Final report

Prepared for the Nova Scotia Species at Risk Habitat Conservation Fund

POPULATION MONITORING AND CONSERVATION OF ROSEATE TERNS (STERNA DOUGALLII) IN SOUTHWEST NOVA SCOTIA (Project NSSARCF18_08)

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BACKGROUND

The Roseate Tern population in Canada has historically been relatively stable at around 100 breeding pairs (Kirkham & Nettleship, 1987) but fell to 55 in 2017 (McKnight, 2017). Roseate Terns are an Endangered species in Canada and provincially in Nova Scotia where 98% of the Canadian population nests (COSEWIC, 2009).

Over the past 18 years, only two colonies have consistently supported more than 15 pairs of the Canadian population of Roseate Terns: North Brother Island (Yarmouth County, NS) and Country Island (Guysborough County, NS; Nisbet et al., 2014). In 2003, 129 of 130 Roseate Tern nests in Canada were on these two islands (Horn & Boyne, 2010) and from 2015-2017, they have been the site of 161 of the 186 Canadian Roseate Tern nests (McKnight, 2017). In 2017, severe predation by an American Crow (*Corvus brachyrhynchos*) family and by gulls (*Larus spp.)* reduced the nesting success of all terns on North Brother Island to 0. Following this predation, a colony of Roseate Terns who abandoned North Brother Island were found 8 km away on Gull Island.

Because of the small number of nesting colonies, the Canadian Roseate Tern population is extremely vulnerable to the effects of climate change but also to disease (Environment Canada, 2010) or predation as we observed in 2017. In order to reduce these threats, at least one more colony must be established either by establishing new Roseate Tern colonies or by attracting Roseate Terns to large existing colonies of Common Terns where Roseate Terns have previously nested (Environment Canada, 2010). Better understanding of Roseate Tern habitat use and selection is necessary for either option.

Studies of habitat selection that compare used and unused sites are an important part of studying habitat selection but do not necessarily indicate an optimal choice at the evolutionary level (Clark & Shutler, 1999). Natural selection can occur when there are habitat differences between successful and unsuccessful nests that might shape nest selection (Clark & Shutler, 1999). In order to properly understand this process of habitat selection, a crucial second step in habitat selection studies is to compare successful and unsuccessful nests in order to determine productivity (Clark & Shutler, 1999).

The mixed colony on Gull Island in 2018 provided us with the first opportunity to study habitat selection in a mixed colony of Roseate, Common and Arctic Terns.

PROJECT GOAL AND OBJECTIVES

The specific goals of this project were:

1) Conservation of Roseate Terns on North Brother Island (long-term Roseate Tern colony)
   - Enhance breeding habitat and productivity of Roseate, Common and Arctic Terns
   - Monitor nesting populations of Roseate, Common and Arctic Terns on North Brother Island
   - Monitor productivity and preference of nest-boxes on North Brother Island

2) Conservation of Roseate Terns on Gull Island (colony established on 2017)
   - Monitor nesting population size of Roseate, Common and Arctic Terns
   - Monitor productivity and examine nest-site preferences of Roseate Terns on Gull Island

3) Establish additional predator free colonies
   - Identify sites in the Lobster Bay area based on suitability for terns and on practicality for restoration
   - Develop a habitat suitability guide for the Canadian Roseate Terns
   - To rank sites based on habitat suitability criteria

No terns successfully nested on North Brother Island in 2018. We monitored productivity and nest-site preferences of naturally co-nesting Roseate, Common and Arctic Terns on Gull Island. To the best of our knowledge, this is the first time that the nesting ecology of three species have

been studied in a situation for which management (e.g., nest box provisions and heavy gull control) has been extensive. The report below highlights preliminary results from Objectives #2 and #3 above.

Study site

Similar to 2017, tern nesting attempts failed on North Brother Island in 2018. The majority of our efforts were concentrated on Gull Island, a low, rocky island with a tidal pond. The island is located in Lobster Bay about 8 km west of North Brother Island (Figure 1). More photos of Gull Island are included in appendix 2.

