Post-Spring Migration Colony-site Prospecting by Roseate Terns *(Sterna dougallii)*

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ABSTRACT

We recorded banded Roseate Terns (Sterna dougallii) *and unbanded individuals mated to banded individuals in May and the first third of June in 2001 and 2002 to quantify post-spring migration prospecting by this species at Falkner Island, Connecticut. In 2001, more than one quarter: 34/125 (27.2%) of those observed by 19 May and 38/150 (25.3%) of those observed by 25 May did not remain at this colony site and went elsewhere to attempt breeding. In 2002, fewer terns were observed by 19 May, but an even higher percentage: 11/28 (39.3%) of those seen by 19 May and 58/151 (38.4%) of those seen by 25 May did not stay and nest. Our results demonstrate that a substantial proportion of the earliest arriving individuals at this site are prospecting and gathering information about local conditions before making a decision about going elsewhere to nest.*

INTRODUCTION

Beginning with their post-breeding dispersal after fledging when young of year from one colony site may visit other colony sites (Shealer and Kress 1994, Ratcliffe et al. 2008), Roseate Terns *(Sterna dougallii)* and other species of waterbirds with delayed maturity and recruitment into the breeding population have multiple opportunities to compare local conditions at their natal and other potential colony sites. In their review of prospecting for breeding sites by first-time breeders and experienced birds, Reed et al. (1999) noted that this gathering of information to assess the quality of possible breeding areas before choosing a colony and nest site may be done many times over a long period and is cited evidence for how some species might acquire and use such information. In species such as the Black-legged Kittiwake *(Rissa tridactyla)*, for example, individuals may spend one or more breeding seasons as prospecting squatters at a colony site (Cadiou et al. 1994; Boulinier et al. 1996) before recruiting into the breeding population. Sooty Terns *(Onychoprion fuscatus)* may spend several years prospecting at a colony site before recruiting (Harrington 1974), but Common Terns *(S. hirundo)* and Roseate Terns usually need just one or two years of prospecting before recruiting (Ludwigs and Becker 2002; Spendelow et al. 2002; Dittmann and Becker 2003). Most studies of prospecting behavior have looked at initial colony and nest site selection by first-time recruits into a breeding population (Reed et al. 1999), but prospecting behavior also can occur again each year as prior breeders evaluate whether or not to use the same one used in the previous year or to move to a new colony site (i.e., show breeding dispersal). The information used in this evaluation can be gathered either after a nesting attempt in one year or at the beginning of the next breeding season (Reed et al. 1999).

While there are several studies of breeding dispersal in Roseate Terns (Spendelow et al. 1995, 2008, 2010; Lebreton et al. 2003; Ratcliffe et al. 2008) and Common Terns (Breton et al. 2014). Relatively little information exists on spring visitation behavior, although (Dittmann et al. 2005) studied Common Terns that had not yet recruited into the breeding population, prospecting at two nearby (4 km) colony sites. In their study of adult breeding dispersal by Roseate Terns at three colony sites in Europe, Ratcliffe et al. (2008) noted that the relatively higher rates of movements from the two smaller colonies to the larger and more productive one at Rockabill Island, Ireland, could not be explained by the order in which terns encountered the three sites during spring migration. Instead, they proposed two options: that the dispersing individuals either followed the bulk of the population migrating north in the spring or choose to

breed at the larger colony after prospecting during the staging period of the previous year.

