SHORT COMMUNICATIONS

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RESPONSES OF LEAST FLYCATCHERS TO EXPERIMENTAL INTER- AND INTRASPECIFIC BROOD PARASITISM[1]

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Hosts of the Brown-headed Cowbird (*Molothrus ater*) exhibit a dichotomy in responses to parasitic eggs (Rothstein 1975a). Cowbird eggs or egg models placed experimentally into nests of potential hosts are either accepted or rejected (Rothstein 1975a). Few hosts are intermediate in their response to being parasitized and most are easily designated as either "accepters" or "rejecters" (Rothstein 1975a, 1976; but see Clark and Robertson 1981).

Ejection of the foreign egg is the most frequent method that passerines use to reject brood parasitism (Rothstein 1975a), although nest desertion and egg burial may function similarly (Rothstein 1976, Clark and Robertson 1981). As a consequence, the observed rate of natural parasitism may underestimate the actual rate (Rothstein 1971). Alternatively, low rates of observed parasitism may result when accepters are parasitized only infrequently (Rothstein 1975b). Only by experimentally adding foreign eggs can a species' response be determined (Rothstein 1971).

Least Flycatchers (*Empidonax minimus*) are parasitized infrequently (Friedmann and Kiff 1985). Friedmann et al. (1977) reported a maximum parasitism rate of 2% in Ontario, although Southern and Southern (1980) calculated that 11.9% of Least Flycatcher nests in Michigan were parasitized. On our study area at Delta Marsh, Manitoba we have observed only seven (2.7%) cases of natural parasitism out of 262 clutches examined from 1984 through 1986. No instances of intraspecific parasitism were detected in 106 of these nests that were examined daily during laying (Briskie 1985).

Based on one experiment, Rothstein (1975a) tentatively classified the Least Flycatcher as an accepter. To determine whether the low rate of parasitism we observed was due to rejection or merely infrequent parasitism, we experimentally parasitized a large sample of Least Flycatcher nests with cowbird eggs. Because the stage in the nesting cycle affects the rate of rejection in at least two species (Cedar Waxwing, *Bombycilla cedrorum,* Rothstein 1976; Northern Oriole, *Icterus galbula,* Rothstein 1978), we parasitized nests from building through the nestling stages. In addition we parasitized nests with Yellow Warbler (*Dendroica petechia*) and other Least Flycatcher eggs. Yellow Warbler eggs are similar in size and color to flycatcher eggs but are spotted brown in a pattern comparable to cowbird eggs. Thus, they mimic a miniature cowbird egg. Least Flycatcher eggs are immaculate white and were used to test host responses to intraspecific parasitism.

METHODS

From 1984 to 1986 we located Least Flycatcher nests in the forested dune-ridge that separates Lake Manitoba from the Delta Marsh, Manitoba (MacKenzie 1982). We tested a total of 50 nests with one of three experimental egg types. Egg additions were made over all daylight hours and no host eggs were removed. Each nest was observed from 20 to 25 m for 10 min after the addition to record the initial reaction of birds. We were able to sex adults since females alone incubate and brood (pers. observ.). Nest contents were then checked at 24-, 48-, and 72-hr intervals and the eggs were examined for damage. An incubating bird or warm eggs indicated acceptance of the foreign egg. The disappearance of the entire clutch was assumed to be because of predation. After 3 days we removed most experimental eggs. A few cowbird eggs remained in conjunction with other studies (Briskie and Sealy, unpubl. data) but responses in these later nests did not differ with the results obtained only after 3 days. We tested each nest only once.

One cowbird egg was added to 34 nests in various stages of the nesting cycle. Two nests were tested during nest building. To qualify, nests in the building stage had to be actively attended on the day of the experiment but complete enough to hold the eggs. Thirteen nests tested during laying contained one to three flycatcher eggs. Eleven clutches parasitized during incubation had been completed at least 3 days previously and eight nests containing young were parasitized 2 to

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5 days after hatching. Eight nests were parasitized with Yellow Warbler eggs and eight with Least Flycatcher eggs. All nests in these last two categories were parasitized during the laying period.

RESULTS

No cowbird eggs were rejected within 24 hr in nests tested during the laying, incubation, and nestling stages. Complete clutches in five nests were depredated between 24 and 72 hr. All nests that survived to 72 hr ($n = 27$) still contained the cowbird egg.

Two nests parasitized during building were deserted. One visited daily for 3 days showed no signs of activity. The cowbird egg disappeared at 5 days and the nest rapidly deteriorated. Similarly, no activity was seen at the second nest when visited at 24 hr, but the cowbird egg was gone when it was checked again at 48 hr. The nest was never used later and it seems likely that it was deserted in response to the cowbird egg.

Both the Yellow Warbler and Least Flycatcher eggs were accepted at all 16 nests. Two nests were lost to predators by 72 hr, but the remaining nests continued to accept the foreign eggs.

The initial reaction of Least Flycatchers to experimental parasitism gave little indication that they recognized any change in their nest. At 12 nests females resumed incubating or brooding without examining the contents. At 11 nests females first examined the contents and then immediately began to incubate. Adults at 14 nests repeatedly returned to look at the nest contents but flew away after each examination. We were not sure whether this response was due to the presence of the foreign egg or our proximity to the nest. No birds returned within 10 min at 13 nests. All nests in the latter two categories accepted cowbird eggs by 24 hr.

