2005 REPORT to the **CASCO BAY ESTUARY PARTNERSHIP**

for habitat restoration conducted under a grant from the
Casco Bay Habitat Restoration Fund

Outer Green Island

A newly hatched Roseate Tern chick, ready for banding – photo by Ellen Peterson

Outer Green Island, located 5 miles east of Portland, Maine was again the bright spot for terns on the Maine coast this summer. This pioneering program in non-lethal gull control has been very successful; in just four years, the colony has increased from 1 to 963 pairs of Common Terns and 36 pairs of federally endangered Roseate Terns (note: the total season roseate nest
count was 42 – making this the fourth largest Roseate colony in the Gulf of Maine).

Diet studies have revealed that
both Common and Roseate Terns at this site rely on two fish prey, herring and hake, to provision their young. Unfortunately a mink swam to this remote Casco Bay island in mid July and killed a minimum of 500 birds, including Common and Roseate Terns, Black Guillemot, Common Eider, Leach's Storm Petrel, Bank Swallow and Song Sparrow before it was captured. However, despite the presence of a mink – about 700 young terns successfully fledged.

Habitat Management

solarization plot on Outer Green Island- photo by Matt Martinkowski

In mid May, heavy guage black plastic was spread over the vegetation on the southern end of the island in zone 22. Prior to placing the plastic, the area was thoroughly weed-whipped to remove tall vegetation. The plastic was held in place with blocks of sod and rock moved to the location from the intertidal zone. Slits were cut into the plastic at low places to facilitate drainage and to prevent water from pooling on top of the plastic. The plastic was left in place over the course of the season and will be removed in May, 2006. _____ pairs of Common terns nested on top of the plastic. The greatest value of the project should be realized during the 2006 nesting season when terns have the opportunity to nest at the new habitat. Previous to spreading the plastic, this part of the island did not provide suitable tern nesting habitat as invasive grasses and other herbaceous plants dominated the location.

GOMSWG Census

We conducted the 2005 GOMSWG tern census at Outer Green Island on 20 June. The island is divided into 22 permanently marked grid squares. All tern nests were counted by walking at arms length across each grid square. The number of nests and the clutch size of each nest in each island sector were recorded. The total island tern nest count was 971 nests (a corrected total of 917 nests counted plus 54 nests in productivity and feeding plots; Table1).

Table1. GOMSWG census nest totals for Common Tern, 20 June 2005, Outer Green Island, Maine.

Time Frame	2002	2003	2004	2005
GOMSWG	1	94	497	971
Post-GOMSWG	11	66	185	N/A

During the census, each nest in grid squares 13, 16, and 19 was marked with a wooden stick. A transect was then walked through the marked grid squares to record the number of marked and unmarked nests. The ratio of marked to unmarked nests was used to calculate the Lincoln Index for observer error:

Lincoln Index = # marked nests + # unmarked nests / # marked nests

This year the ratio of marked to unmarked nests was 250 marked / 7 unmarked:

Lincoln Index = 250 marked + 7 unmarked / 250 marked = 1.033

When applied to the direct nest count of 891, the result is 917 nests. With the additional 54 nests in productivity and feeding studies, the GOMSWG total is 971 nests. To reduce disturbance to the colony and prevent chicks from falling off the cliff on the east side of the island, we did not conduct a second census. This year, nests were established around the entire perimeter of the island. The core of the colony was located along the mid-portion of the eastern ledge.

Productivity

Common Tern productivity (hatching success and fledging success) was monitored by following chicks for 15 days in two enclosures and three feeding study plots (n = 54 total nests). Enclosures and feeding study plots were checked every other day until hatching, then every day until all eggs hatched. Chicks in the productivity plots were weighed and measured every other day. Chicks reaching 15 days of age were considered fledged; however, if chicks were found dead after 15 days, productivity was adjusted to reflect the deaths.