The situation for the part of the NorthWest Atlantic breeding population nesting in the north-central section of Long Island Sound at the Falkner Island unit of the U.S. Fish and Wildlife Service's Stewart B. McKinney National Wildlife Refuge off the coast of Guilford, Connecticut, is different from Ratcliffe et al. (2008). While this is the westernmost Roseate Tern colony site in Long Island Sound, the number nesting there is much smaller than at several other colony sites (Great Gull Island, New York, at the eastern end of Long Island Sound, and in Buzzards Bay, Massachusetts) that the terns likely visit on their way to Falkner Island after spring migration (Spendelow et al., 1995, 2008). While Roseate Terns nesting at these other sites in New York and Massachusetts have been known to visit Falkner Island during the post-breeding period in July and August (Spendelow et al. unpubl. data), for this study we wanted to quantify how much prospecting is performed after the spring migration period when the terns traveling to Falkner Island have had the opportunity to visit other colony sites along the way. Although terns reaching Falkner Island in the spring can remain and nest, they also have the opportunity to reverse course and go back east to those larger and usually more successful colonies after evaluating local conditions at Falkner Island. Between the years 2000 and 2001 breeding seasons, some of the tern nesting habitat at Falkner Island had been modified extensively as a result of the construction of a rock revetment to protect the lighthouse on the island (Grinnell 2010). We hypothesized that habitat modifications resulting from construction of the revetment might have some effects on the choice of nest sites by Roseate Terns, and so in 2001 and 2002 Falkner Island Tern Project staff began observing and identifying terns earlier in the nesting season than had been done in the years prior to revetment construction.

METHODS

Falkner Island is located at 41° 13′ N, 72° 39′ W in Long Island Sound about 5 km south of Guilford, New Haven Co., Connecticut. A general description of the island and the nesting areas used by the Roseate Terns in the 1980s when we began providing artificial nest sites for them is given by Spendelow (1982). The bluff on the eastern side of the island had eroded so severely by the end of the 1990s that it was endangering the lighthouse and so the U.S. Army Corps of Engineers designed a Shoreline Protection Project (SPP) to retard further erosion (Rogers and Spendelow 2007). Construction of the SPP began in the fall of the year 2000 after the end of the tern breeding season. The SPP consisted of a rock revetment that stretches around much of the island; details on the construction of the rock revetment are given in Grinnell 2010. Artificial nest sites in the form of nest boxes and half-buried tires (Spendelow 1996) had been used at this colony site for over 20 years and although construction of the revetment altered some of the nesting habitat, the placement of these structures remained relatively consistent in the years just before and right after construction was completed (Rogers and Spendelow 2007; Grinnell 2010).

To see how Roseate Terns (especially those that had nested previously in the now-altered areas) responded to the habitat modifications from the revetment construction, we began observations of returning terns on 5 May 2001 (about 10 days earlier than in 1998-2000) and 10 May 2002. In addition, in 2001-2002 we made special efforts to identify Roseate Terns seen all around the island instead of concentrating just on those observed inside the nesting areas. The overall spring arrival study period (defined as being from early May to 10 Jun) was divided into six (2001) or five (2002) observation periods depending upon when the Roseate Terns started to arrive and observations began each year. To facilitate comparisons between years, after an initial one or two periods of variable length, the next two 6-day periods and the final two 5-day periods were chosen so that they ended on the same date in 2001 and 2002 (Tables 1 and 2). Observations continued into August in both years and were made from six blinds on the top of the island overlooking the six Roseate Tern subcolony sites, from a blind near the high tide line on the

beach at the tip of the northern subcolony site, and from the jetty surrounding the harbor on the west side of the island (Spendelow 1982).

From 1992-2010, Roseate Tern chicks in the Northwest Atlantic population were banded with a metal incoloy or stainless steel U.S. Bird Banding Laboratory band on one leg and a metal field-readable incoloy band with a four-character complex (two upper and two lower characters) stamped twice on the band for quick identification at distances up to 20 m on the other leg. Adult Roseate Terns trapped at Falkner from 1994 to 2003 received an unique 6-band combination consisting of a lower metal band and two plastic butt-end color bands on each leg. Adults trapped at Great Gull Island during this period received a 4-band combination of a metal band and a single butt-end color band on each leg; terns with full auxiliary band combinations often could be recognized and positively identified at distances up to 50 m throughout the course of this study.

