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RESPONSES OF NESTING COMMON TERNS AND LAUGHING GULLS TO FLYOVERS BY LARGE GULLS

PAUL M. CAVANAGH[1] AND CURTICE R. GRIFFIN[1]

ABSTRACT.—Disturbance can reduce productivity by disrupting nesting behavior. We examined responses of nesting Common Terns (*Sterna hirundo*) and Laughing Gulls (*Larus atricilla*) to frequent overhead flights by Herring (*L. argentatus*) and Great Black-backed (*L. marinus*) gulls to determine if such flyovers may have contributed to declines in productivity. Common Terns and Laughing Gulls ignored most flyovers (97.9 and 99.4%, respectively) and selectively responded to large gulls that exhibited behaviors associated with predation. Common Terns mobbed large gulls more often than did Laughing Gulls ($G = 18.31$, $P < 0.001$), but numbers of birds per mobbing were similar between species ($Z = 1.206$, df = 11, 6, $P = 0.2388$). We suggest that when conditions favor habituation, the presence of large gulls has minimal impact on productivity. *Received 9 May 1992, accepted 19 Nov. 1992.*

Increases in numbers of Herring (*Larus argentatus*) and Great Black-backed (*L. marinus*) gulls have contributed to decreases in populations of other seabirds in the northeastern United States. Species affected include the Atlantic Puffin (*Fratercula arctica,* Kress 1983), Laughing Gull (*L. atricilla,* Nisbet 1971), and Arctic (*Sterna paradisaea,* Kress 1983), Roseate (*S. dougallii,* Crowell and Crowell 1946, Nisbet 1973), and Common (*S. hirundo,* Crowell and Crowell 1946, Nisbet 1973, Kress 1983) terns. Large gulls (i.e., Herring and Great Black-backed) impact smaller seabirds primarily through competition for nest sites and predation on eggs and chicks (Burger 1979). Gulls may also affect other seabirds by disrupting nesting activities (Hatch 1970).

The presence of large gulls in, or over, a tern colony site may disrupt nesting behavior. Crowell and Crowell (1946:7) suggested the mere presence of gulls nesting among terns "creates a disturbance to the normal activities of the latter." More recent studies (e.g., McNicholl 1973) indicate it is the mobbing response of terns to potential predators that interrupts nesting activities and that this response varies among colonies. McNicholl (1973) suggested tern colonies that nest adjacent to potential predators habituate to those predators, while little habituation occurs where terns nest away from predators.

Large colonies of Common Terns and Laughing Gulls once nested on North Monomoy Island (e.g., Nisbet and Welton 1984). Numbers of both

[1] Dept. of Forestry and Wildlife Management, 204 Holdsworth Hall, Univ. of Massachusetts, Amherst, Massachusetts 01003-0130.

species, however, declined sharply during the 1980s (USFWS 1988), as did the productivity of remaining nesters (Nisbet and Welton 1984). The amount of nesting habitat available to both species was stabilized in 1979 (USFWS 1988), making competition for nest sites an unlikely cause of subsequent population decreases. However, remaining colony sites were located beneath a flight path used by large gulls, and frequent flyovers may have disrupted tern and Laughing Gull nesting behavior. Our objectives were to identify responses of nesting Common Terns and Laughing Gulls to Herring and Great Black-backed gulls that flew over the Monomoy colonies and to determine if flyovers disrupted nesting behavior.

METHODS

Common Terns and Laughing Gulls nest on the northern-most part of North Monomoy Island, Monomoy National Wildlife Refuge, Chatham, Massachusetts. A census, conducted on 12 June 1989, identified 375 Common Tern and 378 Laughing Gull nests within the colony site. Most nests contained complete clutches at the time of census, and all were abandoned between 20 July and 3 August. Neither colony fledged any young. Since 1979, nest destruction and harassment have been used to prevent large gulls from nesting in the colony site and a 430 m wide buffer strip along its southern border (USFWS 1988). Approximately 17,000 pairs of large gulls nested to the South of the buffer strip (Cavanagh 1992).

