
Laudholm
18
N Shore reg
476
S Shore reg
574
L Cape reg
1,595 (includes Monomoy S)
U Cape reg
854
Buzz Bay reg
358
Monomoy (S)
619
Eliz I reg
15
Nantucket reg
970
M Vineyard reg
280
Gulf of Maine Seabird Working Group - 2021
Least Tern Sites and Nest Counts
LETE nest count
10 - 116
117 - 619
620 - 970
971 - 1,595
N
0 10 20 30 40 50
Miles
0 20 40 60
Kilometers
CHS, Esri, GEBCO, DeLorme, NaturalVue
Data from GOMSWG report. BHouston 14 DEC 2021 Map #751d

Afternoon Session/Research Abstracts

Offshore wind energy in the Gulf of Maine: Update on current activities

Kate Williams – Wildlife and Renewable Energy Program Director
Wing Goodale – Senior Science Director Biodiversity Research Institute

The United States has a goal of developing 30 gigawatts (GW) of offshore wind energy by 2030, with 5 GW of that coming from the Gulf of Maine (GOM). The GOM has some of the best offshore wind resources in the country (e.g., highest annual average wind speeds), but water depths will necessitate the use of floating turbine technologies in most locations. Offshore wind energy development may present a range of potential effects to wildlife, including risk of collisions, displacement and barrier effects, habitat change, and sensory disturbance.
Recent offshore wind-related activity for the GOM has included:

- Formation of the BOEM Interagency Task Force, a multi-state effort to identify Wind Energy Areas in GOM
- New Hampshire plans to study economic, energy and environmental aspects of offshore wind development
- Permanent legislative moratorium on offshore wind energy development in Maine state waters (within 3 miles of the state coastline or islands)
- Continued progression of the one-turbine floating technology demonstration project Maine Aqua Ventus, to be located south of Monhegan Island (construction tentatively planned for 2023)
- Initiation of the Maine Offshore Wind Initiative, which includes:
    - Maine Roadmap for Offshore Wind: 18-month effort led by the Maine Governor's Energy Office to create an economic development plan for the offshore wind industry in Maine. Will be completed in late 2022. Includes an environment and wildlife working group to identify best practices, data gaps, and research needs to avoid, minimize, or mitigate impacts of offshore wind in the Gulf of Maine on wildlife and habitat.
    - Plans for a state-sponsored research array, a 12-turbine floating wind energy project in federal waters off the coast of Maine that the state will use to conduct research to inform responsible development of future commercial-scale floating offshore wind projects. The State of Maine has conducted initial stakeholder engagement and scoping to a) identify key research questions and b) identify a potential location for the array. The state will submit the research array lease application to the federal Bureau of Ocean Energy Management shortly. A Gulf of Maine Offshore Wind Research Consortium will be formed to develop and implement the research plan for the array.

These efforts are being informed by a variety of ongoing stakeholder engagement and research prioritization efforts elsewhere along the east coast of the U.S., including the birds workgroup report from the recent State of the Science Workshop on Wildlife and Offshore Wind. There are a variety of ways that GOMSWG members can get involved with Maine's offshore wind energy siting and research prioritization efforts; see above links or contact kate.williams@briwildlife.org for more information.

Common and Arctic Tern GPS Tracking at Seal Island NWR 2021

Keenan Yakola – PhD graduate student at Oregon State University

Continuing pilot work conducted in 2019 with collaborators Liz Craig and Linda Welch, Don Lyons and Keenan Yakola deployed 15 GPS tags on Common (n=10) and Arctic Terns (n=5) at Seal Island NWR in June 2021. Deployment and data collection was successful this year, and included reduced handling time and lower

abandonment rates compared to 2019. Unfortunately, productivity for all terns was poor at Seal Island NWR this season, but preliminary results suggest that the nesting success of tagged birds was comparable to control nests. GPS data and provisioning studies conducted on tagged birds this season suggests divergent foraging strategies between Common and Arctic Terns and will be further investigated. We hope to deploy additional tags in 2022 and data from this work will be included in Keenan Yakola's PhD dissertation at Oregon State University beginning this fall.

Quantifying microplastics in seabird guano and the waters surrounding Eastern Maine breeding colonies

Heather Richard – Shaw Institute

This summer, Shaw Institute initiated a pilot study with Project Puffin and US Fish and Wildlife Service to investigate the presence of microplastics in seabird guano from three breeding colonies in Eastern Maine. Funded by the Eastern Maine Conservation Initiative, the goals of this work are to assess the need and feasibility for a larger scale, long-term project monitoring the presence of microplastics in Maine's seabird colonies. Guano was collected at Seal, Ship and Petit Manan Islands, with careful consideration of the potential for researchers to contaminate samples with their own clothing fibers. Airborne microplastics were collected using passive samplers made of glass slides and sticky tape and blank samples will be used to assess lab and field contamination of airborne particles. Microplastics found in guano will be compared across nesting colonies as well as across general bird group (alcids, terns, gulls, cormorants, ducks). Comparisons between chicks and adults will be made where possible, and assessment of microplastics found in old (dried) guano vs fresh guano.

