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Impact of sea gull presence on the reproductive success and vigilance behaviour of common terns in Kouchibouguac National Park, New Brunswick

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Since 1987, increasing numbers of gulls have nested next to a colony of common terns (*Sterna hirundo*) on Tern Island in Kouchibouguac National Park. The goal of this study was to estimate the risk of predation imposed on tern eggs and chicks by the presence of these gulls. During 28 hours of direct observations in 1993, 42 attacks by herring gulls (*Larus argentatus*) on tern chicks were witnessed, 6 of which were successful. In an experiment with enclosures around tern nests, all tern chicks disappeared from the two enclosures set up close to the gull colony, whereas fledging rate was normal (1.2 chick/nest) in an enclosure set up away from the gull colony. There was no evidence of egg predation, either inside or outside the enclosures. Two indexes of tern vigilance were also measured in 1993 and 1994, but no conclusion emerged with regards to exposure to gulls. We estimate that predation pressure by gulls on tern eggs and chicks in 1993 was relatively low and that a more negative influence of gulls on tern reproductive success may be exerted through displacement from preferred nesting habitat.

Key words: Common Tern, *Sterna hirundo*, Gull, predation, vigilance, reproductive success.

RÉSUMÉ

Poussart, C., I. Robichaud, E. Tremblay, and S.G. Reebs. 1997. Impact of sea gull presence on the reproductive success and vigilance behaviour of common terns in Kouchibouguac National Park, New Brunswick. Parks Canada - Tech. Rep. Ecosyst. Sci. 0000: 00p.

Depuis 1987, un nombre croissant de goélands nichent près de la colonie de sternes pierregarins (*Sterna hirundo*) sur l'Ile-aux-Sternes du Parc National Kouchibouguac. Le but de la présente étude était d'estimer le risque de prédation engendré auprès des jeunes sternes par la présence de ces goélands. Lors de 28 h d'observations directes, 42 attaques sur des poussins sternes par des goélands argentés (*Larus argentatus*) furent notées, dont 6 réussies. Tous les poussins sternes emprisonnés dans deux enclos situés près de la colonie de goélands sont disparus, tandis que le taux d'envol dans un enclos situé plus loin fut normal (1.2 poussin/nid). Aucune attaque sur les oeufs ne semble avoir eu lieu, que ce soit à l'intérieur ou à l'extérieur des enclos. Deux estimés du comportement de vigilance des sternes furent mesurés en 1993 et 1994, mais aucune conclusion n'a été possible quant à l'influence des goélands sur cette variable. Nous croyons que la prédation exercée par les goélands sur les jeunes sternes en 1993 était relativement faible, et qu'un effet plus néfaste de la présence des goélands sur le succès reproducteur des sternes se fait par déplacement des sternes lors de la nidification.

Mots clés: Sterne Pierregarin, *Sterna hirundo*, Goéland, prédation, vigilance, succès reproducteur.

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INTRODUCTION

Common terns (*Sterna hirundo*) are small larids that nest in large colonies. Censuses at such colonies along the North American Eastern Seaboard have revealed a gradual decrease in tern numbers since 1940 (Drury 1973, Nisbet 1973). During the same period of time, sea gull numbers have steadily increased (Kadlec and Drury 1968). Displacement of common terns by large sea gulls at preferred nesting locations has been suggested as one possible reason for the decreases in tern populations (Morris and Hunter 1976, Burger and Gochfeld 1991, Howes and Montevecchi 1993). Gulls can displace terns because they arrive at the nesting sites earlier, and their larger body size makes them more competitive in agonistic interactions. Moreover, gulls may further impede tern reproductive success by preying upon their eggs and chicks.

