

COMPARATIVE NEST DEFENSE BEHAVIOR OF FOUR SPECIES OF MARSH BIRDS

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Experimental studies of responses of prey species to potential predators have centered mainly on methods of predator recognition and the roles of instinct and learning in such responses. Experimental work such as that of Nice and Ter Pelkwyk (1941) emphasized the study of hand-reared birds and their innate and "conditioned" responses to both live and model animals. Considerable work also has been directed to the elements of models which serve as releasers (Tinbergen, 1948). Simmons (1952) has discussed possible motivation and the types of displays found in breeding birds. In general, the intensity of predator reactions is greatest in nest defense and, thus, nest sites are a convenient place to study such behavior. However, some workers have avoided nest sites because of the "hypersensitivity" of birds there (Altmann, 1956).

The study here reported was an attempt to compare nest defense behavior of four species of marsh birds which nested in slightly different habitats and to evaluate the relationship between habitat and predator reactions. Data were obtained on two blackbirds and two terns: Redwinged Blackbird (*Agelaius phoeniceus*) which nested in shoreline emergent and terrestrial plants; Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) which used emergents near open water; Black Tern (*Chlidonias niger*) which nested on low, unused muskrat houses or built low nests of floating debris at or near the water level; and the Forster Tern (*Sterna forsteri*) which nested on higher muskrat houses. These species also showed slightly different degrees of colonial nesting, with Yellow-headed Blackbirds and Forster Terns normally being more gregarious than their associates.

Experiments were conducted during the summer of 1961 in Iowa at Goose and Little Wall lakes near Jewell in Hamilton County and at Dan Green Slough, Barringer Slough, and Rush Lake in Clay and Palo Alto counties near Ruthven. The project was financed by the National Science Foundation. Cecil E. Spatcher of the National Science Foundation High School Teachers Research Participation Program assisted in the field work.

METHODS

Nest defense behavior was induced by the two-dimensional models illustrated in figure 1 and the mounted specimens listed in table 1. The square and rounded wooden forms and the wooden painted (*Chrysemys picta*) and snapping (*Chelydra serpentina*) turtle models were rarely used because many individuals failed to respond to them. The Barred Owl (*Strix varia*) was omitted from later tests because responses to it did not differ significantly from those to the Great Horned Owl (*Bubo virginianus*).

The normal testing procedure was to place models as close to the nest as possible and in a natural position for an approaching predator. In the case of tern nests on muskrat houses, models were placed on the houses and within six inches of the nest. Near elevated blackbird nests or floating tern nests, models were placed on mats of vegetation or on stakes within six inches of the base of the nest. The responses of nesting birds then were observed from a distance to minimize the effect of the observers' presence. The sequence in which these models were displayed was constant except in the case of the Yellow-headed Blackbird for which the sequence was varied because birds often were not attracted to the nest site unless a conspicuous model was displayed first.

An attempt was made to standardize the length of time each model was displayed at the nest. The normal procedure was to record the reactions of the birds for two min-

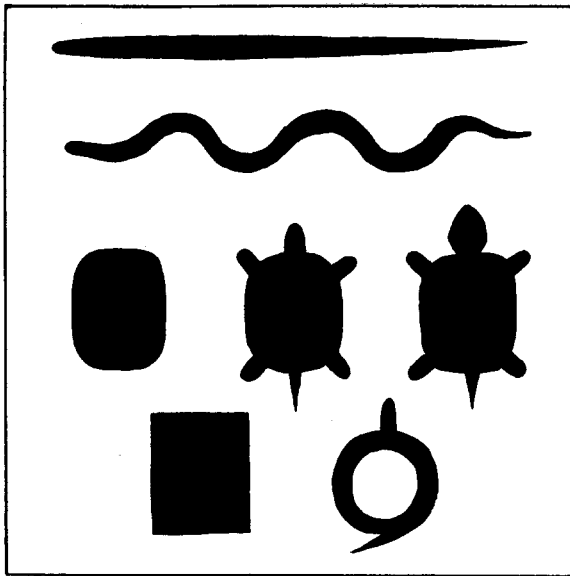


Fig. 1. Two-dimensional wooden models used to test responses to foreign objects and snake and turtle-like forms at the nest.

utes following the first indication that they noticed the model. If the birds did not react within two to five minutes, the model or mount was replaced by another.