Black Tern Migratory Routes and Return Rates to Maine Breeding Wetlands

Danielle D'Auria – Wildlife Biologist, Maine Department of Inland Fisheries & Wildlife

The black tern (*Chlidonias niger*) is the rarest species of tern in Maine and has been identified as a Priority 2 Species of Greatest Conservation Need (SGCN) in Maine's Wildlife Action Plan (2015). Habitat loss and degradation on the breeding grounds are thought to be contributing factors in their decline, but available breeding habitat does not appear to be a primary limiting factor in Maine. It is unknown why numbers have declined within colonies, and why some colonies no longer host nesting black terns. Maine's breeding adults may be dying during winter or moving to other states or provinces to breed. There may be low recruitment of Maine juveniles as breeders in subsequent years. The spring, in collaboration with a graduate student at the University for Saskatchewan, we deployed five geolocators on adult black terns and color banded an additional ten adults to investigate migration routes & wintering locations as well as return rates to nesting sites in Maine. Adults with geolocators will be targeted for recapture in spring 2022. If successful we hope to deploy additional geolocators in future years. We also plan to continue color banding and resighting color-banded adults to determine return rates over time.

Using Fecal DNA to Examine Understudied Aspects of Atlantic Puffin Diet

William Kennerley - M.S. Student, Oregon State University

The observation-based methods currently employed in monitoring Atlantic puffin diet in the Gulf of Maine has many advantages, but also numerous drawbacks. While chick diet composition can be assessed reasonably well, we can currently do little more than assume that adults feed similarly. Adult puffin diet is poorly known as a whole, with comparatively little information from the western North Atlantic and almost none from incubating adults. There is also little known about how the similarity between adult and chick diet varies throughout the

breeding period, particularly in response to environmental variables such as sea surface temperature anomaly. It thus seems critical to understand how adult puffins feed themselves in a rapidly-warming Gulf of Maine. This year, more than 200 fecal samples were collected from chicks and adults of known breeding status on Matinicus Rock throughout the breeding period. With the aid of Dr. Gemma Clucas at the Cornell Lab of Ornithology, we will next employ DNA metabarcoding to learn more about what prey species are consumed by adult puffins breeding in the Gulf of Maine.

Shifting ecosystem states are reflected in diets of Arctic and Common Terns

Lauren Scopel – University of New Brunswick

Marine ecosystems worldwide are changing rapidly, but tracking these changes is difficult owing to the scale of data collection and analysis. Although bioindicator species are commonly employed in ecosystem studies, most marine systems lack well-developed biological indices. In the Gulf of Maine, rapid warming has coincided with major changes to breeding populations of seabirds, especially the Arctic (*Sterna paradisaea*) and Common Tern (*S. hirundo*). To investigate their potential as bioindicators, we examined trends in chick diets and reproductive measures in relation to bottom-up and top-down forcing. We used structural equation modeling, cluster analysis, and link tree analysis to investigate data from six (Arctic) and ten (Common) colonies, between 1991-2017. Both species showed major changes to their diets over time, coinciding with clear regime shifts in oceanographic properties and plankton communities. Arctic Terns fed chicks white hake (*Urophycis tenuis*) and Atlantic herring (*Clupea harengus*) in the 1990s, whereas Common Terns relied primarily on herring and sand lance (*Ammodytes spp.*). Between 2002-2008, salinity and temperatures decreased and preferred prey became less common alongside reduced tern reproductive success. A decline in the small copepod *Centropages typicus* corresponded with changes in tern diets. From 2010 onwards, temperatures increased and promoted species more tolerant of warm water; herring declined and was replaced by other taxa in tern diets. Arctic Terns consumed more white hake, while Common Terns integrated more gadoids and rarely seen taxa into their diets, each improving their reproduction from the previous decade. Lobster landings and herring price correlated with the Atlantic Multidecadal Oscillation, and worked as a combined index for stress of large gulls in the eastern and central Gulf; predation by gulls on tern eggs increased following warming and the decline of the herring fishery. These relationships illustrate the interconnectedness of this ecosystem, where herring and its productivity are strongly affected by top-down and bottom-up forcing, and have cascading effects on gulls and terns. Both tern species have potential as bioindicators, especially using diet data associated with specific ecosystem states.