In Kouchibouguac National Park, New Brunswick, the largest tern colony in the Atlantic provinces has been nesting on Tern Island for the past two decades (Dufresne et al. 1974, Vautour et al. 1993). In 1982, a sea gull colony appeared on a nearby island (North Richibucto Dune). In 1987, two sea gull nests were noted on Tern Island itself. Since then, the number of sea gull nests on Tern Island has increased to a maximum of 36 in 1993. At that time, two sea gull species were present; in decreasing order of abundance, they were the herring gull (*Larus argentatus*), and the greater black-backed gull (*Larus marinus*). With the exception of one pair which nested within the tern colony itself, the sea gulls established their nests near and around the tern colony. The presence of these gulls near tern nests represent a predation risk on eggs and chicks, and may impose a need for greater vigilance by the adult terns.

The purpose of this study was to determine whether predation by gulls on tern eggs and chicks is present at Tern Island, and to obtain an index of tern vigilance. Because most gulls nest next to the tern colony rather than within it, and because previous studies have identified peripheral tern nests as being more at risk of predation (Storey 1987, Becker 1995), we compared the vigilance behaviour of terns nesting at the periphery of their colony to that of terns nesting in the center of it, hypothesizing that vigilance would be greater at the periphery.

STUDY AREA

Tern Island is part of the barrier-island system of Kouchibouguac National Park (Fig. 1). It comprises three patches of vegetation (*Ammophila brevigulata*) called Tern Island # 1, 2, and 3 respectively. Terns nest only within these patches of vegetation. The three islands are separated by sandy areas which are submerged at high tide. The total area of the vegetated patches is 0.16 km^2. Tern Island has been designated a Zone 1 or "special preservation area" (Environment Canada 1993) and public access to it is denied during the tern reproductive season. However, a permanent wooden blind has been erected 1.5 m above ground at the edge of Island # 1 for relatively unobstrusive observation, by authorized personel, of the terns nesting on the southeast corner of this island. Terns also nest on Islands # 2 and 3 but no blind is present there. Important numbers of gulls nest only on Island # 2. On Islands # 1 and 3, only a few isolated gulls have established nests, although groups of gulls often loaf on the beach around these islands.

