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NESTING ECOLOGY AND COWBIRD PARASITISM OF CLAY-COLORED, CHIPPING, AND FIELD SPARROWS IN A CHRISTMAS TREE PLANTATION

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A tree farm or orchard offers unique opportunities for studying bird populations because of its single dominant species composition and the relatively uniform spacing and size of trees. I studied breeding success and nest site characteristics of Clay-colored (*Spizella pallida*), Chipping (*S. passerina*), and Field (*S. pusilla*) sparrows in a Minnesota Scotch pine (*Pinus sylvestris*) Christmas tree plantation and related these data to brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

METHODS

The study area was a 14.6 ha portion of a Christmas tree farm located about 5 km southeast of Hastings, Dakota County, Minnesota. It contained mostly Scotch pine 1–2 m tall, spaced about 1.8 × 1.8 m, that had been sheared several times. Between 8 June and 30 July 1976, I systematically searched the plantation 4 times for nests, inspecting and tapping each tree to flush nesting adults. I marked all nests and eggs and rechecked them at 1–3 day intervals until each nest was abandoned. Eggs that failed to hatch were examined for developed embryos.

For nest sites that could be located near the end of the study, I recorded nest and tree height; distance from the nest to nearest prominent tall tree; and an estimate of nest concealment, tree crown density, and tree density.

Actual or estimated hatching dates were used to assign nests to 10-day periods. Abandoned sparrow nests that could not be identified to species were eliminated from certain portions of the summary. Estimates of survival probability follow Mayfield (1975) and, except where noted, all statistical tests are *t*-tests based on means.

RESULTS

Reproduction

Nests of 6 species were found on the study area, but only 3 were abundant enough to warrant analysis: Clay-colored, Chipping, and Field sparrows. Also found were 7 Mourning Dove (*Zenaida macroura*), 6 Brown Thrasher (*Toxostoma rufum*), and 4 American Robin (*Turdus migratorius*) nests. Thirty of the 73 sparrow nests were parasitized by Brown-headed Cowbirds (Table 1).

Nesting phenology.—The number of active sparrow nests peaked during the period 28 June–7 July (Fig. 1). In contrast, the number of cowbird-parasitized nests was comparatively constant from 18 June to 27 July. This produced 2 peaks in cowbird parasitism (Fig. 2), e.g., parasitism reached 60% twice during the breeding season, but declined to about 35% when host nesting was greatest. This suggests an excess of

TABLE 1. Reproduction of Clay-colored, Chipping, and Field sparrows and Brown-headed Cowbirds in a Minnesota Christmas tree plantation. Data for parasitized sparrow nests refer only to reproduction of the host; that for cowbirds, only to reproduction of the cowbird.

		Clay-colored Sparrow			Chipping Sparrow			Field Sparrow			All Sparrows[2]			Cowbird
		P[1]	NP	T	P	NP	T	P	NP	T	P	NP	T	
Nests	(N)	13	27	40	3	9	12	3	7	10	30	43	73	30
Nest failures: egg stage	(%)	38	22	28	—	—	8	—	—	30	53	23	36	66
nestling stage	(%)	23	11	15	—	—	17	—	—	20	20	9	14	17
Nests fledging young	(%)	31	49	42	—	—	50	—	—	40	17	52	36	7
Unknown[3]	(%)	8	18	15	—	—	25	—	—	10	10	16	14	10
Total eggs	(N)	24	90	114	7	27	34	9	20	29	48	137	185	35
Eggs hatched of those laid[4]	(%)	46	68	63	—	79	77	—	50	52	45	67	61	34
Young fledged: of eggs hatched[4]	(%)	56	77	73	—	100	76	—	70	69	41	81	73	22
of eggs laid[4]	(%)	23	49	43	—	80	59	—	35	33	16	52	44	6

[1] P = Parasitized, NP = Nonparasitized, and T = Total Nests.
[2] Includes 11 abandoned nests that could not be identified to species.
[3] The fate of some nests was unknown because observations were not made daily.
[4] Includes only nests for which the outcome was known.