Common Tern productivity was 0.65 chicks/nest, down from 1.45 in 2004. The average clutch size and the average number of chicks hatched per nest decreased from 2004 (Table 2). As the colony has increased in size, nest density has increased. Nests were often located every 2 feet, and often within a foot. The high density probably resulted in increased competition for food between chicks and an increase in the number of aggressive interactions between neighboring pairs and offspring. One researcher's studied showed that higher the nesting density the higher the aggressive interaction. The principal factors affecting tern productivity on Outer Green in 2005 were weather and

predation. Food supplies were likely more consistent on Outer Green than on other islands.

Table 2. Clutch Size, Hatching Success, and Fledging Success of Common Terns, 2002-2005, Outer Green Island, Maine.

	2002	2003	2004	2005
Clutch Size	n/a	2.64	2.26	2.22
Hatching Success	n/a	2.45	1.92	1.69
Fledging Success	n/a	2.09	1.45	0.67

There was wide variation in productivity between the plots (Table 3). Some of the variation may be explained by the time of laying and the experience of adults. The southern part of the island was colonized first with the colony then spreading northward. It is likely that terns nesting earlier are more experienced and thus more likely to raise more young. This would result in a decreasing productivity trend as you move north (Filmore, Rivendell, Diagon Alley, Isengard, and then Azkaban). However, this trend was not apparent (see Table 9). Predation, weather and nest site competition were likely the strong selective pressures in nesting phenology on OGI in 2005. Early inclement weather prevented early nesting on the island. Predation did not affect nesting until the end of the season. In addition, much of the colony was subject to increased competition and aggressive behaviors due to the high density. This seemed to be especially important in Diagon Alley with the two youngest broods growing at a much slower rate than the other chicks in the plot.

Table 3. Reproductive success of Common Terns in Feeding Study and Productivity Plots, Outer Green Island, Maine, 2005.

Location	# of Nests	# of Eggs	Mean Clutch Size	# Hatched	# Fledged	Hatch Success %	Fledge Success %	# Fledged/ nest
Productivity Plots								
Diagon Alley	15	36	2.4	31	16	86.1	44.4	1.07
Rivendell	3	7	2.33	7	3	100	42.8	1.00
Don&Mike	18	35	1.77	18	4	51.4	11.4	0.22
All Productivity Plots	36	78	2.17	56	23	71.7	29.4	0.564
Feeding Study Plots								
Filmore East	6	14	2.33	9	2	64.2	14.2	0.33
Isengard	6	14	2.33	14	8	100	57.1	1.33
Azkaban	6	14	2.33	12	3	85.7	21.4	0.33
All Feeding Plots	18	42	2.33	35	13	83.3	30.9	0.72
Overall	54	120	2.22	91	36	75.8	30.0	0.67

Tern chick survival depends largely on hatch order. In general, the first chick to hatch in a nest has a greater chance of fledging. In the feeding study and productivity plots, the first, second, and third chicks to hatch are designated the “A”, “B”, and “C” chicks,

respectively. Chicks in nests containing only one egg are referred to as "O" chicks. Hatching success was determined in relation to hatch order. Hatching success for "A", "B", "C", and "O" chicks was 0.97, 0.94, 0.69, and 0.33, respectively . Fledging success for "A", "B", "C", and "O" chicks was 0.91, 0.75, 0.0, and 0.33, respectively.

Chick Provisioning

Feeding studies were conducted on 18 nests in 3 locations for a total of 524 observation hours. With a total of 669 feedings recorded, the average feeding rate was 1.17 feedings/hour. This year the major prey items delivered were hake and herring (Table 4).

Table 4. Diet of Common Tern chicks in 2005, Outer Green Island, Maine.