In all experiments none of the eggs showed any signs of damage. Five nests lost one host egg each, although loss in one nest was likely due to natural parasitism. Partial clutch loss in experimental nests was not significantly different than in nonparasitized nests (4 in 117 days of exposure vs. 34 in 1,958 days of exposure; $\chi^2 = 1.91$, df = 1, $P > 0.05$).

DISCUSSION

Least Flycatchers are typical accepters as suggested by Rothstein (1975a). Three types of parasitic eggs were accepted and at least for the cowbird eggs, this response remained the same once a host egg was in the nest. Flycatchers deserted parasitized nests only during nest building.

Because cowbirds have a short incubation time (10 to 11 days), most flycatchers fail to hatch (incubation time 14 days). Those that do are quickly outcompeted (Walkinshaw 1961). On our study area no flycatcher survived for more than 2 days in two nests in which both the cowbird and flycatchers hatched. For Least Flycatchers, successful cowbird parasitism probably results in total reproductive failure (Walkinshaw 1961). Any mechanism which would prevent or free a nest from becoming parasitized should be advantageous.

Ejecting a foreign egg is the most efficient mechanism for rejecting parasitism, however it requires both (1) recognition of a parasitic egg and (2) a bill large enough to spike or lift an egg out of the nest (Rothstein 1975a). In common with most passerines, Least Flycatchers generally remove damaged eggs (Rothstein 1982, pers. observ.), thus, they can handle eggs at least as large as their own. Rothstein (1975a) correlated ratios of tomial length to egg width with the ability of various species to eject foreign eggs. Ejector species were characterized by ratios greater than 0.7. Least Flycatchers on our study area have a mean tomial length of 15.4 mm ($n = 26$, both sexes combined). The mean width of cowbird eggs used in this study ($\bar{x} = 16.1$ mm, $n = 11$) gives a ratio of 0.95. Thus, by Rothstein's (1975a) criteria, flycatchers could conceivably lift a cowbird egg. However, by using a freshly killed adult flycatcher we could not position a cowbird egg between the mandibles and past the point to where it could be grasped. Perhaps a more relevant measure should include both bill length and the maximum gape. Such an index might explain why some "potential ejectors" are accepters. Alternatively, cowbird eggs could be removed by spiking but this would be disadvantageous if it led to accidental breakage of host eggs (Rothstein 1975a).

By accepting parasitic eggs, Least Flycatchers do not seem to behave optimally (Rothstein 1982). If an accepter is protected by other defenses it may fail to evolve rejection (Robertson and Norman 1977, Rothstein 1982). Least Flycatchers react more aggressively to models of female cowbirds than they do to models of Fox Sparrows, *Passerella iliaca* (Briskie and Sealy, unpubl. data). Since well-defended nests are parasitized, aggression is not a fully effective defense (Robertson and Norman 1977). Indeed, host defense may serve as a cue cowbirds can use to locate nests (Robertson and Norman 1977).

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BILL-SWEEPING BEHAVIOR OF A MEXICAN CHICKADEE[1]

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Key words: Mexican Chickadee; Parus sclateri; *hole-nesting; antipredator behavior.*

Although hole-nesting may reduce predation as compared to open-nesting, predation pressure may still be of sufficient magnitude to have selected for similar defensive behavior in unrelated hole-nesters (e.g., Haartman 1967). Here we describe bill-sweeping, a probable anti-predator behavior, at an unusual nest site of the Mexican Chickadee (*Parus sclateri*). Bill-sweeping had been previously reported only in the White-breasted Nuthatch, *Sitta carolinensis* (Kilham 1968).

We observed a Mexican Chickadee nest at Rustler Park in the Chiricahua Mountains (Cochise County), Arizona, for several hours a morning for 4 days. This nest, apparently excavated by the chickadees, was in an approximately 25-m tall ponderosa pine (*Pinus ponderosa*). The nest hole was approximately 15-m high and was unusual in its location about 6 m from the trunk on the underside of a nearly horizontal branch (about 20-cm diameter) that angled about 20° downward. We observed the nest with Leitz 10 × 40 Trinovid binoculars. On our first day of observation (15 May 1986), both parents brought small insects. By 17 May larger caterpillars were being brought. However, no fecal sacs were removed even on the final day of observation (19 May), indicating that the young were probably only about 1 day old when we discovered the nest (Hinde 1952).

On 15 May we observed bill-sweeping three times by the presumed female (so judged because this individual followed bill-sweeping by entering the cavity and remaining inside at least 15 min, probably indicative of brooding, a behavior absent in male parids). She perched in the nest hole, leaned forward so that her whole body was suspended below the nest hole and swept the area immediately below the nest with the object(s) in her bill in an arc of about 120°. On two subsequent mornings, despite several hours of observations on each, no sweeping was observed. On 19 May, however, five bouts of sweeping occurred in 75 min of observations. Two of these bouts involved dabbing movements, consisting of rapid jabs with the insects immediately under the nest cavity; the remaining incidents entailed sweeping with the insects in an arc. In all cases the area below the nest (toward the trunk of the tree) was anointed with numerous small insects that appeared to be beetles.

Few detailed accounts of the nest sites of Mexican Chickadees occur in the literature, but Brandt (1951) noted that the nests are often high and in dead limbs.

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