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A STUDY OF POSSIBLE NICHE PREFERENCES OF CAVITY-NESTING BIRDS IN THE COLORADO ROCKIES

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INTRODUCTION

This study was initiated in order to examine the hypothesis that the availability of appropriate cavity sites may be a major limiting factor for some cavity-nesting bird species, as has been proposed for the Mountain Bluebird (*Sialia currucoides*) (Miller 1970, Barash 1976). Four objectives of the study were (1) to identify any preferences for cavity characteristics that may exist among a guild of eight species of birds, (2) to determine temporal patterns of utilization of cavities by each species, (3) to determine the extent to which intra- and interspecific competition for preferred cavities may occur, (4) to examine the extent to which the availability at appropriate times of preferred cavities may limit the reproductive success of any species in this area.

METHODS

The study was conducted at Snow Mountain Ranch--YMCA of the Rockies, from 20 May 1982 to 9 July 1982. This 1740-ha site is located approximately 130 km northwest of Denver and about 16 km south of Granby, in Grand County, Colorado. The elevation of the site is about 2600 m.

Trees along two established trails between 2500 m and 2800 m were examined

for habitable cavities. These trails passed through three forest plant communities: quaking aspen (*Populus tremuloides*), lodgepole pine (*Pinus contorta*), and aspen--lodgepole pine ecotones. Data were gathered for each cavity that was considered a potential nest site, and all cavity trees were marked, beginning on 20 May for easy relocation. Pole climbing hooks, standard measuring devices, and topographic maps were used at each cavity site to assist in obtaining the following data: forest community type, approximate canopy enclosure, elevation, condition of cavity tree (vigorous, dying, dead), diameter at breast height (DBH) of cavity tree, height of cavity tree, height of first lateral branch of cavity tree, height of cavity entrance, age of cavity (new=freshly excavated or 1 yr old; old >1 yr old), facing compass direction of cavity entrance. Measurements were made in English system units and converted to the metric system.

Cavity-trees, the majority of which were located in May, were visited regularly throughout the major portion of the nesting season (until 9 July) in order to identify cavity occupants and to determine the status of reproductive efforts. In many instances it was possible to examine the interior of of the cavity. When such examination was not practical, reproductive status usually could be determined from the behavior of mated pairs (e.g., carrying nest materials, frequency of foraging trips, etc.), and in several instances the presence of nestlings was confirmed when vocalizations were first heard, sometimes in response to tapping on the tree trunk. Approximate dates for each of the following segments of the reproductive cycles were recorded: initial occupancy and nest-building, incubation, rearing nestlings, and fledging.

Analysis of Variance (ANOVA) was the statistical test used to determine if significant differences existed among the bird species for each of the niche-parameters that we measured.

RESULTS

We examined 55 cavities that we judged to be habitable. These were located in 45 trees. Although pine trees and pine forests were thoroughly inspected, 40 of these trees were quaking aspens, and only five were lodgepole pines. Three additional cavities were found in buildings (lodges) constructed of rough timber. Thirty-seven of the 55 tree cavities (67%), and all three of the lodge cavities were occupied during some stage of this study.

All species of cavity occupants except European Starlings (*Sturnus vulgaris*) showed an apparent preference for aspen communities or aspen-lodepole ecotones (Table 1). Three of four pairs of starlings selected cavities in buildings, which was undoubtedly a reflection of their tendency to associate with human habitations rather than indicating a preference for the lodgepole pine forests in which these buildings were located. Canopy enclosure and elevation did not appear to influence cavity site selection on this study area.

Table 1. General community parameters at nest site locations for eight species of cavity nesting birds at Snow Mt. Ranch, Grand county, Colorado.

