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DIRECT AND INDIRECT CONSEQUENCES OF MINK PRESENCE IN A COMMON TERN COLONY[1]

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Key words: Common Tern; predation; parental neglect; exposure; Sterna hirundo.

Colonial breeding occurs in 98% of seabird species (e..g, Wittenberger and Hunt 1985). Colonies are conspicuous, however, and as predators are likely attracted to large aggregations of individuals, predation on seabirds by various mammals is frequently cited (e.g., feral cats, *Felis domesticus,* Ashmole 1963; Ermine, *Mustela erminea,* Cairns 1985; Racoon, *Procyon lotor,* Emlen et al. 1966; Otter, *Lutra lutra,* Ewins 1985; Red Fox, *Vulpes vulpes,* Maccarone and Montevecchi 1981). While relatively few citations report predation by mink, *Mustela vison,* (e.g., Burger 1974, Olsson 1974, Folkestad 1982, Alberico et al. 1991, Burger and Gochfeld 1991), mink can be a serious threat to seabird populations. In Norway, for example, breeding of Black Guillemots (*Ceppus grylle*) currently is restricted to areas where mink are absent (Folkestad 1982). While attacks by mink on gulls and terns appear rare (Burger 1974, Dunstone and Birks 1987, Alberico et al. 1991, Burger and Gochfeld 1991), the slaughter of tern and

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TABLE 1. Fate of chicks from study broods during the nocturnal periods of 30 May–7 June 1991 as determined by dawn nest checks. Broods were not checked on the mornings of 4 and 5 June. The mink was first seen on 1 June and was removed from the site on 8 June at 01:00 hr.

Date	Study broods (*n*)	At risk[a] (*n*)	Present AM *n* (%)	Missing AM *n* (%)	Dead AM *n* (%)	Total dead/ missing *n* (%)
30/5	8	15	15 (100.0)	0 (0)	0 (0)	0 (0)
31/5	9	22	22 (100.0)	0 (0)	0 (0)	0 (0)
1/6	12	28	27 (96.4)	1 (3.6)	0 (0)	1 (3.6)
2/6	11	29	13 (44.8)	4 (13.8)	12 (41.4)	16 (55.2)
3/6	11	15	9 (60.0)	3 (20.0)	3 (20.0)	6 (40.0)
6/6	8	11	11 (100.0)	0 (0)	0 (0)	0 (0)
7/6	8	10	4 (40.0)	2 (20.0)	4 (40.0)	6 (60.0)
8/6	7	7	6 (85.7)	1 (14.3)	0 (0)	1 (14.3)
9/6	8	9	8 (88.9)	1 (11.1)	0 (0)	1 (11.1)
10/6	7	8	7 (87.5)	1 (12.5)	0 (0)	1 (12.5)
Totals		154	122	13	19	32

[a] The number of chicks present during the night and at risk to possible nocturnal predation.

gull chicks has occasionally resulted in almost complete breeding failure (Folkestad 1982). We report a case where nocturnal parental neglect, as a result of adults staying off their nests in response to a mink, resulted in many indirect chick deaths and consequent fitness costs to adults.

MATERIALS AND METHODS

The observations were made at a Common Tern colony on a concrete breakwater, 1 km offshore in Lake Erie, near Port Colborne, Ontario (42° 52'N, 79° 15'W). Approximately 900 pairs of Common Terns nest on the loose gravel substrate of the breakwater and presently comprise the largest Common Tern colony on the Great Lakes (Morris et al. 1992).

An observation blind was erected prior to the arrival of terns in late April at the edge of a 15 m × 4 m area of known high density breeding. Daily or twice daily nest checks were conducted beginning on 29 April 1991. Seventeen pairs of birds were chosen for a detailed behavioral study (Burness 1992) and their breeding success was followed until the last chicks reached 20 days of age. Diurnal observation sessions were performed for six hours/day from 30 May–18 June 1991, and for three hours/day alternating morning and evening from 19 June–28 June 1991. Diurnal observations coincided with periods of peak Herring Gull (*L. argentatus*) predation (06:00–09:00 and 17:00–20:45, Morris 1987). Nocturnal observation sessions were performed on 5 June (00:30–05:45), and on 6 June and 7 June (22:30–03:00), to determine the source of an unknown nocturnal disturbance. Daily nest checks of chick survival were performed at dawn and dusk which allowed for calculation of diurnal and nocturnal predation rates.