TABLE 1

LIST OF MOUNTED ANIMALS USED IN TESTS

Fox snake (*Elaphe vulpina*)
 Snapping turtle (*Chelydra serpentina*)
 Muskrat (*Ondatra zibethicus*)
 Mink (*Mustela vison*)
 Crow (*Corvus brachyrhynchos*)
 Red-tailed Hawk (*Buteo jamaicensis*)
 Barred Owl (*Strix varia*)
 Great-horned Owl (*Bubo virginianus*)

RESULTS

Figure 2 summarizes the results of the major tests. These data are separated according to intensity of response. A "positive response" indicates a clear-cut interest in the model or animal as shown by the bird's (1) flying to or over the nest and often calling, or (2) diving at or attacking the model. The term "attack," when used in reference to redwings and yellowheads, implies striking or pecking the model; in terns it suggests the rapidly repeated diving and calling as well as direct striking of the model. Discussions of species will follow a similar pattern and an attempt is made to divide behavior into three or more levels of intensity. Obviously, these are arbitrary boundaries, and we have no data to demonstrate that these represent levels of motivation.

REDWINGED BLACKBIRD

In a low intensity reaction the male hovered over the nest for a few seconds and then departed. The female often returned to the nest after glancing at the model placed

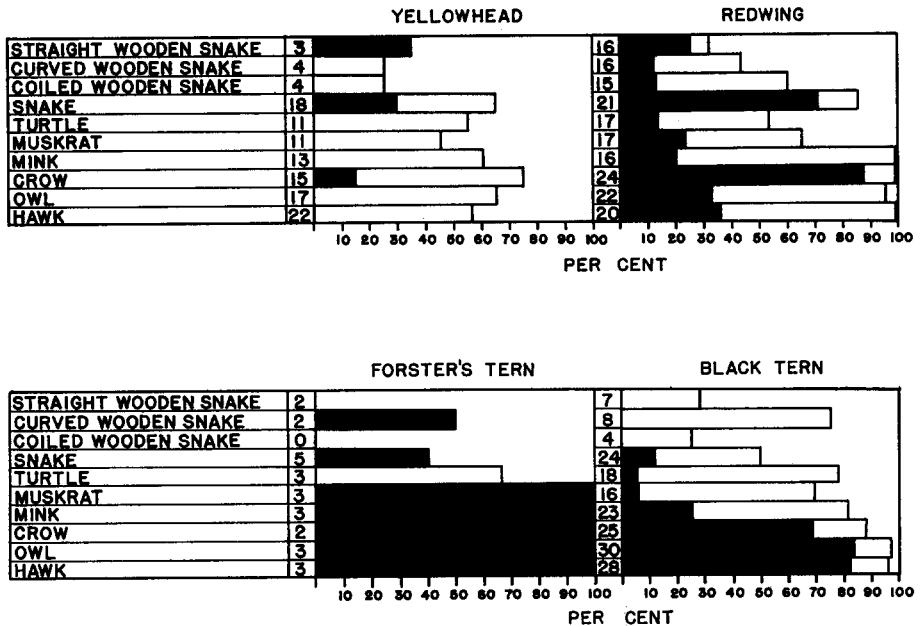


Fig. 2. Total responses (white bar) and proportion of total responses which were considered actual attacks (black bar) for some models or mounts placed at nests of four species of marsh birds. Number of tests indicated to left of each bar.

