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NEST SITE SELECTION IN EASTERN BLUEBIRDS

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Factors affecting the choice of a suitable nesting site by birds are under strong selective pressures that favor individuals who choose sites where the chance of rearing a brood is greatest (Smith 1974, Gibo et al. 1976). Nests of cavity-nesting species have a greater likelihood of success than those of open-nesting species, but success rates of cavity-nesters may differ between natural (tree hole) and artificial (nest box) sites (Lack 1966). Thus, natural selection may favor any mechanism such as imprinting or learned behavior that leads to a preference for the natal type of nest site by birds successfully reared in those site-types.

The Eastern Bluebird (*Sialia sialis*) nests in tree cavities (Pinkowski 1976), nest boxes (Kibler 1969), crevices (Laskey 1971), and rarely in open, exposed situations (Sprunt 1946, Allaire 1976). Male bluebirds typically display at several nest sites, one of which is selected by the female for egg-laying (Krieg 1971); thus both adults of a nesting pair are involved in site selection and a predisposition toward the natal site-type may exist in males, females, or both. In this note I examine data obtained on a nesting population of bluebirds to see if individuals that were reared in artificial cavities tend to prefer these when selecting their own nesting sites.

The study area in southeastern Michigan has been described in detail elsewhere (Pinkowski 1976, 1977). Approximately 50 nest boxes were available in 1968-1977, and bluebirds nested in these as well as natural tree cavities. All birds reared in the study area were color-banded and their natal site-types were known. Other bluebirds entered the study area as adults, and most of these birds were probably raised in natural cavities because: (1) bluebird nests in natural cavities were frequently seen in areas adjacent to the study area; and (2) there were no extensive nest box projects within approximately 150 km of the study area, this distance being greater than that separating breeding and hatching locations of most bluebirds (Pinkowski 1971). In the analysis I consider each member of a nesting pair as a separate individual regardless of whether one or both birds were raised in the same type of site.

Of 324 bluebird nests in the study area, 295 (91.0%) were in artificial sites. Seventy-eight of 648 nesting birds, including 38 males and 40 females, were reared in artificial sites in the study area, and 68 (87.2%) of these birds nested in artificial sites. Likewise, 522 of 570 (91.6%) birds that were not reared in the study area

nested in artificial sites. Thus, the proportion of nests in artificial sites was not greater for birds reared in those site-types than it was for other birds, most of which were evidently reared in natural sites. Although slightly more males that were reared in artificial cavities nested in artificial cavities than was true of females (94.7% vs. 80.0%), a *G*-test for three-way tables (Sokal and Rohlf 1969:601-607) revealed that type of site used, known or presumed natal site-type, and sex were independent ($G = 6.3$, $df = 4$, $P > 0.1$).

For all birds of known age nesting in the study area, yearlings were more likely to use natural cavities than were adults (Table 1). Bluebirds nesting in the study area apparently preferred nest boxes to natural cavities (Pinkowski 1976), and this preference may explain the disproportionate number of natural sites used by yearlings. First-year males and females began nesting later than older birds (Pinkowski 1977), and possibly the yearlings were relegated to the less preferred, natural sites.

Individual bluebirds nested in both natural and artificial sites during the same or different seasons. One male nested three times in two different nest boxes in 1970 but twice in the same natural cavity in 1971. A female who hatched in a nest box in 1973 nested in a natural cavity in 1974 and a nest box in 1975. Another female who was reared in a nest box in 1974 used a natural cavity for her first nest in 1975 and a nest box for her second nest that year. During 1976 one of two female broodmates reared in a nest box nested for the first time in a natural cavity, whereas the other used a nest box; this same pattern was also noted that year for two male broodmates. Finally, a female who hatched in a nest box in 1976 nested in a natural cavity in 1977 after her first nest (which was in a nest box) failed. Altogether, six of eight site-type changes that occurred in the same nesting season followed an unsuccessful nest; this is not surprising in view of the strong dependency of site tenacity on nesting success in bluebirds (Pinkowski 1977).

