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COWBIRD PARASITISM OF MARSH-NESTING RED-WINGED BLACKBIRDS

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While upland-nesting Red-winged Blackbirds (*Agelaius phoeniceus*) often suffer a high degree of nest parasitism by the Brown-headed Cowbird (*Molothrus ater*; Hergenrader 1962, Hill 1976, Robertson and Norman 1977), those nesting in marshes have been shown to be infrequent hosts (Nickell 1955, Friedmann 1963, Robertson and Norman 1976). Only Berger (1951) has reported more than 3% of marsh nests parasitized. Friedmann (1963) believed that the incidence of parasitism in marshes was low because most nests in marshes were built over water. I report here the highest recorded incidence of cowbird parasitism of marsh-nesting Red-winged Blackbirds.

During the summer of 1978, I studied two small populations of Red-winged Blackbirds nesting in cat-tail (*Typha latifolia* and *T. angustifolia*) marshes in the Flint Hills region of central Kansas. One of the study areas, Britt Marsh, is approximately 5 km southwest of Manhattan, Riley County, Kansas. The other, a beaver pond near Tuttle Creek Reservoir, lies 8.8 km north of Manhattan. In both areas nests were constructed over water ranging in depth from a minimum of 6.4 cm in the shallower areas at Tuttle Creek to over 50.0 cm in the deepest parts of Britt Marsh. Of 12 nests studied at Britt Marsh, all supported by *T. latifolia*, none was parasitized even though I often saw cowbirds in the area. At Tuttle Creek, where no cowbirds were seen, I found 17 Red-winged Blackbird nests; 8 in *T. latifolia*, and the remainder in woody vegetation (*Salix* spp., 5; *Cephalanthus occidentalis*, 2; *Cornus drum-*

mondii, 1; *Acer* sp., 1) at the water's edge. Of these, 52.3% (five nests in cat-tails, four in trees or shrubs) contained one cowbird egg each in addition to zero to four ($\bar{x}$ = 1.4) host eggs. All nests in cat-tails were lost to predators and only two of the remaining cowbird eggs hatched. Both nestlings survived to the age of 8 to 10 days but I do not know if either managed to leave the nest successfully. The parasitized nests contained a total of 13 Red-winged Blackbird eggs; but only six birds were fledged (0.67 birds/nest), two of which were from one of the two nests that contained a cowbird nestling. Non-parasitized nests produced 1.7 fledglings per nest.

As Shipley (1977) found no parasitism at Tuttle Creek during the 1974 and 1975 nesting seasons, why was the incidence of parasitism so high during the summer of 1978? The nine eggs were laid on different days during the period 12 June to 12 July. Since the Brown-headed Cowbird is quite prolific (Payne 1976), it is possible that all the cowbird eggs were laid by a single female. Robertson and Norman (1977) found relatively fewer nests parasitized in areas of high nest density ($\geq$24 nests/ha) than in areas of lower density. Using this criterion, Tuttle Creek (covering an area of about 3.2 ha) would be an area of low density; one would, however, think that the blackbird population at Tuttle Creek was large enough to defend nests from a single cowbird. Friedmann (1963) and Friedmann et al. (1977), however, believed that the low incidence of parasitism noted in many Red-winged Blackbird nesting areas was due to cowbird preference for alternate hosts rather than to host aggression. Further investigation may show that marsh-nesting Red-winged Blackbirds are suitable hosts that have not been exploited heretofore.

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MIXED FLOCKS, ACCIPITERS, AND ANTIPREDATOR BEHAVIOR

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Predation has been frequently suggested as a major selective force leading to flocking by forest birds (reviewed by Moriarty 1976, Morse 1977), but encounters between flocks and their predators have rarely been witnessed. I report here my observations of encounters between mixed flocks and Sharp-shinned Hawks (*Accipiter striatus*) and Cooper's Hawks (*A. cooperi*).

The study area was located within San Felasco Hammock State Preserve near Gainesville, Alachua Co., Florida. The area contained primarily open woods of long-leaf pine (*Pinus palustris*) and turkey oak (*Quercus taeda*) surrounded by areas of second growth and mature woods containing such species as laurel oak (*Q. hemisphaerica*), pignut hickory (*Carya glabra*), and southern red oak (*Q. falcata*).

Between October 1977 and April 1978 I spent approximately 550 hours in the study area, of which 350 h were spent following and tape-recording mixed flocks. I recorded vocalizations on a Nagra IIIN open reel tape recorder with a Dan Gibson P200 parabolic reflector microphone, and on a Superscope C105 cassette recorder with a Realistic electret condenser microphone. I analyzed the tapes on a Kay Electric Co. 7029A Sona-Graph.

Carolina Chickadees (*Parus carolinensis*) and/or Tufted Titmice (*P. bicolor*) in groups of two to seven each were "nuclear" (as opposed to "attendant") in that other species tended to join and follow them (terminology from Moynihan 1962). The most regular attendant species were the Black-and-white Warbler (*Mniotilta varia*), Yellow-throated Warbler (*Dendroica dominica*), and Brown Creeper (*Certhia familiaris*), all of which occurred at a density of one individual per flock and were seen only rarely away from the flocks. The Solitary Vireo (*Vireo solitarius*), Downy Woodpecker (*Picoides pubescens*), Red-bellied Woodpecker (*Melanerpes carolinus*), Pine Warbler (*Dendroica pinus*), and Orange-crowned Warbler (*Vermivora celata*) were also regular attendant species, but they occurred at densities of one to three individuals per flock and were frequently seen away from the flocks. The Yellow-rumped Warbler (*Dendroica coronata*), American Goldfinch (*Carduelis tristis*), and Ruby-crowned Kinglet (*Regulus calendula*) occurred irregularly with the flocks in groups of four to more than 30 per flock.

On 55 occasions, a mixed flock gave an alarm response. On 21 of these occasions, the response was associated with the sudden appearance of an accipiter or other large bird with similar shape: eight times it was a Sharp-shinned Hawk, once a Cooper's Hawk, five times a Red-shouldered Hawk (*Buteo lineatus*), and once a Turkey Vulture (*Cathartes aura*). Five other responses were probably caused by attacks (from unknown predators) judging from the scattering of Yellow-rumped Warblers with sharp chipping calls as in other attacks. Three were responses to Sharp-shinned Hawks near roost sites (see below). I saw no likely cause for alarm in the remaining 26 responses. I observed no responses in 40 field hours in October, nor in 110 h in April. I estimate an overall average of one response per five hours observation time for the five months from November to March.

The response to the appearance of a predator began with a high frequency (9–11 kHz), whistle-like call given by a chickadee or titmouse and then chorused by others of these species. (These calls have been described in detail in Gaddis 1979.) All birds in the flock immediately became immobile or dove for cover if it was available. When the hawk actually attacked and flew into the midst of the flock, warblers scattered with outbursts of sharp chip-like calls. The hawk typically made a short chase of one of the fleeing birds but was never successful. It then perched amidst the flock and flew off in less than 10 s. The chorus of whistle-like calls continued for up to a minute after the hawk had left. The calls then gradually faded away.

The chickadees and titmice remained immobile for an average of 4.8 min (S.D. = 3.2, range = 1–15, N = 49) from the first high whistle call. Other species remained immobile for varying periods; the warblers and woodpeckers were usually the first to wander off. Before resuming activity, the chickadees and titmice be-