

### Defecation Behavior of Territorial and Nonterritorial Common Terns (*Sterna hirundo*)

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Bayer (1980) reported that Great Blue Herons (*Ardea herodias*) holding feeding territories generally walk away from their foraging sites to defecate, whereas nonterritorial herons more frequently defecate at their foraging sites. This note reports analogous differences in the defecation behavior of territorial and nonterritorial Common Terns (*Sterna hirundo*).

Feeding territories of Common Terns in Massachusetts usually consist of linear strips of shoreline, typically 150–300 m in length, and shallow water up to about 75 m from the shore (Nisbet 1977, in press). They are occupied and defended regularly up to at least 8.5 km away from breeding colonies. Feeding territories are used throughout the breeding season, although they are occupied most consistently (up to 40% of daylight hours) during courtship and egg-laying periods. They appear to be used by the same individual birds over periods of days or weeks, although I have not been able to confirm this by observing marked individuals. They are used by both members of a pair, although when both birds are present during the courtship period the male does most of the active territorial defense (Nisbet 1977). The prevalence of territorial feeding varies greatly from colony to colony in Massachusetts. Around Monomoy (41°38'N, 69°58'W), where the shoreline is generally unsuitable for territorial feeding, Common Terns feed almost exclusively on schooling fish in open water. Around Bird Island (41°40'N, 70°43'W) in Buzzards Bay, where the shoreline is extensive and suitable for dispersed feeding, most of the birds appear to hold territories, and early in the season about 70% of the fish brought to the colony are of species usually caught close to the shore (Nisbet in press).

While studying territorial feeding, I noticed that territory holders often interrupt their foraging and fly over land to defecate. Since 1973 I have kept notes on defecation behavior during 172 h of observation of Common Terns in established feeding territories. Most of these observations were made in five territories in Buzzards Bay or in two territories near Monomoy. Of 143 clearly observed defecations by Common Terns known to be defending territories, 77 (54%) occurred over land, and a further 25 (17%) were either over land or within about 5 m of the shoreline. Most of these defecations involved a marked deviation from the previous foraging pattern over water. Only 41 defecations (29%) were into water more than

5 m offshore. For comparison, I have notes on 73 defecations by birds identified as intruders (either because they were driven out by territory holders, or because they were foraging in groups of three or more; see Nisbet in press). None of these defecations occurred over land, only 2 (3%) occurred close to shore, and 71 (97%) were into the water more than 5 m offshore. The difference between the observed defecation patterns of territory holders and intruders is highly significant ( $\chi^2 = 87.6$ ,  $df = 2$ ,  $P < 0.0001$ ).

Most defecations into the water were associated with active territorial defense. Among intruders, 55 defecations (77% of those observed that were more than 5 m offshore) occurred while the birds were retreating from territory holders that were flying aggressively toward them. Among territory holders, 32 defecations (78% of those observed that were more than 5 m offshore) occurred after the birds broke off their pursuit and turned back toward the shore.

Only 9 defecations (6%) by territory holders, compared to 16 (22%) by intruders, were into the area of water where the birds had been foraging; the difference is highly significant ( $\chi^2 = 10.1$ ,  $df = 1$ ,  $P < 0.01$ ). In at least 10 cases, a bird identified as an intruder, while foraging, defecated into the water soon after the territory holder had left to carry a fish back to the colony. Thus, intruders were much more prone than territory holders to defecate into the area used for foraging.

Common Terns defecate nonrandomly in at least two other situations. When attacking bird or mammal predators (including humans), they habitually defecate at the lowest point of their dives, thereby often hitting the predator with their feces. Common Terns also habitually fly off the nest during incubation to defecate outside their nesting territories (Cullen 1960, 1962; pers. obs.).

The functions of leaving the territory to defecate are not clear. Cullen (1960) suggested that the primary function of leaving the nesting territory to defecate is to maintain camouflage of the nest. When birds defecate onto predators, this may serve to distract them or even to drive them out of the colony. Cullen (1956) pointed out, however, that defecation at the moment of closest approach to the predator coincides with the moment of greatest fear. The high frequency of defecation by terns fleeing from territorial defenders may similarly reflect fear. This would not explain, however, why holders of feeding territories should deviate from their foraging patterns to defecate over land.

For Great Blue Herons, Bayer (1980) argued that the primary function of defecating away from the

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feeding site is likely to be the reduction of avoidance behavior by prey. This does not appear to be very plausible for Common Terns, however, which range over large feeding areas and are unlikely to drive fish out of them by occasional defecations. Another possible function of leaving the feeding territory to defecate is sanitation. Lemmetyinen and Raitis (1972) have shown that cestode parasites are commonly transmitted through fish caught by terns in inshore waters. Leaving the nesting territory to defecate may also have a sanitary function, as fish are often dropped in the territory and might transmit fecal infections or parasites to the chicks. If nonrandom defecation has any sanitary functions, however, it is not very effective, because at least 10% of observed defecations along the shore were into areas used for foraging. In fact, the prevalence of cestode infestations and coccidiosis is very high in Common Tern chicks (Lemmetyinen and Raitis 1972, G. Faddoul pers. comm.).

Whatever the functions of leaving the territories to defecate may be, this behavior is limited to the birds' own territories. Both along the shore and in the colony, Common Terns defecate freely into the territories of others.

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