Bird Species	No. of Cavities	Floristic Community[a]	Canopy Enclosure[b] (%)	Mean Elevation[b] (m)
Northern Flicker	4	1 ASP 3 ASP-LP	31 (5-60)	2682
Yellow-bellied Sapsucker	7	3 ASP 4 ASP-LP	40 (10-70)	2685
Hairy Woodpecker	1	1 ASP—LP	10	2682
Tree Swallow	11	6 ASP 5 ASP-LP	44 (20-60)	2685
Mountain Chickadee	3	3 ASP-LP	47 (40-50)	2658
White-breasted Nuthatch	2	2 ASP-LP	55 (50-60)	2621
House Wren	8	3 ASP 5 ASP-LP	44 (20-60)	2673
European Starling	4	1 ASP 3 LP[c]	24 (5—70)	2621
Unoccupied cavities	18	2 ASP 1 LP 14 ASP-LP 1 SAM	39 (5—90)	2663

[a]ASP = aspen, LP = lodgepole pine, ASP-LP=aspen-lodgepole, SAM=subalpine meadow.

[b]Mean and range (in parentheses).

[c]Lodge area.

All bird species except starlings appeared to have a preference for cavity-sites in quaking aspen trees, but there was no detectable preference for living, dying, or dead trees, except for the apparent one shown by Yellow-bellied Sapsuckers (*Sphyrapicus varius*) for vigorous aspens (Table 2). Between-species comparisons (ANOVA) of possible preferences for tree size, as reflected by DBH and tree height, revealed no significant differences ($p>>.05$). Differences among species based upon the height of the lowest branch likewise were not significant, and 85% of all cavities were below the lowest branch.

Four parameters of cavity entrances were also examined (Table 3). Although mean heights of cavity entrances seemed to show that Northern Flickers (*Colaptes auratus*), Tree Swallows (*Tachycineta bicolor*), and European Starlings preferred higher cavities, these differences were not significant. The largest cavity-nesting species, the Northern Flicker, required cavity entrances with significantly larger horizontal diameters than all other species ($p<<.05$). Diameter of the cavity entrance was also significantly greater ($p<<.05$) for flicker nests than for unoccupied cavities. There were no other significant differences between species-pairs.

Members of the family Picidae excavated new cavities or occupied cavities that were excavated the previous year (and hence classified as “new” in Table 3). Other species required pre-existing cavities, and all cavities occupied by these five species were 2 yr old or older.

Table 2. Parameters of cavity trees at Snow Mt. Ranch, Grand County, Colorado.

Bird species	No. of Cav.	Tree Species & Cond.[a]	DBH[b] (cm)	Height of Tree[b] (m)	Height of First Branch[b] (m)
Northern Flicker	4	2 VA 1 MA 1 DA	26.7 (18.5—33.0)	12.5 (10.0—13.7)	8.4 (7.6—10.4)
Yellow-bellied Sapsucker	7	6 VA 1 DA	27.4 (20.3—38.4)	11.0 (9.8-13.7)	5.3 (2.3—9.1)
Hairy Woodpecker	1	1 VA	26.2	8.5	2.4
Tree Swallow	11	7 VA 2 MA 2 DA	29.7 (23.6—42.2)	11.8 (10.6—13.7)	6.1 (1.7-9.1)
Mountain Chickadee	3	1 VA 2 DA	21.6 (19.6—24.9)	10.5 (9.1—11.6)	5.1 (3.7—6.7)
White—breasted Nuthatch	2	1 VA 1 DA[c]	28.7 (27.4—29.7)	10.0	6.4
House Wren	8	4 VA 4 DA	26.9 (20.3—42.2)	10.4 (9.1-12.8)	6.5 (3.7-9.8)
European Starling	1	1 DA	18.5	10.0	7.8
Unoccupied cavities in aspens	13	7 VA 1 MA 5 DA	28.2 (18.3—33.5)	9.9 (7.0—13.7)	6.0 (1.8-8.5)
Unoccupied cavities in lodgepole pines	5	1 VP 4 DP	37.8 (25.7-44.7)	12.4 (9.1-19.8)	3.1 (1.5—5.5)

[a] L= living. M = dying, D = dead. A = aspen, P = pine.