Prey Item	Number of items	Percent of Diet	Average Size
Hake	363	54.26	1.55
Herring	124	18.54	1.40
Unknown Fish	78	11.66	1.1
Butterfish	33	4.93	1.31
Lumpfish	15	2.24	0.83
Unknown	15	2.24	0.73
Sand Lance	8	1.20	1.91
Pollock	7	1.05	1.96
Stickleback	7	1.05	1.54
Rosefish	5	0.75	1.80
Euphasid	4	0.60	0.69
Unknown Insect	3	0.45	0.33
Isopod	2	0.33	0.50
Amphipod	2	0.33	0.25
Insect	1	0.15	1.25
Alewife	1	0.15	2.50
Moth	1	0.15	0.50
Totals	669	100	1.18

This was the first season a Roseate feeding study was conducted. Feedings were identified at three nests, blind location was not ideal for a Roseate feeding study. Researchers observed three nests for 69 hours recording 48 feedings at a rate of 0.7 feedings per hour. Hake and Herring were the dominant prey items recorded (Table 11).

Table 5: Diet of Roseate Tern chicks in 2005, Outer Green Island, Maine

Prey Item	Number of Items	Percent of Diet	Average Size
Hake	19	39.6	1.38
Herring	16	33.3	1.20
Sand Lance	7	14.6	2.96
Unknown Fish	5	10.4	1.30
Butterfish	1	2.1	1.25
Total	48	100	1.62

Jenny Island

A total of 544 pairs of terns, including 11 pairs of federally endangered Roseate Terns nested on Jenny Island. Two acre Jenny Island is owned by MDIFW. With two strong colonies, Casco Bay is once again becoming a stronghold for Maine terns. No predators were observed at the island this year, permitting Common Terns to raise an average of 1 chick per nesting pair. We measured the success of this year's project by conducting an island wide census, measuring for productivity and documenting the food delivered to chicks.

A volunteer observer watches prey deliveries to Common Tern chicks on Jenny Island – photo by Scott Hall

Habitat Restoration

The planned burn for April 2005 was not possible because of extremely dry weather during the brief window of opportunity. The window is narrow, because the burn must follow a period of snow melt and drying temperatures before eiders begin nesting. The best opportunity occurs in mid April. Unfortunately, the weather was so dry that the town of Cundy's Harbor would not issue a burn permit.

Our habitat restoration this year focused on cutting tall vegetation hand raking of dead plant stems over the southern third of the island. If the burn was possible, it would have quickly removed the plant matter. In contrast, it took several days of work hand-raking the vegetation by staff and volunteers. This was piled into linear shaped piles. This had the dual benefit of exposing bare substrate and providing nesting opportunities for terns. Later, many terns nested on these vegetation piles. The hand-raked habitat proved very attractive to both Common and Roseate Terns. However, by July, mustard and ragweed dominated the managed areas. By this date, however, most pairs nesting in the managed habitat had produced on average one chick- a respectable productivity for a year noted at most islands for low productivity due to rain and poor food supplies.

Weed-whipping to remove goldenrod and other dense vegetation- photo by Scott Hall

Detail of habitat after weed whipping and prepared for tern nesting- photo by Helen Tupper

GOMSWG Census

On June 19th Jo Hiscock, Lisa White, Lucas Blass, Cricket Tupper and Jean Fujikawa conducted the annual Gulf of Maine Seabird Working Group census. A total of 480 COTE nests were counted. Using the Lincoln index, this was adjusted to a total of 532 COTE nests. This represents an increase from the 213 nests counted in 2004. Table 6 shows the GOMSWG census results from 1991 to 2005.

Table 6.GOMSWG results 1991-2005

Year	Roseate Tern	Common Tern	Arctic Tern
1991	0	57	0
1992	0	167	0
1993	6	363	0
1994	15	491	0
1995	0	542	0
1996	0	730	0
1997	12	1068	0
1998	8	1167	0
1999	10	1129	0
2000	0	1050	0
2001	0	59	0
2002	0	397	0
2003	1*	468	0
2004	2	213	1
2005	11	532	0

*found after GOMSWG date

Tern Productivity

Common Tern productivity on Jenny Island was generally high between 1991 and 1999 due to a number of factors. Predation caused a dramatic decline in productivity from 2000 through 2002.