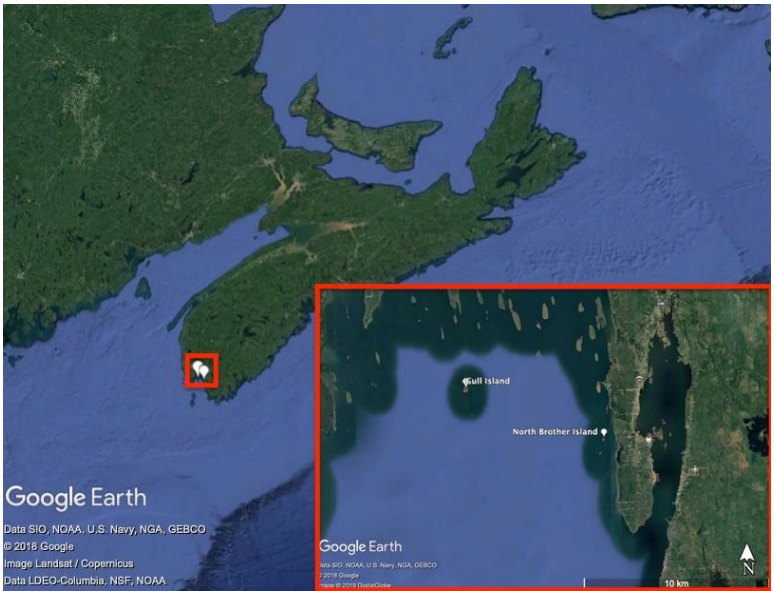

Figure 1. Gull and North Brother Islands, Nova Scotia.

Figure 2. Gull Island, Nova Scotia.

COMPLETED WORK TO DATE

OBJECTIVE #2: TERN NESTING ECOLOGY

Data collection

Gull Island was visited 2-3 times weekly by launching a zodiac from a fishing boat from May-August. Cameras, telescopes, binoculars and blinds were used to watch terns land on eggs, identify nests and confirm species.

Nesting

We did a sweep across the island 21 days after our first recorded nest in order to estimate peak nesting numbers for all three species of tern. Nest visits did not occur during inclement weather

(e.g., rain). We recorded the coordinates of every nest of every tern species with a GPS (EOS Arrow 100, 20cm). We placed a small stick (15cm) with an identifying code about 25 cm West of every Roseate Tern nest as well as 45 Arctic Tern nests and 63 Common Tern nests. Each marked nest was followed until its fate determined (ex. abandoned, predated, or hatched). Dates of nest initiation were estimated based on chronology of egg laying.

Hatching

From early June to mid-July, we did sweeps across the island 2-3 times weekly to check for the presence of chicks in each of our marked nests. We recorded hatching success for each nest (% of eggs that hatched) and banded each chick we found in or very near to the nest bowl. We also recaptured banded chicks throughout their flightless period (<20 days post-hatch) in order to estimate fledgling success.

Measurement of habitat characteristics around nest sites

Once all terns left the island in early August, we placed a 1 m diameter plastic ring around the center of each nest bowl and recorded whether each of the following was present within the ring: rope, bottles, plastic debris, lobster traps, metal debris, buoys, and Maritime Sunburst Lichen, *Xanthoria parietina* (Figure 3).

We recorded overhead concealment at nest sites by placing a black disk about the size of a nest-bowl (10 cm diameter) (Nisbett et al., 2018) with five small white squares placed on it in the middle of the nest bowl (Appendix 2). We took an overhead image of the nest and later estimated

the % of each white square that was visible Nests with a completely visible disk had 0% overhead concealment. Nests with only one visible square had 80% overhead concealment.

Figure 3. Overhead photo, taken post-nesting, of a Roseate Tern nest on Gull Island, 2018.

We recorded lateral concealment by placing two fake tern eggs in the center of the nest bowl. We then attempted to observe the eggs from 40-60 cm off the ground when our eye was above the 1 m plastic ring. We undertook observations from each of the four main cardinal directions and recorded whether the eggs were visible or not. We used this height in order to simulate the average height of a Greater Black-backed Gull walking through the colony.

For each nest site, we collected all variables listed above from a control site. The control sites were selected by using a series of random numbers to choose two distances (0.3-3.3 m)) and directions (either S-N or E-W) from each nest. We chose new sites if our control sites were in unsuitable habitat, ie. an area that flooded daily.

For each species, we ran binomial logistic regression models to examine what habitat variables best discriminated nest types. For nest selection results, we used “nest” or “control” for our dependent variables. For nest success results, we used “successful” or “unsuccessful” as our dependant variables.

