BRIEF NOTE

The Influence of Habitat Characteristics on Nestbox Selection by Eastern Bluebirds (*Sialia sialis*) and Four Competitors[1]

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ABSTRACT. **During the breeding seasons of 1990-1992 and 1994, we examined how habitat characteristics surrounding nestboxes influenced nesting success of eastern bluebirds (*Sialia sialis*) and nesting attempts by tree swallows (*Tachycineta bicolor*), house wrens (*Troglodytes aedon*), bluebirds, house sparrows (*Passer domesticus*), and deer mice (*Peromyscus* spp.). Using linear regression analyses, significant positive correlations were detected between both the number of nesting attempts and nesting success of eastern bluebirds and the distance to the nearest tree >3.0 m tall. The number of house sparrow nesting attempts was positively associated with the distance to the nearest tree <3.0 m tall. Negative relationships were observed between both the distance of nestboxes to the nearest tree >3.0 m and <3.0 m tall and the number of nesting attempts by mice. Although the habitat requirements of these cavity-nesting species overlap, specific nest-site characteristics may influence both the number of nesting attempts and the nesting success of each species.**

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INTRODUCTION

The resurgence in eastern bluebird (*Sialia sialis*) populations is commonly attributed to the development of bluebird nestbox trails throughout the United States and Canada (Ehrlich et al. 1988). The establishment of nestbox trails not only creates additional nesting locations for bluebirds, but also allows for detailed studies on how nestbox placement influences nest success of bluebirds, and competition for nest sites by other secondary cavity-nesting species.

Although much research has been conducted in an attempt to quantify differences in habitat preferences among cavity-nesting species (e.g., Patterson 1969, Willner et al. 1983, Munro and Rounds 1985, Parren 1991, Pogue and Schnell 1994) and the degree of aggressiveness among interspecific competitors (e.g., Gowaty 1981, Eakin 1983, Belles-Isles and Picman 1986), the results have often been inconclusive, thereby making it difficult to ascertain where nestboxes should be placed in order to increase the nesting success of bluebirds. For example, neither Parren (1991) nor Scott et al. (1993) observed an effect of aspect on bluebird nestbox usage. However, Pinkowski (1976) found that more natural cavities used by bluebirds faced southeast than expected by chance, and Hsu and Humpert (1988) found that bluebird selection was influenced by perches located behind the box. In an effort to help clarify some of the conflicting results from previous studies, we examined the influence of habitat characteristics on the nesting success of eastern bluebirds and nestbox selection by tree swallows (*Tachycineta bicolor*), house wrens (*Troglodytes aedon*), bluebirds, house sparrows (*Passer domesticus*), and deer mice (*Peromyscus* spp.).

MATERIALS AND METHODS

In 1989, we erected 33 bluebird nestboxes of similar design in non-forested areas at Hiram College's James H. Barrow Biology Field Station in Hiram Township, OH. Nestboxes were approximately 12 cm wide x 15 cm deep x 24 cm high with a 2 cm radius entrance hole 3 cm from the top of the box. The majority of the boxes were placed in mowed areas with scattered trees or old fields ranging from one to seven years in locations that were thought to have the most potential for attracting bluebirds.

The nestboxes were monitored once- or twice-weekly during the springs of 1990 and 1991 (mid-April to mid-June), and the springs and summers of 1992 and 1994 (late-March to late-August). During each visit we recorded what species, if any, occupied the nestbox as well as the status of the nest effort (i.e., clutch size, nestling numbers, and fledgling numbers). In addition, if nest efforts failed, we tried to determine whether nests were deserted by the parents or preyed upon. The nesting attempts of eastern bluebirds were fully monitored, whereas attempts by other species were only periodically checked. In an attempt to maximize the nesting success of the native cavity-nesting bird species, we removed all house sparrow and mouse nests as soon as they were detected. After nest efforts by bluebirds, wrens, or swallows were completed, old nests were removed and the boxes cleaned.

In order to examine the influence of habitat characteristics on nesting attempts by all species and on the nesting success of eastern bluebirds (where a nesting attempt means at least one egg has been laid, and nesting success means at least one young fledged), the following data were recorded at each box: 1) distance to the nearest large tree (>3.0 m in height), 2) distance to the nearest small tree (<3.0 m in height), 3) distance to the nearest briar or shrub patch, 4) compass direction of the box opening, and 5) compass direction of the nearest tree

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in relation to the nestbox entrance. Simple linear regression analyses were performed, where Y = 0 if unsuccessful and Y = 1 if successful, to determine whether correlations could be detected between distances (X) to the nearest trees and shrubs and the number of nesting attempts or nest success. Chi-square tests were employed to determine if both compass direction of the box and compass direction of the nearest tree in relation to the box influenced the number of nesting attempts by each species and the number of successful bluebird nests.

