# Nocturnal Abandonment Response to Black-Crowned Night-Heron Disturbance in a Common Tern Colony

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**Abstract.**—Common Tern reproductive success on Stratton Island, Maine, was severely affected in 1989 by nocturnal Black-crowned Night-Heron disturbance. Night-herons preyed upon tern chicks and caused adult nocturnal abandonment. Common Tern fledging success in 1989 was 0.24 (± 0.65) chicks/pair. Hatching success was significantly greater but fledging success was lower between early and late nesting terns. Night-heron disturbance allowed Herring and Great Black-backed Gulls, Ruddy Turnstones and ants access to the deserted nests. Nocturnal predators destroyed 51 nests in 1989, and 62 other nests failed due to adult abandonment of eggs and chicks. Our observations suggest that Common Terns cannot distinguish between the similar silhouettes of Black-crowned Night-herons and large owls after dusk and that night-herons alone may cause large-scale desertion in a tern colony. *Received 10 April 1990, accepted 23 November 1990.*

**Key Words.**—Black-crowned Night-Heron, *Nycticorax nycticorax*, Common Tern, *Sterna hirundo*, nest defense, nocturnal abandonment, nocturnal predation, reproductive success.

**Resumen.**—El éxito reproductivo de la gaviota común en Isla de Stratton, Maine, fue afectado severamente en 1989 debido a disturbios nocturnos por la yaboa real. Yaboas reales depredaron pichones de gaviota y causaron el abandono nocturno de adultos. El éxito de emplumaje de la gaviota común en 1989 fue de 0.24 (± 0.65) pichones por nido. El éxito de nidada fue significativamente mayor pero el éxito de emplumaje fue menor en la face temprana de anidaje. Los disturbios debido a visitas de yaboas reales también permitieron el acceso de otros depredadores, tales como la gaviota argentea, la gaviota mayor espaldinegra, el playero turco y hormigas, a los nidos abandonados. Depredadores nocturnos destruyeron 51 nidos en 1989, y otros 62 nidos ne tuvieron éxito debido al abandono de los huevos y pichones por las gaviotas comunes adultas. Nuestras observaciones sugieren que las yaboas reales en si pueden causar enormes abandonos y reducir el éxito reproductivo en una colonia de la gaviota común.

**Palabras clave.**—yaboa real, *Nycticorax nycticorax*, gaviota común, *Sterna hirundo*, defensa de nido, abandono nocturno, depredacion nocturna, exito reproductivo.

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Colonial nesting in seabirds is advantageous in that it may facilitate detection of and defense against predators (Tinbergen 1956, Kruuk 1964, Lack 1968, Hamilton 1971). Diurnal responses to predators have been thoroughly documented (e.g., Kruuk 1964, Hatch 1970, Fuchs 1977, Burger and Gochfeld 1988), but the responses to nocturnal predation are not well known.

Nocturnal predators cause abandonment of nests for an extended period of time (Emlen *et al.* 1966, Hunter and Morris 1976, Patton and Southern 1978, Southern *et al.* 1982), and may prolong the duration of the incubation period (Hunter *et al.* 1976, Nisbet and Welton 1984), resulting in high egg and chick mortality (Emlen *et al.* 1966, Nisbet 1975, Shugart 1977, Nisbet and Welton 1984). In a review of published reports of nocturnal predation, Southern and Southern (1979) concluded that many breeding *Larus* gull species lack adequate nocturnal predator defense mechanisms.

Several reports have documented nocturnal predation of Common Terns (*Sterna hirundo*) by Great Horned Owls (*Bubo virginianus*; Nisbet 1975, Nisbet and Welton 1984) and Black-crowned Night-Herons (*Nycticorax nycticorax*; Marshall 1942, Hunter and Morris 1976). Actual predation events have rarely been observed and are difficult to interpret. This study presents information regarding the effects of Black-crowned Night-Herons on nest attendance, antipredator behavior, and reproductive success at a Common Tern colony in Maine.

## STUDY AREA AND METHODS

Our observations were made from May through August, 1989, on Stratton Island, (43°, 31'N; 70°, 19'W), at the Phineas W. Sprague Memorial Sanctuary of the National Audubon Society. Stratton Island is an 11 ha island located in the mouth of the

Scarborough River, Saco Bay, Maine, approximately 2 km southeast of Prouts Neck.