OBJECTIVE #3: IDENTIFYING ADDITIONAL TERN NESTING SITES IN LOBSTER BAY

During peak tern nesting in June, we conducted boat surveys in Lobster Bay specifically focusing on determining the distribution of nesting terns. For each island, we indicated the presence or absence of tern nesting activity. For islands used by terns, we counted the number of individuals and nests of each species.

Over the coming months, we will undertake spatial analyses that determine landscape variables that best discriminate islands used and unused by terns in Lobster Bay (e.g., island size and shape, distance from shore, vegetation characteristics, gull nesting).

PRELIMINARY RESULTS

Nesting population size of Roseate, Common and Arctic Terns on Gull Island

We found a total of 292 tern nests on Gull Island during 2018 (Table 1). The terns nested in two subcolonies, divided by a thick patch of Stinging nettle (*Urtica dioica*) (Figure 4). We followed productivity at a total of 143 nests from each side of the Stinging nettle. The Roseate Tern

nesting period on Gull Island started on May 30th, a few days after the Common and Arctic Terns (Figure 5). Arctic Terns generally initiated nests earlier than both Common and Roseate Terns.

Table 1. Total nests and followed nests for each species of tern on Gull Island in 2018.

	Total nests	Followed nests
Roseate Tern	35	35
Common Tern	176	63
Arctic Tern	81	45
Total	292	143

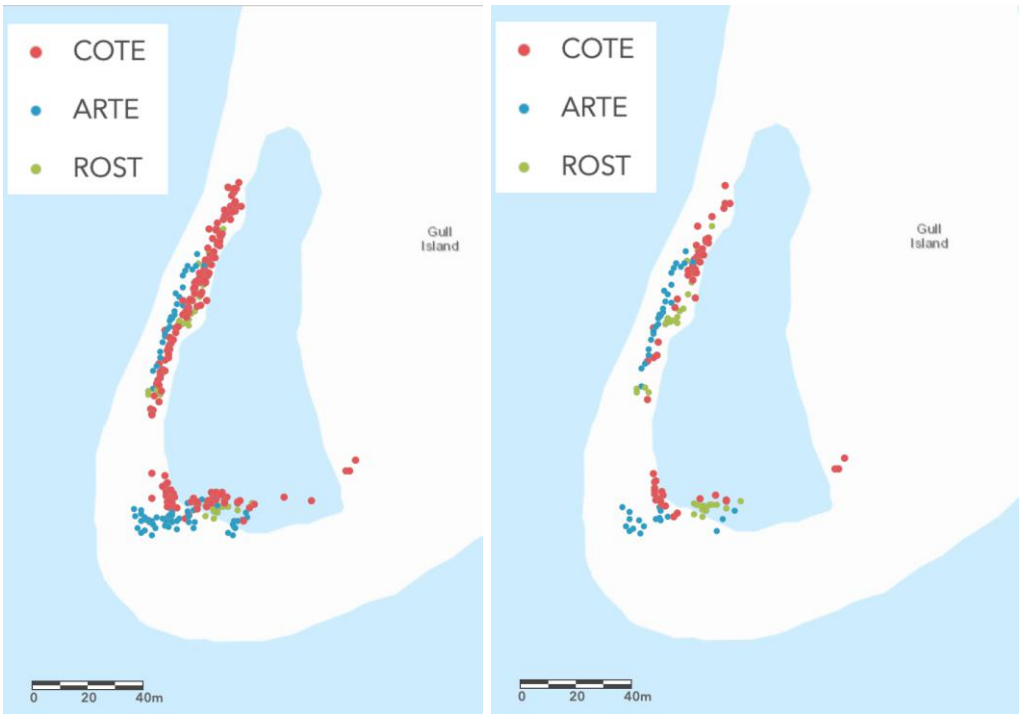

Figure 4. All (left) and followed (right) Roseate (ROST), Common (COTE) and Arctic Tern (ARTE) nests. Gull Island 2018