[b] Mean and range (In parentheses).

[c] The crown of this tree had broken off.

Table 3. Parameters of cavity entrances at Snow Mt. Ranch, Grand County, Colorado.

Bird Species	No. of Cav.	Height of Cav. Entrance[a] (m)	Diameter of Facing Cavity[a] (cm)	Age[b]	Directions
Northern Flicker	4	5.8 (3.4—7.0)	8.4 (7.1-9.4)	2 new 2 old	S-1, SE-1. SSW—1, E-1
Yellow-bellied Sapsucker	7	4.1 (1.8-8.8)	4.6 (4.1-5.6)	7 new	SE-2, SW-1 SSW-l, NE-1
Hairy Woodpecker	1	2.8	4.8	1 new	SSW-1
Tree Swallow	11	5.5 (2.4-8.5)	5.3 (3.8—7.1)	11 old	S-6, SW-1 E-2, ENE—1 N-1
Mountain Chickadee	3	3.2 (1.6—4.6)	4.8 (4.6—5.1)	3 old	S-2, SSE-l
White-breasted Nuthatch	2	4.8 (2.7-6.9)	5.8 (5.6-6.1)	2 old	S-l, SE-1
House Wren	8	3.4 (1.3—5.8)	4.6 (2.8-5.6)	8 old	S-l, SSW-2 E—l. N—2 NW-1, NNW-l
European Starling	4	6.4 (3.1—10.2)	5.3 (4.1—7.9)	4 old	E-1, WSW-l W—1, NW—l
Unoccupied cavities in aspens	13	3.9 (2.4-6.7)	5.1 (3.6-7.6)	13 old	SW-5. E-2 SE—4, N—1 NW-1
Unoccupied cavities in lodgepole pines	5	4.6 (1.2—12.2)	6.1 (3.8—7.6)	5 old	S-2, SE-1 N—l, NW—1

[a] mean and range (in parentheses).

[b] new = freshly excavated or 1 yr old; old= >1 yr old.

For statistical analysis of orientation of cavity entrances 90-degree quadrants were assigned dummy values of 1-4. We found no significant differences among species for the facing directions of cavity entrances. When all cavity directions are considered collectively, 36 are facing some southerly direction, 14 some northerly direction, 7 directly east, and 1 directly west. When these bearings were assigned to the nearest of 16 cardinal compass directions the resulting distribution was far from uniform, i.e. the cavity orientations departed drastically from random compass directions (chi-square=63.3, p=0.005). Thus there was a collective preference, at least among the excavators of the cavities, for southerly directions and an avoidance of a westerly orientation.

As a result of a late spring (harsh weather, including snowfall, throughout May), the onset of reproductive activity may have been delayed in 1982. The

relative temporal pattern of the species, however, was probably preserved. The most striking niche differences among the eight species were associated with the timing of the onset of reproductive activities (Table 4). The earliest recorded breeding activity was in late May, when a pair of Hairy Woodpeckers (*Picoides villosus*) and a pair of European Starlings were both incubating. Incubation was first recorded for Yellow-bellied Sapsuckers during the first week of June, for Northern Flickers and Mountain Chickadees (*Parus gambeli*) during the second week, for House Wrens (*Troglodytes aedon*) during the third week, and for Tree Swallows during the fourth week. The onset of incubation was not determined for White-breasted Nuthatches (*Sitta carolinensis*), although one pair had nestlings by the first week in July, which indicates that they were also incubating during the latter part of June.

Because this study did not begin until 20 May, we obtained no data concerning the possible use of winter (shelter) cavities of permanent residents for summer nesting cavities.

Table 4. Temporal patterns of reproductive cycles[a] of eight species of cavity nesting birds at Snow Mt. Ranch, Grand County, Colorado.