From 21 June to 20 July 1989, we observed responses of Common Terns and Laughing Gulls to flyovers. We attempted systematic observations one day per week during the two-hour periods after sunrise and before sundown, periods that coincided with the greatest movement of large gulls over the colony site (pers. obs.). Frequent fog, however, prevented observations during some periods. We recorded numbers of flyovers, mobbings, and disturbances. A flyover is defined as the passing of a Herring or Great Black-backed gull over the colony. Mobbings occurred when one or more Common Terns or Laughing Gulls chased a Herring or Great Black-backed gull. A disturbance was any event that caused a group of incubating terns or Laughing Gulls to take flight for purposes other than mobbing. Observations were made with 7 × binoculars from the northern border of the buffer strip. Numbers of gulls flying over the colony were recorded by species and altitude (20 m or less or greater than 20 m; Hatch 1970). We identified numbers and species of birds mobbing. We also identified numbers of terns or Laughing Gulls disturbed and attempted to identify causes of disturbances.

We tested for differences between Common Terns and Laughing Gulls for numbers of mobbings, birds per mobbing, disturbances by unknown causes, and birds per disturbance by unknown causes. A lack of disturbances to Laughing Gulls by large gulls prevented comparison of disturbances by gulls, and birds per disturbance by gulls. Numbers of events (i.e., mobbings and disturbances) were evaluated using G-tests with Williams' correction (Sokal and Rohlf 1981:706–707), while numbers of birds per event were evaluated using the Mann-Whitney U statistic (Statistix V. 4.0, Analytical Software, St. Paul, Minnesota).

RESULTS

We observed 2341 flyovers during 12.5 hours of observation. Most flyovers (N = 2299, 98.2%) were within 20 m of the ground, and many

were within 1 m. We observed no responses to flyovers at heights greater than 20 m (N = 42). Forty-nine flyovers at heights of 20 m or less resulted in mobbings by (N = 48) or disturbances to (N = 1) Common Terns. Laughing Gulls mobbed 15 times in response to flyovers of 20 m or less. Common Terns averaged 11.5 ± 5.2 ($\bar{x}$ ± SE), and Laughing Gulls 3.0 ± 1.9, birds per mobbing. No disturbances to Laughing Gulls by flyovers were observed. Additionally, we observed 11 disturbances to Common Terns and six disturbances to Laughing Gulls when there were no large gulls over the colony and no other potential causes could be identified. Common Terns averaged 116.1 ± 24.0 and Laughing Gulls 75 ± 32.8 birds per disturbance due to unknown causes.

Most responses to flyovers were similar between species. Common Terns mobbed more often than did Laughing Gulls ($G = 18.31$, $P < 0.001$), but no interspecific differences in numbers of birds per mobbing were detected ($Z = 1.178$, df = 48, 15, $P = 0.02388$). Both species appeared to respond to the behavior of large gulls rather than their altitude. All gulls mobbed either attempted to land within the colony site or noticeably changed direction while flying over. No gulls that flew directly through the colony site were mobbed. No interspecific differences were identified in numbers of disturbances by unknown causes ($G = 1.48$, $P > 0.1$) or birds per disturbance by unknown causes ($Z = 1.206$, df = 11, 6, $P = 0.2278$).

We observed few mobbings or disturbances in response to species other than Herring or Great Black-backed gulls. One Laughing Gull was seen chasing a Common Tern, and another chasing a Laughing Gull. Common Terns were never observed mobbing Laughing Gulls. Black-crowned Night-Herons (*Nycticorax nycticorax*) were the only potential predators, other than gulls, that commonly flew over North Monomoy Island. None was observed during observation periods.

DISCUSSION

Habituation to potential predators may develop under conditions of repeated exposure and the absence of predatory behavior. McNicholl (1973) suggested frequent mobbings of Herring Gulls may decrease Common Tern productivity by reducing time spent incubating, brooding, and guarding eggs and chicks. Under such conditions, responses of terns to potential predators should be a balance between habituation and aggressive response (McNicholl 1973). Numbers of responses to flyovers, and behaviors of gulls mobbed, suggest Common Terns and Laughing Gulls on Monomoy may have habituated to large gulls. Large gulls flew over the Monomoy colony site at an average rate of more than three birds per minute. It is unlikely Common Terns or Laughing Gulls could have main-

tained nesting activities had they responded to all flyovers. Instead, terns and Laughing Gulls appeared to respond selectively to those gulls that exhibited behaviors associated with predation e.g., landing in the colony site. Ryden (1970:49) reported a similar discriminatory response; terns attacked only when a gull moved "in a conspicuous manner." Lack of response to most flyovers was likely due to habituation to movements along flight paths, and those few mobbings that occurred represent the balancing of aggression and habituation.