Not all of the recognizable individuals could be positively identified, but our previous work on breeding dispersal (Spendelow et al., 2010) in this species has shown that members of pairs usually move together when changing colony sites (Spendelow et al., unpubl., data). For birds deemed as paired on the basis of observations of typical pair-like behavior (e.g., attempted mountings, copulations and/or mate-feedings, etc.) where one member could be positively identified and the second member was recognizable but not positively identified, it was assumed that the second bird demonstrated colony-site prospecting behavior similar to its banded mate. Therefore, for determining the last day on which an individual was present, when an identifiable individual departed we assumed that its mate departed at the same time.

RESULTS

The minimum number of new individuals observed in each arrival period, the cumulative number of arrivals, the total number for each period that did not stay, the percentage that did not stay, the cumulative number that did not stay, and the cumulative percentage that did not stay are given in Tables 1 and 2 for 2001 and 2002, respectively. In 2001, Common Terns were first seen on 30 Apr and we estimated that more than 1,000 were present by 2 May. The first Roseate Terns were seen on 3 May and the first three Roseate Tern eggs were found on 17 May. Observations to identify individual Roseate Terns began on 5 May and by 31 May more than 200 different adults had been seen. Fifty individuals that were first seen between 5 May, and 10 Jun were not seen during the second half of Jun and one-third of the Roseate Terns identified in the first nine days apparently were prospecting as they did not stay to nest at this site (Table 1). A few adults seen in May that had departed by early Jun returned later with a fledgling in late Jul or Aug, proving that they had nested elsewhere.

Compared to 2001, in 2002 Roseate Terns began to arrive later, far fewer were seen during the first half of May, there was no second pulse of arriving adults in the last six days of May, and relatively more of the earliest arriving individuals left without nesting (Table 2). Of 186 individuals seen between 5 May and 10 Jun 2002, 69 (37.1%) did not stay at this site. Despite the difference in the timing of the first arrivals, similar numbers had been identified by 25 May and the percentage that did not stay was highest for terns identified in the first two arrival periods in both years (Tables 1 and 2).

Adults known to be at least five years old arrived earlier in both years than did younger 2-, 3- and 4-yr-old birds (Tables 3 and 4). On average, about three-quarters of the older (six or more years old) adults were first seen by 25 May in both years. By comparison, only six of 20 (30.0%) of the four-yr-olds, two of 31 (6.5%) of the three-yr-olds, and none of the 17 two-yr-olds identified in 2001 were seen by 25 May (Table 3), and eight of 13 (61.5%) of the four-yr-olds, two of 11 (18.2%) of the three-yr-olds, and none of the 16 two-yr-olds identified in 2002 were seen by 25 May (Table 4). Most of the spring prospecting we observed in the earliest arrival periods in both years, therefore, was done by older terns.

Table 1. Numbers of Roseate Terns identified on Falkner Island, Connecticut, in spring 2001. "DNS" means did not stay.

Period First Identified	New Arrivals	Cumulative Arrivals	New DNS	% age DNS	Cumulative Total DNS	Cumulative % age DNS
05-13 May	42	42	14	33.3	14	33.3
14-19 May	83	125	20	24.1	34	27.2
20-25 May	25	150	4	16.0	38	25.3
26-31 May	57	207	11	19.3	49	23.7
01-05 June	7	214	1	14.3	50	23.4
06-10 June	1	215	0	0.0	50	23.3

Table 2. Numbers of Roseate Terns identified on Falkner Island, Connecticut, in spring 2002. "DNS" means did not stay throughout the summer. The first weeks are combined into a single row as observations did not start until 10 May in 2002.