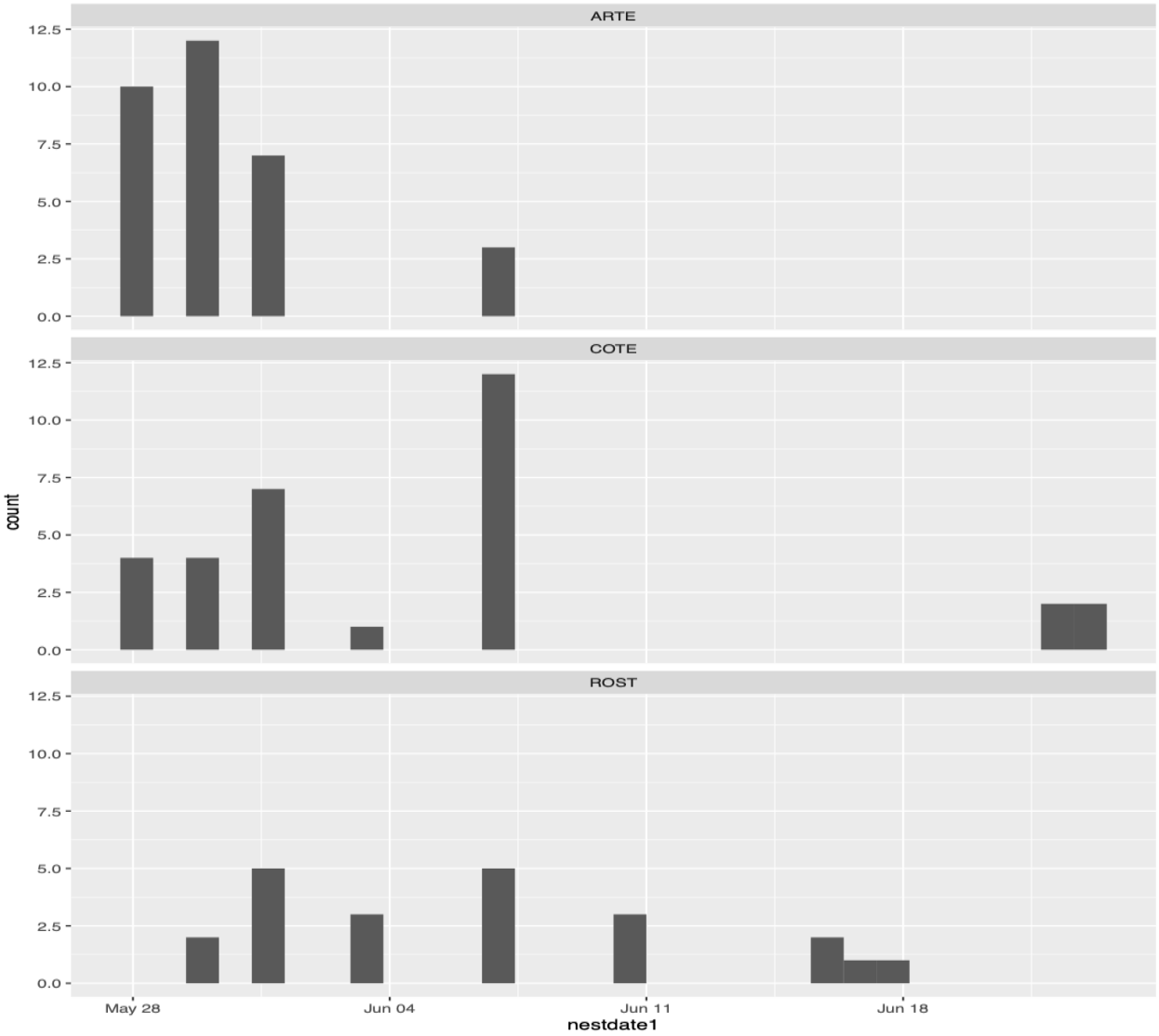

Figure 5. Nesting dates of 35 Roseate Terns, 63 Common Terns, and 45 Arctic Terns on Gull Island in 2018.

Nest-site preferences of Roseate, Common and Arctic Terns

There was a significant difference in lateral cover between Roseate Tern nest sites and control sites ($p>0.01$) (Table 2). When we did the same analysis on Common and Arctic Terns, we found no difference. There was no difference between presence of lichen or garbage at nests and control sites for all three species.

Table 2. Results from a binomial regression comparing tern nest sites and control sites. Gull Island 2018.

	Roseate Tern	**Common Tern**	**Arctic Tern**
Lateral Cover	Yes (p>0.001)	No (p=0.07)	No (p=0.26)
Presence of Lichen	No (p=0.09)	No (p=0.75)	No (p=0.99)
Presence of Garbage	No (p=0.42)	No (p=0.39)	No (p=0.06)

Productivity of Roseate, Common and Arctic Terns

Common Terns had both the highest average clutch size and the lowest hatch success of the three species, possibly indicating higher predation pressure (Table 3).