While Stratton Island supported a large tern colony with peak numbers reaching 1000-1500 terns in the 1930s, no terns nested there in the early 1980s. In 1987, efforts were undertaken to restore the nesting colony (methods given in Kress 1983). Five pairs of Common Terns nested on the island in 1987, and in 1988 the colony increased to 147 nests (71 early, 76 late—see below), including 11 Roseate Tern (*Sterna dougallii*) nests. The island supports an extensive mixed-species heronry (ca. 200 m north of the ternery), which in 1989, included 29 Black-crowned Night-Heron nests. Approximately 500 pairs of Herring (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*) also nest on the island. The tern colony was situated along the southeast side of the island and encompassed ca. 1000 $m^2$. Nocturnal observations were conducted from one of four blinds on eight nights in July and August.

All tern nests were marked with a painted white rock placed adjacent to the nest and numbered with indelible ink. Nest censuses were conducted once per week in the morning hours and only during fair weather. Most chicks were banded within three days of hatching. The fate of each nesting attempt was followed from egg-laying to chick fledging or nest failure. Chicks that survived to 21 days of age were presumed to have fledged; chicks that disappeared before this time were presumed to have died or to have been preyed upon. To estimate reproductive success, we enclosed two areas (ca. 12 m x 6 m x 0.5 m, each) with 2.5 cm wire mesh poultry fencing.

For comparisons of success and failure, we arbitrarily divided the nesting season into early (eggs laid on or before 30 June) and late (on or after 1 July) periods. We assumed that clutches initiated after 1 July represented renesting attempts by birds that had failed previously. We used a Chi-square analysis to compare differences between early and late nesting periods. Each nest was treated as a statistical unit. We defined a "nest" as an area where at least one egg was laid, whether incubated or not. We measured hatching and fledging success as the mean number of eggs that hatched and chicks that fledged per pair, respectively.

## RESULTS

### Breeding success

Common Terns initiated nesting by 28 May, and in 1989, we found 153 nests (121 early, 32 late). Hatching success was 2.02 (± 1.18) eggs/clutch and fledging success was 0.24 (± 0.65) chicks/pair in 1989 (Table 1). At least one egg hatched from a greater proportion of early than from late clutches ($X^2 = 24.7$, df = 1, $P < 0.001$). Among clutches that hatched at least one egg, however, the proportion of early-nesting terns that fledged at least one chick was significantly less than that of late nesters ($X^2 = 44.8$, df = 1, $P < 0.001$). Clutches and broods failed due to abandonment (N = 62), predation (N = 51), and high tides (N = 6, Table 2). Observed causes of predation were Black-crowned Night-Herons (N = 3 nests), gulls (*Larus* sp., N = 2), ants (unknown species, N = 2), and Ruddy Turnstones (*Arenaria interpres*, N = 2). Gull, ant and turnstone predation occurred only on abandoned or unattended eggs. Many more clutches and broods were preyed upon than the nine we directly witnessed, evidenced by broken eggs and missing chicks.

### Predation and nocturnal abandonment

The first tern eggs began to hatch on 20 June, and by 30 June we noticed an unusually high percentage of chick disappearance and mortality. During a colony census on 1 July, we collected 47 dead tern chicks (all under three days old). Many dead chicks (N = 33) were found in or near the nest with no visible signs of molestation or emaciation. The remaining chicks (N = 14) were scattered throughout the colony. Several chicks disappeared overnight from study nests enclosed with chicken wire. On 14 July, we conducted an all-night observation from a blind which overlooked several nests. Many of the incubating terns deserted their clutches ca. 20 min after dark. Hereafter we refer to such de-

**Table 1. Comparison of Common Tern reproductive success between early (clutches before 1 July) and late (after 1 July) nest initiations on Stratton Island, 1989**

| | Nests | Eggs (mean/clutch ± 1SD) | Eggs hatched (mean/clutch ± 1SD) | Chicks fledged (mean/pair ± 1SD) | Nest success[1] |
|---|---|---|---|---|---|
| Early | 121 | 323 (2.67 ± 0.65) | 276 (2.28 ± 1.01) | 9 (0.07 ± 0.26) | 0.07 |
| Late | 32 | 71 (2.22 ± 0.65) | 33 (1.03 ± 1.21) | 27 (0.84 ± 1.15) | 0.38 |
| All | 153 | 394 (2.58 ± 0.66) | 309 (2.02 ± 1.18) | 36 (0.24 ± 0.65) | 0.14 |

[1]Percentage of nests that fledged at least one chick.