	Dates					
Bird Species	20-31 May	1-7 June	8-14 June	15-20 June	22–30 June	1-8 July
Northern Flicker		CAV	INC	INC	NES	NES
Yellow-bellied Sapsucker	CAV	INC		NES	NES	
Hairy Woodpecker	INC	NES				
Tree Swallow	CAV				INC	INC NES
Mountain Chickadee	CAV	CAV	INC	INC	NES	NES
White-breasted Nuthatch						NES
House Wren			CAV	INC	NES	NES
European Starling	INC	NES	NES	NES FLG		NES

[a] CAV = cavity occupation, INC = incubation, NES = nestlings, FLG = fledglings.

Three pairs of Tree Swallows and one of Mountain Chickadees abandoned cavities, but these were not reoccupied by other birds. On the other hand, four trees were occupied simultaneously by two or more species. House Wrens and Tree Swallows shared one tree, House Wrens and Mountain Chickadees two others, and House Wrens, Tree Swallows, and Yellow-bellied Sapsuckers all nested in one tree. The only exception to this pattern of peaceful coexistence involved a pair of starlings and a pair of Violet-green Swallows (*Tachycineta thalassina*). These swallows, whose nest occupied a crevice in the wall of one of the cabins, were vigorously attacked by one of the

starlings. Although initially repelled, the starlings were raising young in this crevice only three weeks later.

The authors have kept summer checklists of the birds at Snow Mt. Ranch for eight of the past 11 years, including three of the past four summers. These checklists include two species of cavity nesters, Williamson's Sapsucker (*Sphyrapicus thyroideus*) and Mountain Bluebird (*Sialia currucoides*), that were not encountered during this study. Williamson's Sapsuckers are always of rare occurrence at Snow Mt. Ranch, and nesting pairs of Mountain Bluebirds, although common, occupied bird houses in the lodge area.

SUMMARY AND CONCLUSIONS

Niche differences for eight species of cavity-nesting birds were remarkably subtle. The species were minimally influenced by the various parameters that we measured for cavity trees and cavity entrances. Except for the requirement of Common Flickers for cavities with entrance sizes that are significantly larger than those for all other species, the data did not partition species with respect to preferences. Rather, there was considerable overlap of dimensions of cavities used by the eight species, and each appeared to be generally opportunistic with respect to selection of cavities.

The most pronounced differences between species had to do with temporal patterns of utilization of cavities. Although cavities were occupied on a "first-come—first-served" basis, there were no obvious advantages to early nesters with respect to gaining access to "choice" cavities. The late-nesting House Wrens and Tree Swallows apparently had numerous suitable cavities to choose from.

Apparently neither interspecific nor intraspecific competition for cavities occurred. Although four mated pairs of birds abandoned cavities, these cavities were never reoccupied. This suggests that cavities were not in short supply, and that abandonment was not the result of competition. Conversely, interspecific relations were characterized by harmony, with four trees occupied simultaneously by two or more species.

It is probable that the availability of suitable nesting cavities at appropriate times during the breeding season is not a limiting factor in this area for any of the eight species studied. This conclusion is based primarily upon the following considerations: (1) 18 cavities that were not occupied at any time during the study period did not differ significantly from the cavities used by any species except the Northern Flicker, (2) abandoned cavities were not reoccupied, and (3) no apparent interspecific nor intraspecific competition for cavities was detected. But, the apparent lack of competition reported in this study may not apply to other regions of the Rockies where these eight species coexist. The high availability of cavities at the Snow Mt. Ranch area obviously was associated with the presence of mature stands of aspens. In areas where such stands are not present, suitable nesting cavities may indeed be in short supply. Furthermore, The summer of 1982 was the first in which European Starlings appeared at Snow Mt. Ranch. It is therefore possible that interspecific relations among cavity nesting birds may become complicated in this area if an influx of the more aggressive starlings continues.

Finally, it should be noted that the results of this study concerning cavity preferences must be considered tentative for two reasons: 1) sample sizes were small, and 2) possible preferences concerning internal parameters of cavities were not studied.

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