The lack of a relationship between natal site-type and nest sites selected by bluebirds is similar to the findings of Cink (1976), who found no evidence for

TABLE 1. Relationship between age of nesting Eastern Bluebirds and type of site used for nesting.^a

Age	Natural site		Artificial site	
	No.	Percent	No.	Percent
Adult	5	4.2	112	95.7
Yearling	9	17.3	43	82.7

^a Based on birds of known age only; type of site used is dependent on age ($G = 5.9$, $df = 1$, $P < 0.05$ using Yates' correction for continuity).

imprinting on natal site-type in House Sparrows (*Passer domesticus*). Juveniles of cavity-nesting species frequently inspect nest cavities in fall, and young bluebirds sometimes carry nesting material into these sites (pers. observ.). Although the types of sites that are visited after the young are out of the nest could influence the site-types that are later preferred for nesting (cf. Brewer and Harrison 1975), the fact that bluebirds often use more than one type of site during a single season indicates that preferences established after fledging are not strong, if they exist at all.

In summary, age and previous nesting success are evidently the most important factors influencing nest site selection in this species. Imprinting or early learning relative to the natal type of site are not important, and the birds do not become unchangeably conditioned to one site-type.

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CHOICE OF HOST NEST BY THE BROWN-HEADED COWBIRD IN COLORADO AND WYOMING

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Patterns of brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) vary geographically, differing markedly between recently invaded ranges and the more arid western plains (see Friedmann et al. 1977). The western short-grass plains are the original range of this species before its recent range expansion following deforestation and agriculture (Friedmann 1963, Mayfield 1965). I present here observed patterns of brood parasitism from plains, foothills, mountain river valleys and mountain parks of north-central Colorado and south-central Wyoming, as studied in 1977 and 1978. I further attempt to relate these patterns to differences between these habitats and those of more recent ranges.

Of 21 species (869 nests), 7 species (76 nests) were parasitized. Fully 91% of the parasitized nests (69) belonged to Red-winged Blackbirds (*Agelaius phoeniceus*) and Brewer's Blackbirds (*Euphagus cyanocephalus*; see Table 1). Nests of the following species were unparasitized: Mourning Dove (*Zenaidura macroura*, 30 nests examined), Western Wood Pewee (*Contopus sordidulus*, 8), Olive-sided Flycatcher (*Nuttallornis borealis*, 1), Dusky Flycatcher (*Empidonax oberholseri*, 2), Western Flycatcher (*E. difficilis*, 1), Say's Phoebe (*Sayornis saya*, 8), American Robin (*Turdus migratorius*, 25), Yellow Warbler (*Dendroica petechia*, 7), Yel-

low-breasted Chat (*Icteria virens*, 1), Common Grackle (*Quiscalus quiscula*, 18), Lazuli Bunting (*Passerina amoena*, 1), Gray-headed Junco (*Junco caniceps*, 2), Brewer's Sparrow (*Spizella breweri*, 2).

I found one instance of parasitism for each of the following species: Solitary Vireo (*Vireo solitarius*, 3 nests examined), Warbling Vireo (*V. gilvus*, 2), and Lincoln's Sparrow (*Melospiza lincolnii*, 1 nest containing 1 cowbird egg and 2 nearly fledged sparrows). Two of the four nests of Northern Orioles (*Icterus galbula*) examined were parasitized.

Published records of cowbird parasitism indicate tyrant flycatchers, vireos, wood warblers and sparrows to be the principal hosts of the Brown-headed Cowbird over most of its range (Friedmann 1963, Friedmann et al. 1977). Parasitism of Red-winged and Brewer's blackbirds is local and generally reported from the western plains (Friedmann et al. 1977). Thus, cowbirds appear to parasitize related icterids more heavily in the semi-arid habitat to which they originally were confined. Most of the nests I examined were in areas inhabited by cowbirds at the time of European settlement (Bailey and Niedrach 1965, Marsh 1968). However, the pattern of parasitism appears to be no different in the plains and foothills than in the upper river valleys and mountain parks which, though similarly arid, are probably recently invaded ranges (see Cooke 1897, Sclater 1912). The 5 vireo nests (2 parasitized), 100 of the Yellow-headed Blackbird nests (2 parasitized), the Lincoln's Sparrow nest (parasitized), and 98 of 217 Brewer's Blackbird nests (21 parasitized) were probably from new ranges for the cowbird. All other nests almost certainly were from original cowbird range.

Availability of water could limit the production of