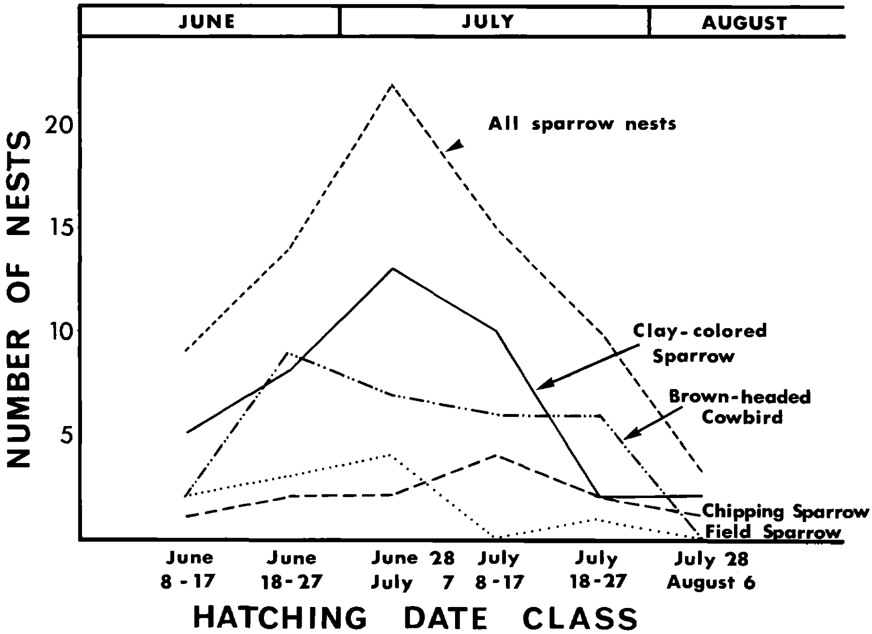

FIGURE 1. Seasonal distribution of sparrow and cowbird nesting on a southern Minnesota Christmas tree plantation.

host nesting relative to cowbird abundance during the period. During the breeding season the percent of known nest failures appeared to rise for parasitized nests and decline for nonparasitized nests. Using combined data for the period 28 June to 27 July, a Chi-square test of a null hypothesis that parasitism had no effect on failures yielded a significant difference ($\chi^2 = 13.59$; 1 df, $P < .005$). The above suggests that in addition to any other benefits of nesting at a particular time, sparrows may use a strategy of swamping the cowbird by synchronizing nesting when failures are low.

Brood parasitism.—Among sparrow nests identified by species, the parasitism rate by species ranged from 25 to 32%. However, when 11 unidentified, abandoned, parasitized sparrow nests were included, the overall rate of parasitism for the genus *Spizella* was 41%. Young (1963) reported a parasitism rate of 42, 15, and 11% for the Clay-colored, Field, and Chipping sparrows, respectively. However, it is evident from Bent (1968), Friedmann (1963), and Friedmann et al. (1977) that parasitism rates vary greatly among these species. The similarity of rates among species in my study may reflect that they were nesting on the same area under similar situations.

Nest success and reproductive efficiency.—Known nest success (nests fledging young) was 37% for all sparrows combined but was lower for par-

