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NEST SITE SELECTION IN MOUNTAIN BLUEBIRDS

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ABSTRACT.—Nest site selection was analyzed for a Mountain Bluebird (*Sialia currucoides*) population using two different types of nest box in south-central Washington. The majority of adult females successful in fledging young during the previous year either returned to the same territory and nest box or selected the same type of nest box if they changed territories. If they were unsuccessful, adult females tended to change territories and box types. Most male and female bluebirds breeding for the first time selected the same type of box as housed their natal nest even though none of these birds returned to its natal territory. Nest site selection and breeding area fidelity were influenced by age, sex, previous breeding experience, and natal nest type.

Recently, Cink (1976) examined the degree to which nestling House Sparrows (*Passer domesticus*) imprinted on the type of structure housing their natal nest. Although he found no evidence that early learning or imprinting had any effect on nest site selection, females tended to choose hole-type nests over open nests. Other studies have shown that some species prefer a larger to a smaller nest box (Järvinen 1978) and that floor dimensions of a box can influence clutch size (Karlsson and Nilsson 1977). Jackson and Tate (1974) analyzed selection of artificial nest sites by Purple Martins (*Progne subis*), House Sparrows, and Starlings (*Sturnus vulgaris*) and found only slight differences related to interior and exterior colors, location, and materials from which the boxes were constructed. Lumsden (1976) reported that Starlings preferred small entrance holes and dark interiors.

Bluebirds, like all cavity-nesting species, are limited by availability of suitable nest sites. Many studies (e.g., Miller 1970, Power 1974) have shown that bluebird populations can be increased by placement of nest boxes in suitable habitat. Although much is known about the reproductive biology of bluebird populations (Power 1966, Peakall 1970, White and Woolfenden 1973, Pinkowski 1977a, 1979a), little has been published concerning nest box selection and breeding area fidelity (the tendency for birds to return to the territory used the previous breeding season). Pinkowski (1979b) analyzed breeding data for Eastern Bluebirds (*Sialia sialis*) using artificial and natural nest cavities and found that age and nesting success seemed to be the most important factors influencing nest site selection. Additionally, he concluded that imprinting on the natal type of nest site was not important.

I theorized that imprinting on the natal type of nest site would be important for secondary cavity-nesting species because of the scarcity of natural cavities and that species-specific differences could influence nest site selection. To test these theories, I examined breeding data for a Mountain Bluebird (*Sialia currucoides*) population using two different types of nest box and analyzed the influences of age, sex, previous breeding experience, and natal nest type on nest site selection.

STUDY AREA AND METHODS

The study area was located south of Bickleton and Cleveland, Klickitat County, Washington. Elevation ranges from 915 m near Bickleton on the north to 701 m in valleys running north-south. The northern edge of the study area is on the ecotone between ponderosa pine-Oregon white oak (*Pinus ponderosa-Quercus garryana*) forest and big sagebrush-bluebunch wheatgrass (*Artemisia tridentata-Agropyron spicatum*) steppe. Much of the land south of Bickleton and Cleveland is farmed with winter and spring wheat and with barley. Areas not cultivated are moderately grazed by cattle.

The two types of nest box were designated as either "old" or "new" indicating how long they had been present on the study area. The "old" boxes were first erected in 1966 and new boxes were added each year (J. Brinkerhoff, pers. comm.). These boxes resembled a small house with a peaked roof. The inside dimensions of the floor were 30 × 15 cm with an entrance hole diameter of 4.4 cm; the entrance hole was approximately 10 cm above the floor. The outside of these boxes had a blue roof and white sides; the interiors were not painted. All of the "new" boxes had inside floor dimensions of 12.7 × 12.7 cm with a 3.8-cm diameter entrance hole, the bottom of which was 14 cm from the floor. The "new" boxes were not painted. Both "old" and "new" boxes were made of wood. The number of "old" box types available was usually 50 (except for 41 in 1976) and "new" box types numbered 30–31. "Old" type boxes were placed on top of wooden fence posts and "new" type boxes were nailed to the

TABLE 1. Numbers of Mountain Bluebirds banded during the breeding season near Bickleton and Cleveland, Klickitat County, Washington.

Age and sex class	Year banded			Total
	1976	1977	1978	
AHY[a]-M[b]	7	3	1	11
AHY-F	38	38	19	95
L-U	216	201	64	481
Total	261	242	84	587

[a] AHY—after hatching year; birds banded as adults whose exact year of hatch is unknown. L—local; birds banded as nestlings.
[b] M—male; F—female; U—unknown.

sides of posts. All boxes were about 1.5 m above ground and were placed about 400 m from neighboring boxes. "Old" and "new" nest boxes were randomly interspersed throughout the study area. In the present study, reproductive success (clutch size, number hatched, number fledged) did not differ between "old" and "new" style boxes (Herlugson 1980).