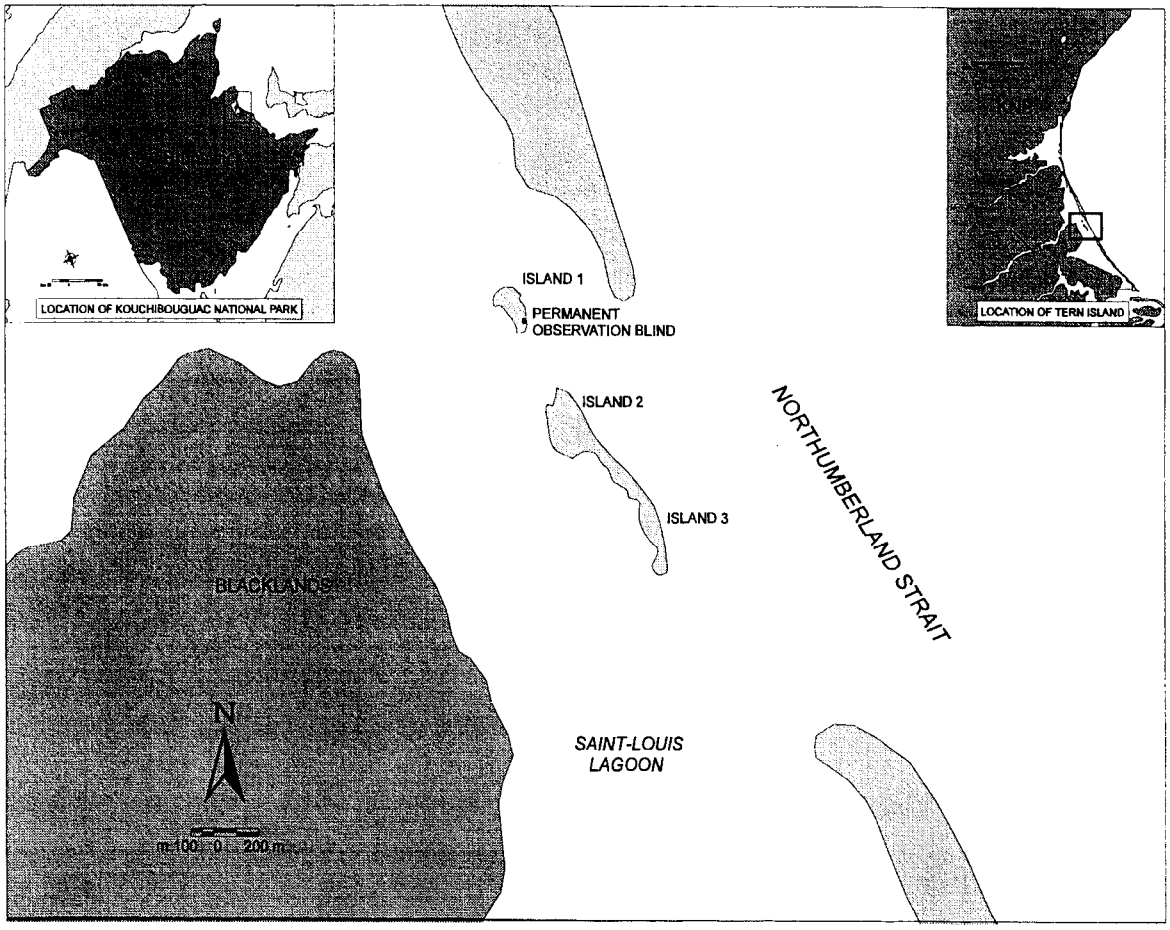

FIGURE 1: Location of Tern Islands in Kouchibouguac National Park

STUDY PERIOD

This study took place during the summers of 1993 and 1994. Egg laying on Tern Island started around mid-June in both years. In 1993 a storm destroyed 20-30 % of tern nests on 22 June. The terns involved renested a few days later. This caused staggered egg hatching at the colony level, from the second through the last week of July. In 1994, egg hatching was more closely centered around the second week of July.

STUDY # 1: PREDATION BY GULLS

Methods

In 1993, circular enclosures (diameter 2.5 m) were installed around groups of tern nests that contained eggs on Island # 2 and 3. Enclosure walls were made of wire with a mesh of 1 cm^2. Walls were 45 cm high and their base was buried in the sand. Chicks could not escape the enclosures, allowing easy monitoring of their number and survival (once hatched, tern chicks are fairly mobile in and around grass clumps, making them hard to follow if they are not within enclosures). One enclosure was set up on 30 June, on Island # 3 where only two gull pairs nested. It surrounded 10 tern nests with a total of 24 eggs, in what appeared to be typical nesting habitat. Two enclosures were set up on Island # 2, where 12 gull pairs nested; one enclosure was set on 29 June around 10 tern nests with a total of 22 eggs, while the other was set on 19 July around 6 tern nests with a total of 14 eggs, also in typical nesting habitat. Daily monitoring of these enclosures allowed us to measure hatching success, fledging success, and chick disappearance.

In order to note predation attempts by gulls on tern chicks outside of the enclosures, direct observations were carried out on Island # 2 from 29 July to 13 August 1993, for a total of 28 h. These observations were made by the same observer from a portable blind made of dark green canvas. The blind was left in place throughout the observation period. Attention was given to whether attacks took place at the periphery (within 3 m of the edge) or at the center of the colony.

Results

Hatching success was high and similar for all three enclosures (Table 1). However, all hatched chicks subsequently disappeared from the two enclosures set up on Island # 2, where gulls were abundant. Hence, fledging success was measured as 0 % in both enclosures placed on Island # 2 (Table 1). In the enclosure on Island # 3, where gulls were not abundant, tern fledging success was 50 % (Table 1).

During the 28 h of direct observations, 42 predation attempts by gulls on tern chicks were witnessed. All attempts were made by herring gulls. Of these 42 attacks, 28 took place in the center of the tern colony and 14 near the periphery. In the center, four attacks were successful; near the periphery, two attacks were successful. Success rate was therefore similar for both center and periphery (14%). All six successful attacks involved chicks that were several days old.