RESULTS AND DISCUSSION

Eastern Bluebirds

During the four year study, 17 (41%) of 41 bluebird nesting attempts produced at least one fledgling. This percentage is lower than the 44% and 52% reported by Patterson (1969), 57% found by Pinkowski (1979), and 58% observed by Scott et al. (1993). However, Pinkowski (1979) observed annual variations from 32 to 76%.

The low nesting success of bluebirds may have been due in part to the occupation of nestboxes by house wrens. In this study, 7 (17%) of the 41 bluebird nesting attempts failed when wren nests usurped nestboxes and built nests on top of active bluebird nests. House wrens have been reported not only to build nests on top of bluebird nests (Rustad 1972), but also to destroy eggs and attack nestlings (Rustad 1972, Eakin 1983, Belles-Isles and Picman 1986).

Regression analyses revealed a significant positive relationship between the number of nesting attempts by bluebirds and the distance to the nearest large tree (Table 1). Boxes used by bluebirds at least once were a mean distance of 4.80 m from the nearest large tree, whereas unused boxes were situated on average 3.04 m from the nearest large tree (standard error = 1.15 m and 0.74 m, respectively). A more pronounced positive linear relationship was found between the number of successful bluebird nesting attempts and the distance to the nearest large tree (Table 1). Mean distance to the nearest large tree was 6.55 ± 1.88 m for boxes in which bluebirds produced at least one fledgling, and 2.67 ± 0.73 m for boxes in which bluebirds attempted to nest, but never were successful.

Our findings support those of Parren (1991), who reported that bluebird nest sites were located farther from high perches than unused sites. Bluebirds have also been reported to prefer areas with sparse or short ground cover and few trees (Willner et al. 1983, Munro and Rounds 1985, Pogue and Schnell 1994). Such habitats provide bluebirds with an extended field of view from perches (Parren 1991), which presumably aids them in finding food. We detected no significant effects of either compass direction of the box opening or compass direction of the nearest tree in relation to the nestbox entrance on bluebird nesting attempts or success.

Other Species

We detected a significant positive linear relationship between the number of house sparrow nesting attempts and the distance to the nearest small tree (Table 1). The mean distance of boxes used by sparrows to small trees was 9.17 ± 2.12 m versus 3.07 ± 0.77 m from unused boxes. However, we have read no reports that sparrows necessarily avoid nesting near small trees. Thus, the biological significance of this finding is unclear.

We found significant negative relationships between nestboxes selected by mice and the distance to the nearest large and small tree (Table 1). The mean distance to large trees was 3.70 ± 0.80 m from selected boxes, and 12.6 ± 3.22 m from unselected boxes. The mean distance to small trees was 3.13 ± 0.89 m from selected boxes, and 6.40 ± 1.20 m from unselected boxes. Hsu and Humpert (1988) found that deer mice usually chose boxes where vegetation was located close to the hole. One reason for selecting boxes close to trees is that it may be easier to access boxes by using tree limbs than climbing up poles. We found no significant effect of any habitat variable on tree swallow or house wren nesting attempts.

Conclusions

Although habitat requirements of many cavity-nesting species overlap (Parren 1991), specific habitat

TABLE 1

Results from simple linear regression analyses examining the relationship between both nesting attempts and nesting success of each species and the distance to the nearest large and small trees (alpha = .05). Because data were collected from 33 boxes, the error degrees of freedom for each test was 32.

	Trees >3 m				Trees <3 m			
	Slope	Int.	F	R^2	Slope	Int.	F	R^2
Eastern Bluebird Nesting Attempts	0.14	0.74	5.02	0.14	Not Significant			
Eastern Bluebird Successful Attempts	4.28	2.02	8.23	0.31	Not Significant			
House Sparrow Nesting Attempts	Not Significant				0.61	3.00	10.49	0.25
Mice Nesting Attempts	-0.37	4.97	6.42	0.17	-0.23	4.92	7.71	0.20

characteristics may influence both nesting attempts and nesting success of individual species. Our study is one of many that attempted to discern specifically what habitat characteristics influence which species, and recommend ways in which to enhance the nesting success of eastern bluebirds. Our findings regarding nestbox preferences indicated that: 1) eastern bluebirds attempted to nest and nested successfully more often in boxes farther from large trees; 2) house sparrows attempted to nest in boxes farther from small trees, and 3) deer mice attempted to nest in boxes close to both large and small trees.

One reason why so few significant results were observed is that nestboxes were erected with the intention of increasing bluebird abundance rather than addressing a particular research question. As a result, few factors were held constant, and comparisons among nestboxes often required examining several potentially important variables simultaneously. In addition, the study was unable to address how nesting by interspecific competitors may influence nestbox selection by other cavity-nesting species. We therefore conclude that in order to determine the habitat characteristics that influence nestbox selection and nesting success, there is a need for additional studies whereby nestboxes are placed in a controlled manner that is conducive to addressing questions regarding the habitat preferences of cavity-dwelling species.

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