In 2005 season researchers followed two productivity plots containing 13 nests and two feeding study plots containing 12 nests. Nests were numbered and each chick was banded with a stainless steel BBL band. The nests were monitored and the banded chicks were checked for presence during each island visit, about 2 times/week. Chicks were considered statistically fledged at the age of 15 days.

Overall breeding success was high due to the lack of predation. Table 7 shows the average clutch size (which is typically a measure of food availability), hatching success and fledging success in the 2005 season, based on a sample size of 25 nests. Average

clutch size was 2.2 eggs/nest, hatching success was 1.88 chicks/nest, and fledging success was 1.0 chicks/nest. Productivity has been high at this site in previous years due to the abundance of food in nearby inshore waters. Bold numbers indicate highest and lowest measures of success.

Table 7: COTE productivity in 1991 -2005

Year	N	Avg. Clutch (SD)	Avg. Hatch (SD)	Avg. Fledging (SD)
1992	39	2.69 (0.47)	**2.54** (0.60)	2.03 (1.04)
1993	54	2.54 (0.61)	2.19 (1.05)	1.94 (1.11)
1994	52	2.54 (0.58)	1.98 (1.02)	1.71 (1.05)
1995	43	**2.72** (0.45)	2.37 (0.93)	**2.12** (0.98)
1996	60	2.52 (0.57)	2.27 (0.80)	1.23 (0.72)
1997	84	2.57 (0.57)	2.31 (0.78)	1.83 (0.77)
1998	88	2.42 (0.62)	2.15 (0.85)	1.49 (0.71)
1999	73	2.51 (0.59)	2.19 (0.90)	1.37 (0.91)
2000	72	2.28 (0.65)	**1.36** (1.07)	**0.01** (0.12)
2001	28	2.50 (0.69)	1.54 (1.29)	0.07 (0.26)
2002	36	2.53 (0.61)	1.53 (1.21)	0.31 (0.52)
2003	40	2.30 (0.56)	1.92 (1.10)	1.50 (1.04)
2004	31	2.35 (0.11)	2.13 (0.10)	1.13 (0.17)
2005	25	**2.20** (0.58)	1.88 (0.93)	1.00(0.65)

Roseate Tern Presence

Roseate terns have nested intermittently on Jenny Island since 1993, and returned to nest on the island again in 2005. This season 11 nests were found during the census, with an additional nest found after the count. Average clutch size was 1.64; hatching success was 1.27 and fledging success 1.18 chicks per nest.

Chick Provisioning

In the past, the high productivity of Jenny Island terns was likely due to the abundance of prey items in the surrounding waters. The major food items in the past have been Hake and Atlantic Herring (*Clupea harengus*). This season Hake consisted of 53% of the tern diet and Herring consisted of 11%. Table 8 summarizes the prey items delivered in 2005. There were 2 plots and 12 nests in this season's feeding study. A total of 523 feedings were observed during 434 observation hours with an average feeding rate of 1.21 deliveries per hour.

Table 8: prey delivered to Common Tern chicks

Prey Species	**No. Feedings**	**% of Feedings**	**Av Prey Length**
Hake	279	53 %	1.35
Unknown	66	13 %	0.96
Herring	56	11 %	2.0
Unknown Fish	48	9 %	0.84
Butterfish	18	4 %	1.6
Lumpfish	15	3 %	0.75
Insect	13	3 %	0.62
Pollock	9	2 %	1.75
Stickleback	6	1 %	1.38
Euphausid	4	0.8 %	0.25
Sand Lance	2	0.4 %	2.0
Silverside	2	0.4 %	0.5
Unknown Invert	1	0.2 %	1.0
Rock Eel	1	0.2 %	4.0
Alewife	1	0.2 %	3.0
Earthworm	1	0.2 %	2.0
Bluefish	1	0.2 %	3.0