McNicholl (1973) suggested Common Terns would not habituate to predators that did not nest among or adjacent to the tern colony. Our results, however, suggest Common Terns need not nest with potential predators for habituation to develop. Although habituation may occur when two species nest together, due to frequent exposure it may also occur under other conditions. Frequent flights of large gulls over the Monomoy colony site is believed to have led to the habituation of terns and Laughing Gulls, and it is likely any similar prolonged exposure would favor habituation.

Hatch (1970) reported large gulls that flew over a Common Tern colony site at heights of 20 m or less were mobbed, while those that flew above 20 m were not, suggesting the mobbing response may be height dependent. Although gulls that flew over 20 m above the Monomoy colony site were not mobbed, neither were most gulls that flew at heights of 20 m or less. Mobbings on Monomoy were in response to behaviors associated with predation (e.g., turning or landing near a nest). Mobbing responses in Hatch's (1970) study may have also been influenced by gull behavior rather than height. Hatch (1970:246) described flights at altitudes of 20 m or less as "hunting flights." It is likely that the terns in Hatch's study were responding to predatory behavior, and that hunting gulls were those that flew close to the colony site.

Common Terns and Laughing Gulls exhibit different nest defense behaviors. Common Terns aggressively defend their nests, attacking potential predators of varying sizes (e.g., Erwin 1979). Laughing Gulls, in contrast, may avoid aggressive interactions with larger species (Burger and Shisler 1978). Similar differences were reported by Burger and Gochfeld (1988), who identified interspecific differences in the defensive responses and aggressive behaviors of seven species of terns. We suggest that interspecific differences in numbers of mobbings observed on Monomoy represent species-specific nest defense behaviors.

Several factors may have produced disturbances attributed to unknown causes. Morris and Wiggins (1986) reported external stimuli (e.g., Herring Gulls in the colony site) caused small disturbances (i.e., those involving a small segment of the colony) to nesting Common Terns, while large

disturbances (i.e., those involving almost the entire colony) were an indirect consequence of owl predation. On 20 June, two headless Laughing Gulls and a Great Horned Owl (*Bubo virginianus*) feather were found in the colony site, suggesting nocturnal predation. We attribute large disturbances to the after-effects of this predation. Causes of smaller disturbances are less readily identified. They were not due to large gulls or other avian predators, no researcher or other human disturbance was observed, and there were no mammalian predators on North Monomoy Island. Observations indicated interactions between Common Terns and Laughing Gulls were not responsible for disturbances. It is likely that small disturbances were due to intraspecific interactions. Disturbances due to such interactions would have been attributed to unknown causes due to the absence of heterospecifics from the vicinity of the disturbance.

Our observations indicate the location of colonies beneath a flight path used by large gulls had little effect on Common Tern and Laughing Gull nesting behavior. Both species ignored most large gulls and appeared to habituate to their presence. Large gulls that exhibited predatory behavior were chased out of the colony site, and no predation was observed. We attribute the failure of the Common Tern and Laughing Gull colonies not to large gulls but rather to nocturnal desertion in response to nocturnal predation by Great Horned Owls (Nisbet 1975). Owl predation and associated egg and chick losses reduced Common Tern productivity on Monomoy throughout much of the 1970s (Nisbet and Welton 1984). Although believed to have ceased after 1983 (USFWS 1988), Great Horned Owl predation may still be affecting tern and Laughing Gull production on Monomoy. We suggest that when conditions favor habituation, large gulls have minimal impact on nesting Common Terns and Laughing Gulls. Under such conditions other factors should be investigated if causes of decreases in productivity are to be identified.

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