**Table 2. Fate of Common Tern nesting attempts during early (clutches initiated before 1 July) and late (after 1 July) periods on Stratton Island, 1989. Percents are given in parentheses.**

| | Number | Abandoned | Predated | Successful[1] | Washed out | Unknown[2] |
|---|---|---|---|---|---|---|
| Early nests | 121 | 48 (39.7)[3] | 48 (39.7) | 9 (7.4) | 5 (4.1) | 11 (9.1) |
| Late nests | 32 | 14 (43.8) | 3 (9.4) | 12 (37.5) | 1 (3.1) | 1 (3.1) |

[1]At least one chick fledged from nest.
[2]Failed due to unknown causes.
[3]Percent includes 4 "dump" nests, each with one egg that was never incubated.

partures as "selective abandonment." We did not observe any cause for these abandonments.

During nine nocturnal blind observations between 14 July and 3 August, selective abandonment occurred on six occasions (Table 3). We observed night herons causing this response during two of the observation periods.

On 24 July, at 2120, and adult Black-crowned Night-Heron flew into an isolated area of the colony from the direction of the heronry and landed ca. 0.5 m from a pair with one chick. Two adult terns attending their respective nests uttered distress cries before the heron landed and then flew up from their nests. The heron attempted to take the chick, but it was startled when an observer turned on a bright flashlight. In apparent response to the light, the heron took wing and was driven off by the two terns. The entire sequence of events lasted less than 5 s. Neither the terns nor the heron returned to the area for the remainder of the night, but the terns resumed incubation at dawn.

The following night (25 July), we conducted a night observation in a different area of the colony. In the moonlight, we observed several night herons flying low over the tern colony (ca. 2115), which resulted in selective abandonment by terns in the area. The appearance of the night herons was followed by a few ($N < 4$) gulls that walked through the colony, undisturbed by the remaining terns. A search of the area the next morning revealed that the eggs in two out of nine clutches had been broken.

The majority of the deserting terns spent the night on a rocky ledge ca. 100 m southwest of the colony. During most desertion nights, small groups of terns were heard calling as they periodically circled over the colony. The terns always returned at first light and resumed incubation. These observations were similar to Nisbet and Welton's (1984) report of Common Tern reaction to nocturnal visits by a Great Horned Owl in which terns abandoned the colony *en masse* and remained away until dawn.

We observed only two aggressive responses of terns toward a night heron. On 31 May, an adult heron landed at dusk (ca. 2030) in the periphery of the tern colony. It was attacked and driven off by approximately 30 terns, many of which were nesting nearby. On 6 August (ca. 1115), a juvenile night heron attempted to land

**Table 3. Nocturnal observations of Common Terns on Stratton Island, 1989.**

| Date and time of observation period | | Tern response | Appx. percent of colony responding | Time & duration of response | Cause of disturbance |
|---|---|---|---|---|---|
| 5/31 | 2020-2033 | attack; mob | 40 | 2030 (3 min) | night heron |
| 7/14 | 2030-0130 | abandoned | 80 | 2110 (until dawn) | undetected |
| 7/17 | 2300-2305 | attack; mob | 20 | 2300 (5 min) | unknown |
| 7/21 | 2030-0530 | abandoned | 86 | 2050 (until dawn) | undetected |
| 7/24 | 2030-0545 | abandoned | 100 | 2120 (until dawn) | night heron |
| 7/25[1] | 2030-0500 | abandoned | 70 | 2115 (until dawn) | night heron |
| | 2030-0530 | remained | 100 | —— (entire night) | none obs. |
| 7/27 | 2045-0500 | remained | 100 | —— (entire night | none obs. |
| 7/29 | 2030-0500 | abandoned[2] | 37 | 2050 (until dawn) | undetected |
| 8/03 | 2030-0500 | abandoned | 15 | 2040 (until dawn) | undetected |

[1]Two nocturnal observations were conducted simultaneously in different areas of the colony.
[2]Investigator disturbance may have contributed to abandonment response.

near two remaining nests in an isolated area of the colony. This bird was attacked by the nesting terns as well as by ca. 10 other terns that were loafing nearby. Because of investigator interference, we do not consider the incident of 24 July an aggressive response, since terns initially appeared to flee and did not attack the heron until it was startled by the researcher.

The terns responded effectively to potential diurnal predators. All Herring and Great Black-backed Gulls which either landed near or flew low over the colony in hunting flight (Hatch 1970) were quickly mobbed and driven away. Small groups (N = 1-6) of night herons routinely flew over a portion of the colony at dusk on their way to the feeding grounds but were never harassed by terns while in flight.