From 1976 through 1978, I banded 587 Mountain Bluebirds (Table 1) and I recaptured 44 (7.5%) between 1977 and 1979 (Table 2). Recaptures included 8 (18.2%) males and 12 (27.3%) females banded as nestlings and 24 (54.5%) females banded as adults; no males banded as adults were recaptured. Three females banded as nestlings and four adult females were recaptured one time each in two separate years, giving a total of 51 recoveries on which the analyses that follow are based. Birds were aged with reference to date of capture. SY (second year) were birds that were banded as nestlings the preceding year. These birds were in their first breeding season and were used in the analysis of the influence of natal nest type on breeding nest type selection. ASY (after second year) included two groups of birds whose nest site selection was analyzed with respect to previous breeding experience and breeding success. One group is composed of birds banded as nestlings and recaptured in both their first (SY) and second breeding seasons. The other group is birds banded as adults and then recaptured in following years.

Two factors complicate the analysis of recaptures of adult (ASY birds with previous breeding experience) female Mountain Bluebirds. First, both Power (1966) and Pinkowski (1977a) reported that bluebirds frequently return to the general area and often reoccupy the nest box they used the previous breeding season. Breeding area fidelity must therefore be separated from selection of a nest box type. Second, breeding success is known to influence the degree to which birds return to territories or nest sites. Successful breeders often return to a former nest site (Freer 1979) or establish a territory within 100 or 200 m of the preceding year's territory (Darley et al. 1977, Harvey et al. 1979). Birds not raising young successfully may move long distances (Scott and Lane 1974, Freer 1979) and change types of nest site before attempting another brood (Pinkowski 1977a).

During the early stages of nest box selection and territory defense, Mountain Bluebirds often investigated more than one type of nest box. Once final selection of a box was made by the female and territory boundaries were established, the territory contained only one nest box.

RESULTS AND DISCUSSION

Of the 31 recaptures of females known to have previous breeding experience, 17 (54.8%) were using the same territory and the same box of the year before (Table 2) thus substantiating the findings of Power (1966) and Pinkowski (1977a). Seven (50.0%) of the 14 females nesting on a different territory selected the same box type and 7 selected a different box type. There was no difference ($t = 0.53$, $df = 12$, $P > 0.500$) in the distances moved by females using the same ($\bar{x} = 1.1 \pm 1.2$ km, range 0.3–3.6 km) or different ($\bar{x} = 1.5 \pm 1.1$ km, range 0.8–3.6 km) nest box type.

Breeding success seemed to influence both breeding area fidelity and choice of a nest box by females. I have breeding success records for 27 of the 31 adult females recaptured. Of 22 females who were successful in rearing at least one offspring the preceding year, 15 (68.2%) reoccupied the same territory and nest box, and only 7 (31.8%) changed territories. Five (71.4%) of these seven used the same type of nest box. Of five unsuccessful females, two returned to the same territory and box, and three changed territories, two of these also changing box type. Pinkowski (1979b) reported that 75% (6/8) of unsuccessful Eastern Bluebirds changed site-type.

TABLE 2. Territory and nest box selection by Mountain Bluebirds recaptured near Bickleton and Cleveland, Klickitat County, Washington.

Age and sex class	Territory and nest box selection at recapture			Total
	Same territory, same box	Different territory, same box type	Different territory, different box type	
SY[a]-M[b]	0	5	3	8
SY-F	0	8	4	12
ASY-F	17	7	7	31
Total	17	20	14	51

[a] SY—second year; birds banded as nestlings and recaptured in their first breeding season. ASY—after second year; birds with previous breeding experience.
[b] M—male; F—female.

Breeding area fidelity of SY birds differed from that of adults. Competition for territories usually resulted in younger, later-arriving males being forced to disperse from the natal area in order to establish a territory (e.g., Pinkowski 1977a). Selection may favor wide dispersal by SY females to prevent inbreeding, which can result in lowered breeding success (Bulmer 1973).

No second-year Mountain Bluebirds were recaptured on their natal territory (Table 2); therefore selection of a box type by SY bluebirds cannot be attributed to their faithfulness to a particular area. More SY females (8/12, 66.7%) and SY males (5/8, 62.5%) used the same type of box as housed their natal nest for their first breeding attempt, thus indicating that the natal box type did have some, although not significant ($\chi^2 = 0.04$, $P > 0.750$), influence on selection of a breeding box type. There was no significant difference ($\chi^2 = 0.01$, $P > 0.750$) between SY males and SY females in using the same box design or switching to one different from that of their natal nest. Of those individuals who changed box types, males changed from "new" to "old" once and from "old" to "new" twice, whereas all changes of box type by SY females were from "old" to "new." Pinkowski (1979b) reported that Eastern Bluebirds changed types of nest site both in one breeding season and individually in successive years.