Table 3. Average clutch size (eggs/nest), hatch success (chicks/eggs), and nest success (nests with at least 1 hatched chick/ total nests) for all three species of terns on Gull Island, 2018.

	Roseate Tern	Common Tern	Arctic Tern
Clutch Size	1.49	2.14	1.93
Hatch success	54%	40%	56%
Nest success	62%	51%	71%

Factors Influencing Nest Success

There were no differences in lateral cover, overhead cover, garbage or lichen between successful and unsuccessful nests across all three species (Table 4). There was no significant difference in the number of other terns within one and two meters of successful and unsuccessful nests. There was however a significant difference in the number of tern nests within 10m and the success of Roseate and Common Terns.

Table 4. Results from a binomial regression comparing successful and unsuccessful tern nests. Gull Island 2018.

	Roseate Tern	**Common Tern**	**Arctic Tern**
Tern nests within 1m	No (p=0.28)	No (p=0.94)	No (p=0.83)
Tern nests within 2m	No (p=0.65)	No (p=0.45)	No (p=0.60)
Tern nests within 10m	**Yes (p>0.01)**	**Yes (p>0.01)**	No (p=0.07)
Lateral Cover	No (p>0.49)	No (p=0.96)	No (p=0.99)
Overhead Cover	No (p>0.81)	No (p=0.99)	No (p=0.99)
Presence of Garbage	No (p>0.95)	No (p>0.14)	No (p>0.46)
Presence of Lichen	No (p>0.73)	No (p>0.72)	No (p=0.99)

Tern nesting on other Lobster Bay Islands

Aside from Gull Island, tern nesting was confirmed on the following islands in southwest NS in 2018: Half Bald, Peases, Pinch Gut, Flat, Blanche, Coffin, Toby, and Bear Point Thrum. Of particular interest was Peases, on which at least one Roseate Tern pair nested in 2018. Roseate Tern adults were also observed on Pinch Gut and on Bear Point Thrum.

ASSESSMENT OF ACHIEVEMENTS AND LESSONS LEARNED

Although we once again had no nesting on North Brother Island, the information gathered in 2018 is amazing. Important achievements include:

- Established monitoring procedures for the tern colony on Gull Island for the first time.
- Observe naturally nesting (no nest boxes) Roseate Terns in a mixed colony with Common and Arctic Terns for the first time.

- Collect nest site characteristics at all 35 Roseate Tern nests as well as 63 Common Tern nests and 45 Arctic Tern nests (followed nests).
- Collect productivity data from all followed nests.
- Collect precise (<20cm) GPS coordinates for every tern nest (n=292) as well as gull nests (n=45) on Gull Island.

We learned that it was much harder than we foresaw to catch fledgling chicks. We underestimated their ability to hide among large rocks, even far into the intertidal zone.

RECOMMENDATIONS FOR FOLLOW UP

We recommend the following actions as extensions of our work:

- Continued monitoring of the Roseate, Common and Arctic Terns on Gull Island.
- Additional efforts during fledging period
- Obtain productivity information for more nests in the colony
- Obtain more foraging information
- Study what habitat tern chicks use to survive fledging

LITERATURE CITED

Clark, R., & Shutler, D. (1999). Avian Habitat Selection: Pattern from Process in Nest-Site Use By Ducks? *Ecology*, *80*(1), 272–287.

COSEWIC. (2009). COSEWIC Assessment and Update Status Report on the Roseate Tern (*Sterna dougallii*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii +48 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Environment Canada. 2010. Amended Recovery Strategy for the Roseate Tern (Sterna dougallii) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada. Ottawa. vii + 36 pp.

Kirkham, I., & Nettleship, D. (1987). Status of the Roseate Tern in Canada. *J. Field Ornithol*, *58*(4), 505–515.

McKnight, J. (2017). Roseate Tern colony counts in managed colonies. Unpublished Data.

Nisbet, I. C. T., Gochfeld, M., & Burger, J. (2014). Roseate Tern (*Sterna dougallii*), version 2.0. In The Birds of North America (P. G. Rodewald, editor). Cornell Lab of Ornithology, Ithaca, New York, USA.

APPENDIX 1

Additional photos of Gull Island, 2018

Observing Gull Island. Photo: Ted D'Eon

Southern end of Gull Island. Photo: Ted D'Eon

Gull Island tidal pond. Photo: Ted D'Eon

South west edge of Gull Island. Photo: Ted D'Eon

Appendix 2

Image of disk used for calculating overhead concealment