Period First Identified	New Arrivals	Cumulative Arrivals	New DNS	% age DNS	Cumulative Total DNS	Cumulative % age DNS
05-19 May	28	28	11	39.3	11	39.3
20-25 May	123	151	47	38.2	58	38.4
26-31 May	27	178	7	25.9	65	36.5
01-05 June	8	186	4	50.0	69	37.1
06-10 June	0	186	0	0.0	69	37.1

DISCUSSION

We saw an unexpectedly high degree of colony-site prospecting behavior by the earliest-arriving Roseate Terns in both years. The overall percentage of early arriving adults that did not stay in 2002 was even greater than in 2001, suggesting that this general behavior was in response to other factors (such as the availability of prey fish) and not just due to the terns responding to alterations of the nesting habitats following revetment construction done before their arrival in 2001. The prospecting behavior we observed in the first few arrival periods each year was performed primarily by experienced breeders at least six years old, and the relatively lower breeding dispersal rates of adult Roseate Terns at Falkner Island reported in prior research (Spendelow et al., 1995; Lebreton et al., 2003) apparently do not reflect the much larger degree of colony-site prospecting being done at this site by individuals that already may have nested one or more times in previous years.

We do not know the degree to which the high percentage of prospecting adults seen in 2001 that did not stay was a consequence of the revetment construction that altered much of the tern nesting habitat at Falkner Island (Grinnell 2010). However, as the percentage of Roseate Terns that did not stay in 2002 was even higher than in 2001, this suggests that revetment construction did not necessarily increase the amount of prospecting that typically occurs on an annual basis at this site as the arriving birds are evaluating the prey base. Falkner Island is the western-most colony site in Long Island Sound, and by the time they arrive at this site most terns will have had the opportunity to visit and assess the availability of prey at other colony site locations along the way.

Embedded transponders were used to track young Common Terns in the process of recruiting to the breeding population that moved back-and-forth between two colony sites in Germany that were only 4 km apart (Dittmann et al. 2005), and it is likely that the individuals that nested at both those sites used similar feeding areas. While it is possible that the older Roseate Terns that we observed during the first few weeks of arrival may have made similar multiple back-and-forth movements between Falkner Island and the nearest Roseate Tern colony site at Great Gull Island before deciding where to nest each spring, this is thought to be unlikely

given the much greater distance (45 km) between these two sites. Our results do show, however, that even if they do end up nesting at the same colony site that they did in the previous year, older terns that may have nested many times already continue to show prospecting behavior again each spring to evaluate conditions at more than one potential colony site.

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Table 3. Numbers of known-age Roseate Terns and older unknown-age individuals (i.e., first banded as adults) grouped by arrival period at Falkner Island, CT, USA in spring and summer 2001. "Age 6+" includes all known-age individuals six or more years of age. "Age 'A+3' and up" includes individuals first banded as adults three or more years prior to the current year. "11 June +" includes individuals first seen anytime on or after 11 June. Individuals first banded as adults one (A+1) or two (A+2) years before the current year are not included in this table so row totals in this table and will not match entries in Table 1.

Period First Identified	Age 2	Age 3	Age 4	Age 5	Age 6+	Age "A+3" and up
05-13 May	0	0	1	0	26	8
14-19 May	0	2	4	6	49	18
20-25 May	0	0	1	1	21	0
26-31 May	0	2	7	0	34	11
01-05 June	0	6	1	0	0	2
06-10 June	0	0	0	0	0	0
11 June +	17	21	6	1	5	2
Total	17	31	20	8	135	41

Table 4. Numbers of known-age Roseate Terns and older unknown-age individuals (i.e., first banded as adults) grouped by arrival period at Falkner Island, CT, USA in spring and summer 2002. "Age 6+" includes all known-age individuals six or more years of age. "Age 'A+3' and up" includes individuals first banded as adults three or more years prior to the current year. "11 June +" includes individuals first seen any time on or after 11 June. Individuals first banded as adults one (A+1) or two (A+2) years before the current year are not included in this table so row totals in this table will not match entries in Table 2.

Period First Identified	Age 2	Age 3	Age 4	Age 5	Age 6+	Age "A+3" and up
05-13 May	0	0	0	1	4	1
14-19 May	0	0	2	0	12	6
20-25 May	0	2	6	4	65	27
26-31 May	0	1	4	3	16	2
01-05 June	1	0	1	2	2	1
06-10 June	0	0	0	0	0	0
11 June +	15	8	0	5	7	0
Total	16	11	13	15	106	37

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