nearby or delayed returning to the nest until the model was removed even though she appeared unconcerned over its presence. A greater intensity of response was indicated when both male and female hovered over the nest or perched nearby while one or both gave a quiet *chenk* or *check* call (see Allen, 1914). Other redwings often were attracted but quickly lost interest. The nesting pair eventually became less concerned, and the female sometimes returned to the nest. In a high intensity situation, the male excitedly called *chenk* or *cree*, and the female often emitted a high pitched *chee*. One or both members of the pair attacked the model with intense and repeated pecking. Other birds were attracted by the calls and hovered or perched nearby calling excitedly, but they rarely attacked the model. These visitors gradually departed, but the nesting pair continued to attack the model as long as it was present. Occasionally a male attacked his mate during the peak of the battle; this behavior may have represented redirected aggression.

As shown in figure 2, the majority of high intensity reactions were directed toward the mounted snake, crow, owl, and hawk, but there was considerable individual variation in intensity of response to the different models.

YELLOW-HEADED BLACKBIRD

The most simple and characteristic response was that the male flew over the nest once or twice and departed. Occasionally the female performed in a similar manner. The female usually would not return to the nest, but this may have been due to the observers' presence nearby. In some cases, Black Terns would hover over the yellow-head nest without eliciting further response from the owners. When more intensely interested, both male and female hovered over the nest or perched nearby while the male

gave a *chink* call intermittently. They occasionally attacked the mounts while other yellowheads only inspected them. The male and female sometimes remained near the nest but often lost interest rather quickly. Neither the male nor female called as often as did redwings. The least common and most intense situation was shown when the female gave a piercing *chee* while hovering over the potential predator. The male, also hovering, gave a trill-like alarm call, not unlike the call of the nestling, which attracted other males from adjacent territories. This resulted in a "mobbing" by the pair and by other birds in the area, with considerable calling and occasional attacks.

Yellowheads responded positively to all models except the turtles, but the only models attacked were the straight wooden snake and the mounted snake and crow. The responses of the yellowheads to the different models varied much more in intensity than did the responses of the redwings. In many cases, the stuffed snake, crow, owl, and hawk elicited little response. Some difference in response of yellowheads was attributed to the sequence in which the models were displayed. When the owl or hawk was used first, the yellowheads then reacted more clearly to the other models. General observations showed that the response to live hawks in flight was intense. Males hovered over the nesting areas while giving the loud "trill." This aroused all nesting birds. Simultaneously, redwings gave a high-pitched *cee* (usually while perched) so that no hawk passed over the marsh without a general alarm.

BLACK TERN

In a low intensity response, one to several terns would hover over the nest with very little or no calling. They would usually disperse within a few seconds, and in a few cases the female returned to the nest with the model present. When more aroused, one to a dozen or more terns hovered over the model, all of them calling excitedly. A few dived low over the model. Presumably because there was no movement of the model, the birds gradually left except for one or two, probably the nest owners, that continued to hover over the nest and dive at the model. In higher intensity, the birds hovered and called more rapidly and with a louder pitch. Many of the birds dived low over the model, and one or two birds, presumably the owners of the nest, pecked the model each time they dived. The intensity of the response often remained high throughout the duration of the test and few birds departed.

FORSTER TERN

The reactions of the Forster Terns were similar to those of the Black Terns in all major respects except that the proportion of positive responses which were termed attacks was higher. Nevertheless, Forster Terns rarely dived closer to the models than six inches. This is in contrast to the Black Terns which struck some models as they occasionally strike humans. However, the models attracted larger numbers of Forster Terns than Black Terns, and their loud calls and impressive dives seemed an effective deterrent to any predator.

DISCUSSION

These tests did not contribute to an understanding of the roles of instinct and learning in predator identification because the work was done only with experienced adults which, presumably, had seen many live predators. A higher response to mounted animals than to two-dimensional models was noted. However, it was apparent in highly aggressive individuals that there was an innate aggressiveness to most foreign objects near the nest. Birds often responded to mounts of usually harmless associates such as musk-

rats and turtles. Nesting birds showed little interest in live muskrats or turtles on muskrat houses away from the nest but their reactions to models were not tested.