SY males ($\bar{x} = 3.7 \pm 2.0$ km, range 1.0–7.0 km) dispersed slightly farther ($t = 0.31$, $df = 18$, $P > 0.500$) than SY females ($\bar{x} = 3.4 \pm 1.7$ km, range 1.5–7.3 km) from their natal site. SY females who used the same box type as their natal nest dispersed shorter distances ($\bar{x} = 2.9 \pm 1.2$ km, range 1.5–4.5 km) than those who changed box type ($\bar{x} = 4.4 \pm 2.2$ km, range 2.5–7.3 km); however, the difference was not statistically significant ($t = 1.55$, $df = 10$, $P > 0.100$). SY males who used the same ($\bar{x} = 3.8 \pm 1.9$ km, range 1.3–7.0 km) or a different ($\bar{x} = 3.2 \pm 3.1$ km, range 1.0–5.4 km) box type dispersed nearly equal distances ($t = 0.35$, $df = 6$, $P > 0.500$).

Nest site selection (using "site" to mean a territory and a nest box) in adult Mountain Bluebirds seems to depend primarily on previous successful breeding experience. Bluebirds tended to choose the same box type from year to year even though some successful birds changed breeding territories. Age would seem to influence nest site selection only in relation to previous experience.

The main difference between my results and those of Pinkowski (1979b) is the effects of early learning or imprinting on the natal nest site and how this influences nest site selection during the first breeding season. Although the two box types were dispersed throughout the study area in approximately equal proportions (1.3–1.6 "old":"new"), most (13/20, 65.0%; $\chi^2 = 1.8$, $P > 0.100$) of the Mountain Bluebirds recaptured in their first year of breeding selected the same box type as the one that housed their natal nest even though none of the birds was breeding on its natal territory. Sargent (1965), working with caged Zebra Finches (*Poephila guttata*), found that the habitat of the nest was important for first-time breeders and that information about the habitat was gained during the fledgling period. Bluebirds, unlike Zebra Finches, are somewhat restricted in their choice of nest locations by their cavity-nesting habit and therefore would not be expected to be influenced by the same selective pressures as those on a species that constructs its nest in more variable locations. A moderate degree of imprinting on the natal nest cavity coupled with well-developed natal area fidelity would be advantageous for bluebirds due to the scarcity of natural cavities. SY birds would return to the same area and seek the same or a similar type of cavity for nesting. If their natal cavity was occupied by parents or others, or was destroyed, the birds would be able to disperse and seek other types of cavities. Information on the type of nest cavity would probably be gained during the nestling and fledgling periods and, if the birds inspected cavities before fall migration (Pinkowski 1979b), the early learning experiences could be reinforced. Inspection of cavities in the fall may also serve to familiarize the birds with alternative nest sites.

One possible explanation for the differences between my results and Pinkowski's (1979b) could relate to the variety of site-types available to the bluebirds. Pinkowski (1979b) compared site selection between artificial and natural cavities which had generally similar internal dimensions and shapes (Pinkowski 1976) and which were located about the same height above ground (Pinkowski 1977b). The two types of nest box available to Mountain Bluebirds in my study were similar only in their relative location on top ("old" type) or near the top ("new" type) of fence posts, but otherwise differed in interior shape and size. These differences may have afforded a greater number of discriminable features on which selection could be based.

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RECENT PUBLICATIONS

Transactions of the Forty-fourth Federal-Provincial Wildlife Conference.—1980. Canadian Wildlife Service. 292 p. Paper cover. Source: Minister of Supply and Services [Ottawa, Canada]. The theme of this conference, "A national policy on wildlife," was the focus of policy statements, a keynote address, several lectures, and workshops. A complete record of the conference, this volume shows how much thinking has already gone into the formulation of a wildlife policy for North America.

Wildfowl 31.—G. V. T. Matthews and M. A. Ogilvie, eds. 1980. Wildfowl Trust, Slimbridge. 176 p. Paper cover. $10.00. Source: Administrative Officer, Wildfowl Trust, Slimbridge, Gloucestershire, GL2 7BT, England. The latest volume in this series (previously noted in *Condor* 78:278 and 82:42) contains 22 articles or reports about waterfowl or sandpipers. As compared with former issues, the articles show more attention to the biology of birds in nature, wider geographic scope, and less emphasis on studies at Slimbridge. In addition to scientific illustrations, the volume carries a color painting on the cover and a few drawings by Peter Scott.