GOMSWG 2021 – Attendees

(sorted by last name)

First name	Last name	Affiliation	email address
Brad	Allen	Maine Department of Inland Fisheries and Wildlife	brad.allen@maine.gov
Mark	Baran	Common Murre Restoration Project (formerly UNB)	MarkABaran@gmail.com
Kelly	Bell	Sr Admin Asst., Seabird Inst.	kelly.bellbrown@audubon.org
Brian	Benedict	USFWS - Maine Coastal Islands NWR	brian_benedict@fws.gov
Morgan	Bennett	USFWS - Monomoy NWR	Morgan_bennett@fws.gov
Shannon	Blake	Intermountain Bird Observatory, SRP 2016-2018	shannon.g.blake@gmail.com
Jake	Brown	National Audubon Society	brownjake1@uri.edu
Lindsy	Buckland	National Audubon Society	lindsy.buckland@audubon.org
Patrick	Carr	USFWS	Patrick_Carr@fws.gov
Joseph	Cleaves	USFWS - PMI	cleaves.ja@gmail.com
Liz	Craig	Shoals Marine Laboratory	elizabeth.craig@unh.edu
Shawn	Craik	Université Sainte-Anne	shawn.craik@usainteanne.ca
Danielle	D'Auria	Maine Department of Inland Fisheries and Wildlife	Danielle.Dauria@maine.gov
Diane	DeLuca	New Hampshire Audubon	blackfox@mcttelecom.com
Tony	Diamond	University of New Brunswick/MSI	tonydiamond49@gmail.com
Eddy	Edwards	USFWS - Maine Coastal Islands NWR	eddy_edwards@fws.gov
Kay	Garlick-Ott	National Audubon Society	garlickottkj@gmail.com
Natasha	Gownaris	Gettysburg College	ngownaris@gmail.com
Anthony	Hill	SRP volunteer 1996-2015	anhinga13@hotmail.com
Bob	Houston	USFWS - Gulf of Maine Coastal Program	robert_houston@fws.gov
Tiffany	Huenefeldt	National Audubon Society	tiffany.huenefeldt@audubon.org
Derrick Z.	Jackson	Co-Author, Project Puffin & The Puffin Plan	dzjphoto@gmail.com
Ed	Jenkins	Biodiversity Research Institute	edward.jenkins@briwildlife.org
Kristen	Johnson	USFWS - Rachel Carson NWR	johns42k@mtholyoke.edu
Kimberly	Keller	National Audubon Society	kimberly.keller@audubon.org
Emmylou	Kidder	National Audubon Society	emmylou.kidder@audubon.org
Zack	Klyver	Blue Planet Strategies	zack@blueplanetstrategy.com
Stephanie	Koch	USFWS - Eastern Massachusetts NWR Complex	stephanie_koch@fws.gov
Adrienne	Leppold	Maine Department of Inland Fisheries and Wildlife	adrienne.j.leppold@maine.gov
Lauren	Lescure	University of Manitoba	lmtlescure@gmail.com
Meredith	Lewis	University of Maine	meredith.a.lewis@maine.edu
Pam	Loring	USFWS - Migratory Birds	pamela_loring@fws.gov

Don	Lyons	National Audubon Society	donald.lyons@audubon.org
Helen	Manning	USFWS - Rachel Carson NWR	helen_manning@fws.gov; helenjmanning7@gmail.com
Catherine	Neal	National Audubon Society	nealcj@hawaii.edu
Kate	O'Brien	USFWS - Rachel Carson NWR	kate_obrien@fws.gov
Ryan	Potter	USFWS - PMI	Rynpotter@gmail.com
Heather	Richard	Shaw Institute	hrichard@shawinstitute.org
Michael	Rickershauser	National Audubon Society	m.rickershauser@gmail.com
Susan	Schubel	National Audubon Society	susan.schubel@audubon.org
Lauren	Scopel	University of New Brunswick	l.c.scopel@gmail.com
Paula	Shannon	National Audubon Society	paula.shannon@audubon.org
Beth	Spiegel	USFWS - Ship Island	spiegelb1@gmail.com
Becky	Suomala	New Hampshire Audubon	beckysuomala@gmail.com
Caitlin	Walker	USFWS - Metinic Island	cmw9@g.clemson.edu
Linda	Welch	USFWS - Maine Coastal Islands NWR	Linda_Welch@fws.gov
Kate	Williams	Biodiversity Research Institute	kate.williams@briwildlife.org
Keenan	Yakola	National Audubon Society	kyakola@gmail.com
Gwendolyn	Zeckowski	USFWS - PMI	gwendolyn.zeckowski@gmail.com
Brad	Zitske	Maine Department of Inland Fisheries and Wildlife	brad.zitske@maine.gov
Laura Minich	Zitske	Maine Audubon	lzitske@maineaudubon.org