One accident produced an interesting result concerning the redwing's ability to identify owls. During an experiment at a redwing nest, the mounted owl was knocked over. The intense hovering and attacking ceased almost immediately. As soon as the owl mount again was erected, the vicious attack resumed. However, no difference in response was noted in a similar experiment with the highly aggressive Forster Terns.

The most significant results of the tests were the measurements of quantitative differences in nest defense behavior. These were most clear-cut between the blackbirds:

Responses of Yellow-headed Blackbirds to models were considerably more variable and of lower intensity than those of Redwinged Blackbirds, and some curiosity, rather than aggressiveness, may be registered in the records for the yellowhead. Attacks were a common response of redwings but were rare among yellowheads. General observations indicate that attacks on humans also are much less common in Yellow-headed than in Redwinged blackbirds. However, hawks which flew over the marsh always caused a much more intense alarm and flight call in yellowheads than in redwings. Thus, reactions of yellowheads to potential predators can be clear-cut but such aggressive responses seem restricted to aerial predators or, perhaps, to an object actually in the nest.

The different reactions in these two species seem to accord with their nest sites. Redwings, which nest near or over land, are in closer contact with land predators (snakes, weasels, mink, raccoon, foxes) than are yellowheads. An intensive pecking and mobbing attack probably is necessary to deter such predators. Yellowheads nest over water where fewer terrestrial forms occur, and a noticeably lower response was recorded to most immobile predators. Both species are subject to predation by hawks and crows and respond to aerial predators, but these could not be tested in these experiments. However, general observations indicate that yellowheads have an elaborate distracting display when an aerial predator appears. In the highly social yellowhead, the mass distraction caused by the hovering and trill call may be quite effective for the whole colony, whereas redwings, which often nest singly or in small groups, might be conspicuous targets if they displayed alone or in small numbers.

Terns are well known for their highly social warning and mobbing behavior and are even more respected by predators than are redwings because of the velocity of their dives which are accompanied by piercing cries. Tests with models and mounts demonstrated an intense social type of aggressive behavior at the nest site which involved most of the terns nesting in the locale. There was only a slight difference in nest site selection between the terns that were studied, and a lesser difference in defense behavior is to be expected than in the blackbirds. Both species of terns nested over water some distance from shore in clearings. Although a lesser response to mammals and terrestrial predators might be expected than was found, the shallow nest could easily be destroyed by a muskrat, mink or turtle which climbed on it, and intense diving and pecking might deter the animal. Moreover, the evolution of such defensiveness may be linked with the more common land-nesting terns, as studied by Cullen (1960).

It is of interest to compare the intense predator reactions of Black and Forster terns with the less vigorous responses of the Yellow-headed Blackbird since all nest over water. The major habitat difference is that blackbird nests are 8 to 30 inches above the water on emergent vegetation while those of terns are nearer the water and more subject to disturbance by semi-aquatic forms such as turtles, snakes, and muskrats.

In general, it appears that predator responses in these species have evolved in conjunction with nest sites and with the species which might be predatory or cause acci-

dental nest loss. Social behavior and colony-nesting probably also play a role in the nature of predator responses.

SUMMARY

The reactions of four species of marsh birds to models and mounts of potential predators at the nest suggest that behavior is related to both nest site and social habits. Redwinged Blackbirds, which nest close to shore or on shore, used pecking and mobbing to deter terrestrial predators. Yellow-headed Blackbirds, which nest over water, were much less disturbed by terrestrial forms but reacted conspicuously to aerial predators.

Less difference in nest site and behavior occurs between Black and Forster terns, which both nest over water. Both showed highly social behavior and responded aggressively to any mounted animals near the nest.

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