RESULTS

While a larger number of pairs had broods within our study area, the observations and numerical data that follow are restricted to the chicks associated with the 17 study pairs. The first egg laid by a study female was found on 6 May 1991, and the first chick hatched 28 May. The first study chick was observed missing on 29 May. A mink was first seen on 1 June running through an adjacent Ringed-bill Gull (*L. delawarensis*) colony, and a dawn nest check on 2 June performed on 11 remaining study nests found that 16 of the 29 (55.2%) chicks that were present the night before, and at risk to predation, were either dead or missing (and presumed dead; Table 1). Periodically thereafter during the daytime observation sessions the mink swam or ran behind the breakwall from its den, toward the east end of the colony. The terns exhibited a stereotypical mobbing behavior, hovering as a tight group approximately 10 m above the water surface. The mink was never seen entering the colony during the day.

During an overnight observation session on 5 June however, we saw the mink make repeated nocturnal trips through the tern colony. First, it swam or ran east from its den behind the length of the breakwall, out of sight of the terns, and then appeared from over the back of the breakwall and ran into the east end of the colony. The mink then ran from east to west through the colony toward its den, attacking chicks as it went. During the 47 min of mink activity (00:55–01:42, 5 June), it ran through the colony 16 times. Poor lighting conditions prevented accurate quantification of the number of chicks taken. However, on each of five trips made between 00:55–01:14 (5 June), the mink was seen to capture and carry a single chick toward its den. The chicks varied in size, but the largest appeared about 6–7 days of age. Although caching by the mink was not observed on 5 June, on 6 and 7 June, the mink captured and cached a number of chicks in rocks near the blind. Some chick carcasses were found the following morning, although as they were not banded, their natal nests could not be determined. The mink was removed from the colony at approximately 01:00 hr on the morning of 8 June, and chick loss thereafter dropped to pre-disturbance levels (Table 1).

When the mink entered the colony most adults immediately performed "dreads" (Marples and Marples 1934) and circled the colony. After the mink passed through a region of the colony the birds with nests in

that area returned while those in the direct vicinity of the mink hovered about 5 m above their nests. The frequent runs by the mink through the colony on 5 June left little time for the birds to settle before they took flight again.

The number of chicks recorded as missing or dead at the dawn check after an overnight period of nocturnal predation when the mink was active (Table 1) was contrasted with the number missing or dead at the dusk check. The number of chicks found dead in their nests at the beginning of a dawn nest check ranged from 0–41% of the number of chicks present the night before and consequently at risk to nocturnal predation (Table 1). Between 0 and 20% of chicks went missing overnight. In contrast, no chicks were found dead in their nests during the day while the number of chicks that went missing over the day ranged from 0–20%. Between 30 May and 7 June, 22% (29 of 130) chicks were found dead or were recorded as missing overnight. This was significantly greater than the 8% (nine of 108) recorded as missing or dead during the day ($G = 6.70$, $df = 1$, $P < 0.05$).

Chicks that went missing overnight during periods of mink activity were marginally older (4.60 days ± 1.58, $n = 10$) than those that went missing during the day (3.22 days ± 1.56, $n = 9$; Mann-Whitney U-test, $U = 22.5$, $Z = -1.88$, $P = 0.06$). There was, however, no significant difference between the age of dead chicks (4.22 days ± 1.22, $n = 18$) and those that went missing overnight (4.60 days ± 1.50, $n = 10$; $U = 76.0$, $Z = -0.69$, $P = 0.49$).

The number of missing chicks is a likely index of the time spent by the mink in the colony. There was a significant positive correlation between the percentage of chicks that were recorded as missing at dawn and the percentage that were found dead in their nests (Spearman-rank correlation, $r_s = 0.81$, $Z = 2.0$, $P < 0.05$). This suggests a relationship between the number of dead chicks and the length of time that the mink was in the colony.