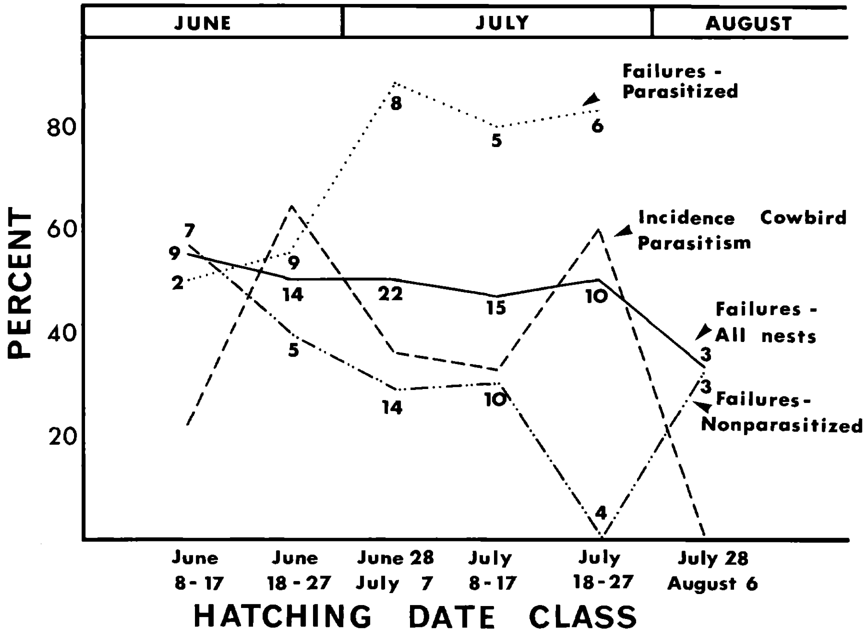

FIGURE 2. Seasonal distribution of known nesting failures and incidence of cowbird parasitism in sparrow nests in a southern Minnesota Christmas tree plantation. The numbers are the number of nests, e.g., for 8–17 June, two nests were parasitized, one of which failed.

asitized (17%) than for nonparasitized (51%) nests (Table 1). Data for the Clay-colored Sparrow on known nest success, reproductive efficiency (percent young fledged of eggs laid), and percent eggs hatched are similar in most cases to results summarized by Root (*in* Bent 1968) and Walkinshaw (1952 and *in* Bent 1968).

Most cowbird parasitized nests failed during the egg stage. Known reproductive efficiency of cowbirds was low and less than half that of their parasitized, sparrow hosts (Table 1). The low reproductive efficiency found for cowbirds (7%) is also lower than previous reports of 12–28% (O. M. Root and L. H. Walkinshaw *in* Bent 1968, Young 1963). This may be partly because we found numerous inactive, parasitized nests. The discovery of these nests reduced reproductive efficiency from what would have been found had we located nests by watching host females as is done in most other studies.

Probability of survival.—Over the incubation period, the probability of a nest surviving (survival of at least one egg or nestling) was .71 for all sparrows combined. Similarly the probability of an individual surviving was .68 in all sparrow nests. For cowbirds only, both values were .77. The nearness of these values reveals that if an individual is to survive, it will most likely survive along with its nest mates rather than be left by itself. Among 16 nest losses in parasitized sparrow nests, 12 were abandoned. Among 10 nest losses in nonparasitized sparrow nests, 8 were destroyed by predators.

The strength of the incubation stimulus may be proportional to the number of host eggs remaining: all 7 nests with no host eggs were abandoned; 4 of 8 nests with one host egg were abandoned; and only 1 of 15 nests with 2 or more host eggs were abandoned. These differences were significant (χ^2 = 10.67, 2 df, $P < .005$).

During the hatching stage, the probability of survival for nests and individuals was .95 and .79 for all sparrows combined. Thus during this stage, an individual was more likely to be lost by itself, rather than along with its nest mates. For cowbirds, both values were .53, much less than for their hosts. Only 10% of all sparrow eggs and 6% of cowbird eggs were infertile, similar to Rothstein's (1975) report of 9.7% for the Chipping Sparrow.

During the nestling stage, the respective probability of survival for nests and individuals was .74 and .72 for all sparrows combined; for cowbirds, both values were .42. As with the incubation period, the nearness of these values suggests that an individual was more likely to survive with its nest mates rather than be lost by itself. The probability of nest survival was lower in parasitized (.50) than in nonparasitized (.85) sparrow nests and survival was lower for cowbirds than for their hosts. Predators caused 6 of 10 nest losses in sparrow nests during the nestling stage.