No nocturnal disturbances were observed after 25 July, although selective abandonment still occurred. Of the 33 late nests, none were predated (excluding the three nests on 24 July), although 14 clutches were deserted (Table 2). We did not observe any other direct cause of nocturnal abandonment than Black-crowned Night-Heron disturbance. One two dates after periods of high chick mortality, we searched the entire island for Great Horned Owl feathers, pellets, and kill sites, as well as mammal tracks, but found no evidence of either type of predator. We did not witness large-scale nocturnal abandonment in the nesting gulls, nor did we find abnormal gull chick mortality. Thus, we believe that the predator(s) only visited the tern colony or were only effective there.

## DISCUSSION

Although our nocturnal observations were conducted only during the late-nesting phase, the appearance of a night heron on 31 May supports our belief that they were visiting the tern colony early in the season as well. Herring and Great Black-backed Gulls were the only other potential predators in the area; however, they were kept relatively clear of the tern colony by an aggressive control program which involved shooting and nest destruction (USFWS depredation permit #PRT-691789; MDIFW permit #50-6). Gulls are not known as nocturnal predators of tern eggs and chicks, although our observations of 25 July suggest that they may be opportunistic scavengers at night.

Our observations are similar to other published reports in which night heron predation was either observed or suspected. Marshall (1942) witnessed a single night heron eating eggs in a colony that terns had temporarily abandoned. Collins (1970) noted an unexplained disappearance of both Common and Roseate Tern chicks in a New York colony and subsequently collected an adult night heron which had ingested a Roseate Tern chick. Hunter and Morris (1976) saw single night herons during three nocturnal observations and heard one on two other nights in an Ontario colony. In this colony, chicks disappeared and adults abandoned nests both in the presence and absence of the predator. They speculate (and we agree) that Black-crowned Night-Herons may contribute to chick mortality directly by predation and indirectly by exposure of eggs and chicks through adult nocturnal abandonment.

Hatching success (2.02 eggs/clutch) on Stratton Island in 1989 was relatively high, even with extensive nocturnal abandonment (Table 1). Our data are comparable to other published reports in which a nocturnal predator was involved (1.61, Nisbet 1975; 2.00, Nisbet and Welton 1984). In both of these studies, Great Horned Owls were visiting the tern colony at night, preying upon adults and chicks, and causing desertion.

Fledging success (0.24 chicks/pair) on Stratton Island was also comparable to other North American colonies with nocturnal predation (0.29, Nisbet 1975; 0.17, McKearnan and Cuthbert 1989). This is considerably lower than the 1.1 chicks per pair proposed by Nisbet (1978) as the minimum number needed to sustain a breeding population. Night heron disturbance on Stratton was significantly more detrimental to early than to late nesting terns in terms of fledging success (Table 1), although it was not determined whether chicks hatching later suffered slower growth rates or any other consequences of reduced parental investment.

We do not know why night heron predation ceased in late July. One possible ex-

planation is that only one individual was involved in preying upon tern chicks, and after it was frightened by the researcher on 24 July, it did not return. That we did not observe more than one night heron attempting to prey upon tern chicks at any one time supports this suggestion.

The observations on Stratton Island in 1989 support the claim of Southern and Southern (1979) that some species of seabirds (in this case, Common Terns) are unable to effectively defend against nocturnal predation. Instead, the response is to flee the colony and leave eggs and chicks unguarded.

Our observations contrast with Nisbet and Welton's (1984) assessment of predation on terns by night herons. In their study area in Massachusetts, night herons were believed to be secondary predators, taking advantage of nocturnal abandonment caused by a Great Horned Owl. Night herons were mobbed during diurnal encounters and were not believed to cause desertion among terns. At our site, we suspect that night herons alone were responsible for causing nocturnal abandonment by most terns, as we observed no other primary cause.

Terns on Stratton mobbed night herons that encroached upon the colony during diurnal periods but fled from them at night. This suggests that visibility is important in a tern's decision to defend or abandon the nest. Nocturnal abandonment may have evolved in response to predation from large owls (e.g., Great-horned), which may kill incubating terns. Terns recognize night herons as potential predators but may be unable to distinguish between the silhouettes of night herons and owls after dusk.

Predation of Common Terns by Black-crowned Night-Herons appear to be widespread; it has been documented in New York, Ontario, Massachusetts, and Maine (Collins 1970, Hunter and Morris 1976, Nisbet and Welton 1984, this study, respectively). Investigators studying terns and other colonial seabirds should be aware that night heron predation is difficult to detect and document conclusively; yet a single predator may severely reduce productivity in a tern colony for the entire season.

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