TABLE 1: Reproductive parameters at groups of tern nests surrounded by enclosures at Tern Island, Kouchibouguac National Park, 1993.

	Island # 2 29 June	Island # 2 19 July	Island # 3 30 June
Mean number of eggs per nest	2.2	2.3	2.4
Total number of eggs	22	14	24
Total number of eggs hatched	19	12[1]	24
Hatching rate (eggs/nest)	1.9	2.0[1]	2.4
Total number of fledged young	0	0	12
Fledging rate (young/nest)	0	0	1.2

[1] minimum

Discussion

No evidence of gull predation on tern eggs was found. Casual observation of gull activity during the egg stage failed to show any predation attempts on eggs. Moreover, the hatching rate was high and similar for all of the three enclosures set up in 1993, even though two of them were set up close to the gull colony on Island # 2. We conclude that sea gull presence has very little impact, if any, on tern reproductive success at the egg stage in Kouchibouguac National Park. Researchers working at other tern colonies have also failed to find evidence of gull predation on tern eggs (Hatch 1970, Morris and Hunter

1976, Morris et al. 1976). At the egg stage, one parent is always incubating or present next to the nest, and this continuous presence combined with that of others at neighbouring nest seems sufficient to repel gulls.

We did, however, find evidence of gull predation on tern chicks. Direct observations revealed a relatively low level of predation (6 cases during 28 h of observations). Care must be taken in using these data to estimate a daily predation rate because our observations did not take place equally at all times of day (they were concentrated in the middle of the day) and in all kinds of weather. Similarly, care must be taken in interpreting the high levels of chick disappearance in the two enclosures set up next to the gull colony; although it is likely that these chicks disappeared because of gull predation, it is also possible that the enclosure restricted the movement of the tern chicks and prevented them from reaching areas of denser vegetation where they would have been better hidden from gulls (see Burness and Morris 1992). Moreover, the enclosure itself may have attracted the attention of the gulls. We can nevertheless conclude that, given the chance, gulls will successfully attack chicks and that unrestricted evasive action by the chicks or concerted defense by the terns are necessary to keep gull predation at a low level.

Incidentally, even though the presence of an enclosure had an effect on predation rates, it did not seem to have an effect on tern parental care and reproductive success. The fledging rate of 1.2 chicks/nest observed in the enclosure on Island # 3, where few gulls were present, is comparable to that measured by other researchers at this colony without enclosures (1.0 chick/nest, Dufresne et al. 1974; 1.4 chicks/nest, Chevarie 1976).

STUDY # 2: VIGILANCE BEHAVIOUR OF TERNS

Methods

All observations of vigilance behaviour took place at the egg stage (when grasses were still low enough to allow observations of incubating terns), and from the permanent blind on Island # 1. Nests were identified by their position relative to numbered stakes driven in the sand. In 1993, we noted the percentage of time spent simultaneously by both parents at the nest, based on continuous observations of 30-60 min at a time. Collected data were divided in two periods: before the storm (13-21 June) and after (6-27 July). Before the storm, we compared tern nests located at the periphery of the colony in full view of nearby gull nests ($n = 11$), tern nests located at the periphery but out of sight from gull nests ($n = 8$), and tern nests located centrally within the colony (also out of sight from gull nests, $n = 12$). Gull nests were wiped out by the storm, and no renesting took place, and so after the storm we only compared peripheral ($n = 5$) and central ($n = 6$) tern nests. Nests were considered peripheral if within 3 m of the edge of the colony, otherwise they were considered central. We assumed that peripheral nests and those

directly exposed to gulls would be more at risk of predation (see also Storey 1987, Becker 1995), and therefore we predicted that parents at such nests would spend more time together in order to provide better vigilance and/or protection.