During the incubation, hatching, and nestling periods combined, the probability of a sparrow surviving was substantially less for individuals in parasitized nests (.21) than in nonparasitized nests (.45). Also the probability of an individual cowbird surviving (.17) was lower than that of its sparrow hosts.

Clutch size.—The average clutch size for nonparasitized nests of Clay-colored, Chipping, and Field sparrows was 3.3, 3.0, and 2.9, respectively and that for cowbirds, 1.2. These clutch sizes are similar to those reported by Young (1963) and Bent (1968).

Mayfield (1965) examined the distribution of the number of cowbird eggs in nests from various studies and suggested that nonrandomness in some studies was a result of a failure to find nests abandoned early because of the presence of a cowbird egg. Because of our nest searching system, the distribution should be nearly random. From a sample of 73 nests of all sparrow species, 30 of which contained at least one cowbird egg, a Chi-square goodness-of-fit test with the Poisson distribution gave a satisfactory fit ($0.25 < P < .50$). Thus, these data support Mayfield's (1965) assertion that cowbirds randomly place their eggs in host nests.

Nest Site Attributes

The mean height of nest trees was 1.33 m (SE = .05), 1.43 m (SE = .05), and 1.42 m (SE = .08) for Clay-colored, Chipping, and Field sparrows, respectively (Table 2). However, the differences in nest tree height

TABLE 2. Location, concealment, and tree stocking† for nest sites of 3 *Spizella* species on a southern Minnesota Christmas tree plantation.

Species	Nests (N)	Nest height (m) Mean ± (SE)	Concealment[2] category 1 (N)	2 (N)	3 (N)	Tree stocking† (%) Mean ± SE
Clay-colored Sparrow	38	0.57a[1] ± .04	13	16	9	53 ± 3
Chipping Sparrow	11	0.74b ± .06	0	8	3	62 ± 4
Field Sparrow	10	0.44a ± .07	4	5	1	58 ± 6

[1] Values followed by the same letter are not significantly different at the .05 level of probability.

[2] 1 = not visible from any direction, 2 = visible from one direction, and 3 = visible from several directions.

† Refers to the percent of tree sites (the number of sites is defined by tree spacing goals) that had a tree present.

among bird species were not significant nor did nest trees differ in height or crown density from other trees in the vicinity of nests. Nest heights did differ among sparrow species. Chipping Sparrows nested significantly higher than Clay-colored or Field sparrows. Although absolute heights obtained in this study differ from those in the literature, the relative height of nests among species was similar (Walkinshaw 1944 and *in* Bent 1968; Messersmith 1963). No significant differences could be detected in nest concealment among sparrow species (Table 2).

Do parasitized and nonparasitized nests differ in their site attributes? One hypothesis is that cowbirds locate nests by watching for host nesting activity (Thompson and Gottfried 1981). If so, cowbirds could probably detect host nesting activity best about nests located in tall trees, at great heights, in close proximity to vantage points, and in open areas. Once activity was detected, cowbirds could locate nests easier if they were not well concealed and situated in trees of low crown density. None of these attributes differed significantly between parasitized and nonparasitized nests. However, the differences did coincide with the above expectations for all attributes except nest concealment and tree density near the nest. The fact that parasitized nests tended to be concealed better than nonparasitized nests suggests that detection of host nesting activity may be most important. Once detected, the activity could be used to zero in on the nest location. At some point then, the cowbird should switch from observation (to reduce the search zone) to nest searching behavior.

An alternative hypothesis is that cowbirds locate nests by searching trees, but this does not seem reasonable. There were about 25,500 trees on the study area. Assuming the location of all nests was known and a nest is at the proper stage for parasitism during a 5-day period, I calculated that there was one suitable nest for every 2300–5700 trees during June and July. If a cowbird spent 10 sec searching a tree and 2 sec flying between trees, it would take an average of 8–19 h of searching to locate a suitable nest during these months. If this hypothesis were true, the dominant activity of cowbirds would be searching for nests. Casual observations did not bear this out.

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