A comparison among the minimum daily temperatures recorded at St. Catharines airport (Atmospheric Environment Service monthly meterological summary) over 30 May–7 June in 1989, 1990, and 1991 revealed significant differences among years when data were log-transformed ($F_{(2)} = 4.41$, $P = 0.02$). The mean minimum temperature in 1991 was significantly warmer (13.5 ± 3.88°C, $n = 9$) than 1990 (10.0 ± 4.24°C, $n = 9$, Scheffe F-test = 3.85, $P < 0.05$). Regular nest checks performed in 1990 in the absence of the mink found few dead chicks despite cooler temperatures.

DISCUSSION

This study indicates that the presence of a mink had severe incidental effects on the annual breeding success of Common Terns at this location. More striking than the numbers of missing chicks were the numbers found dead in their nests, and these only during dawn nest checks. There are at least three possible causes of death: (1) chick starvation; (2) direct predation by the mink; (3) exposure due to parental neglect during mink incursion. First, it is unlikely that such large numbers of chicks would have simultaneously succumbed to starvation and there was no indication of body mass loss from the sternum region typical of starving birds (Blokpoel et al. 1984). Second, as dead chicks showed no obvious signs of injury, critical wounds by the mink seem unlikely.

We suggest, therefore, that the chicks died due to exposure. Parental neglect in response to an avian predator has been suggested previously in Common Terns (Nisbet 1975, Hunter and Morris 1976, Nisbet and Welton 1984, Shealer and Kress 1991). While Common Tern chicks are capable at three days of age of maintaining a nearly stable body temperature independent of ambient, they likely have sub-adult body temperatures for some period of time (LeCroy and Collins 1972). The average age of the dead chicks was four days and ranged from 2–6 days so the degree of temperature regulation varied between chicks. Furthermore, the chick deaths were noted on the mornings of 2, 3, and 7 June following cool overnight minimum temperatures of 13.2 and 13.1 and 9.4°C, respectively. On the night of 5 June, the mink kept adults off their nests for 47 consecutive minutes (15% of the observation period) preventing brooding by parents. The positive correlation between the number of missing chicks (a likely index of time spent in the colony by the mink) and dead chicks (a likely index of degree of parental neglect) supports this conjecture.

During the mink attacks adult terns did not abandon the colony. Their responses were distinct from the synchronous nocturnal desertion or "selective abandonment" reported in response to Great Horned Owls, *Bubo virginianus* (Nisbet 1975, Nisbet and Welton 1984) and Black-crowned Night-Herons, *Nycticorax nycticorax* (Hunter and Morris 1976, Shealer and Kress 1991) where the colonies remained essentially deserted until dawn. Our observations more closely resembled the "upflights" performed by Common Terns in response to a disturbance localized to one part of the colony (Morris and Wiggins 1986).

Chicks went missing from study broods during the day in the same frequency as overnight. Some were likely predated by gulls while others could have strayed into neighbors' nests and been adopted (cf. Morris et al. 1991). Chicks that disappeared overnight were slightly older than those that went missing during the day. This could have been because the mink could more easily see the older, larger chicks, or they were more prone to running during a nocturnal attack.

A diurnal nest check of the entire colony performed on 2 June showed that the occurrence of dead chicks was restricted to the west end of the colony. As egg laying started earlier at the east end, chicks at the east end were probably old enough to survive any cold nights without being brooded. If so, we conclude that there appears to be a narrow window during which tern chicks are subject to potential exposure due to parental neglect.

The behavior of adult terns in response to the mink resulted in a heavy seasonal breeding cost for individuals (some lost entire broods). In long-lived organisms such as terns, selection is likely for self preservation. Adults that lost chicks during the peak may have relaid later in the season (e.g., Palmer 1941 for Common Tern; Massey and Atwood 1981 for California Least Tern, *Sterna antillarum*). Consequently in 1991, the

seasonal breeding success of individuals, although reduced by the mink, was not necessarily zero.

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