In 1994, we measured eye closure during rest as an index of vigilance. Resting birds adopt a typical "sleep posture" and while in this posture they alternately open and close their eyes. Lendrem (1983, 1984) has shown that birds resting in a more exposed location tend to close their eyes less often. Incubating terns often doze off during the day, and we hypothesized that parents at peripheral nests would close their eyes less often than parents at central nests. Resting birds were observed for one minute at a time with a 15-45 X scope, and the percentage of time spent with at least one eye closed was noted. Observations alternated between central and peripheral nests, forming temporally paired observations. In all, 32 central and 24 peripheral nests were observed, some of them more than once.

Results

Before the storm in 1993, the mean percentage of time spent by both parents simultaneously at the 8 peripheral nests exposed to gull nests, the 11 peripheral nests not exposed to gull nests, and the 12 central nests was 7.8 ± 9.5 (SD), 10.2 ± 7.8, and 9.6 ± 8.9 respectively. There is no significant difference between these values (ANOVA, $P = 0.839$). After the storm, the same variable at the 5 peripheral nests and the 6 central ones was 13.3 ± 3.6 and 11.5 ± 3.6 respectively. Again, there is no significant difference between these two values (t-test, $P = 0.31$).

In 1994, the average number of seconds per minute during which the sleeping parent had at least one eye closed was 12.1 ± 19.9 for peripheral nests and 20.0 ± 20.3 for central ones. These means are based on 58 temporally paired observations of a central and a peripheral nest. A Sign test (Conover 1980) applied on these 58 paired observations revealed a significantly higher percentage of time spent sleeping with an eye closed for central birds ($P = 0.048$).

Discussion

Contrary to our expectations, the position of a tern nest and its proximity to gull nests on Island # 1 had no effect on the percentage of time spent by both parents simultaneously at the nest during the incubation period. This may be explained by the fact that gull predation was not important during the egg stage, and by the possibility of one parent being enough to deter predation. It would be interesting to determine whether parent attendance varies according to nest position at the chick stage, when gull predation is more important, but the height of grasses on Tern Island at that time of the year makes

such an endeavor impossible, at least by means of direct observation. Moreover, it is unclear what the prediction should be: although conventional wisdom dictates that peripheral nests are more vulnerable (as indeed they are in many colonial species, including the common tern; Tenaza 1971, Siegel-Causey and Hunt 1981, Storey 1987, Becker 1995), at Tern Island we observed more attacks by gulls on chicks in the center of the colony.

According to expectation however, peripheral terns incubating their eggs were found to spend less time with at least one eye closed while in a sleep posture, as compared to central birds. This is compatible with a greater need for vigilance, as obviously vigilance is seriously impaired during eye closure. However, we cannot conclude that this greater need for vigilance is due to the proximity of sea gulls on the beach. Peripheral terns can also be more disturbed by stronger winds and passing boats, although care was taken not to collect data during such events. Peripheral nests were also closer to the blind, and although care was taken to minimize movement during observation, the terns may still have heard noise or been conscious of human presence. We divided our data into a subset that contained only temporally paired observations of central and peripheral nests that were equidistant from the blind, and no statistical difference could then be detected (Sign test, $P > 0.05$; it must be said however that the sample size was small: $n = 11$).

GENERAL CONCLUSION

Our study failed to find an effect of gull presence, either nesting next to the tern colony or loafing on the beaches around it, on the vigilance behaviour of peripherally versus centrally nesting terns. We also found no evidence of gull predation on tern eggs. We did however find evidence of herring gull predation on tern chicks. (Predation levels may increase if the gull colony becomes larger; see Becker 1995.) Despite the evidence for predation, we feel that the greatest potential impact of gull presence on tern reproductive success is through the earlier arrival of gulls at the island and their occupancy of potentially valuable nesting habitat. Some terns may thus be displaced to nesting sites where they are more exposed to flooding during storms, or where their chicks find less cover and become more exposed to predators, not necessarily limited to, but including gulls.

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