Fauna Using Nest Boxes in Four Timber Types in Eastern Texas

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ABSTRACT.-occupancy of 240 nest boxes in pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forests (60 boxes in each forest type) were monitored for six years on the Stephen F. Austin Experimental **Forest, Nacogdoches County in eastern Texas. Three boxes were placed at twenty sites in each forest type. Initially, each site had a box with 3.2, 4.7, or 5.7 cm diameter entrance, but squirrels and woodpeckers enlarged entrances and altered diameters over time. A wide variety of birds, mammals, reptiles, amphibians, and arthropods used the nest boxes. Spiders and wasps used nest boxes more than any other fauna1 group. Tufted Titmice (*Parus bicolor),* Eastern Screech Owls (*Otus asio),* and Carolina Wrens *(Thryothorus ludovicianus)* were the only birds that we observed using nest boxes.**

Nest boxes have been widely used over the past three decades in North America to provide nesting sites for a variety of secondary cavity-nesting birds (Dunn et al. 1975; McComb and Noble 198 1; Willner et al. 1983; Toland and Elder 1987; **Blem and Blem** 199 **1; Caine and Marion** 199 **1). Most notable have been efforts to increase populations of Eastern Bluebirds** (*Sialia sialis)* (Kibler 1969; Zeleny 1976). European literature has abundant reports on the value of nest boxes to increase populations of cavity-nesting birds in forest habitats where dead trees and other sites for natural cavities have been eliminated by intensive forestry practices (MacKenzie 1949, 1952; Cohen 1963; Henze 1966; Campbell 1968; Stande 1968). The value of nest boxes to study avian biology has been known for many years (Lack 1955; Pulliainen 1977).

Most nest box studies have focused on areas where snags (standing dead trees) and natural cavities tend to be in short supply. We examined the occupancy of wooden nest boxes in four forest types in eastern Texas to evaluate how birds and other wildlife respond to artificial boxes in mature forest habitat. Our objectives were to explore differences in avian use rates by forest type and nest box entrance diameter.

Study Areas and Methods

Two-hundred-and-forty nest boxes were constructed from southern yellow pine (*Pinus* spp.) and were approximately 20 X 20 x 30 cm with a sloping roof attached to the box by hinges to facilitate examination of occupants. Boxes were constructed with 3 different entrance diameters (3.2, 4.7, and 5.7 cm; 80 boxes for each diameter). The back board of the box extended above and below the box chamber

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Table 1. Vegetation characteristics (mean ± SD) in mature stands of pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forest habitat where wooden nest boxes were studied on the Stephen F. Austin Experimental Forest in eastern Texas.

Vegetation variable	Pure pine (n = 20)	Pine-hardwood (n = 20)	Upland hardwood (n = 20)	Bottomland hardwood (n = 20)
Vegetation height (m)	30.0 (3.7)	27.4 (5.5)	20.6 (2.9)	27.1 (5.3)
Pine basal area (m^2/ha)	23.5 (3.9)	22.6 (7.3)	3.8 (3.6)	0.2 (0.5)
Hardwood basal area (m^2/ha)	0.2 (0.6)	4.0 (3.2)	15.6 (3.5)	18.5 (4.8)
Tree density (#/0.04 ha)	11.5 (3.6)	18.5 (9.6)	10.1 (3.2)	14.0 (3.6)
Canopy closure (%)	73.1 (11.1)	71.2 (14.3)	69.3 (13.8)	72.5 (13.0)
Ground cover (%)	2.9 (2.8)	3.5 (2.4)	3.5 (2.7)	9.6 (6.4)
Natural snags (#/0.04 ha)	0.8 (0.8)	0.7 (0.9)	0.7 (0.8)	1.1 (1.0)

6 cm to facilitate attachment to trees. All boxes were completely submerged into a tank containing wood stain and sealer to retard decay. A wooden dowel 10–12 cm in length was placed 3 cm below box entrances as a potential perch site.

Nest box trails were established in four forest types (mature stands of pure pine, pine-hardwood, upland hardwood, and bottomland hardwood forest habitats) on the Stephen F. Austin Experimental Forest (31°29′N, 94°47′W) in southern Nacogdoches County, Texas. Dominant trees (70+ years-old) within all forest types exceeded 50 cm in diameter at breast height and stand height ranged from 20 to 30 m depending on forest type (Table 1). Each study area (forest type) was at least 25 ha in size. Each trail (one per forest type) was generally circular and approximately 1,130 m in length. Twenty box sites approximately 56 m apart were located along each trail. At each box site we nailed three nest boxes (3.2, 4.7, and 5.7 cm diameter entrances) to trees, one box per tree. Trees with boxes were >26 cm diameter at box height (3 m above the ground), were devoid of vines, and were 5-l 0 m apart. Box entrance orientation to the nearest cardinal direction was determined using a spinner fixed to a piece of cardboard.

We checked all nest boxes for occupants during the winter (January), spring (March-May), and late summer (August-September). All nest boxes were cleaned of nest material, hymenoptera nests, and cobwebs during February of each year in an attempt to increase their acceptability to birds. Boxes were checked once per season unless a nest was found or recent activity was evident. These boxes were revisited to confirm the identity of the occupant and check for avian nesting during the spring season. To check boxes for occupants we used a ladder and a pole with a mirror attached to the end. The pole and mirror were adjusted so that the contents of the box could be seen in the mirror as the tip of the pole lifted the lid of the nest box. Initially, boxes were checked at night and during the day during each season. Nocturnal box checks revealed no additional information during the first year of the study and were discontinued for the remainder of the project.

We measured vegetation characteristics at all nest box sites on each trail (Table 1). We measured vegetation height to the top of the crown canopy with a clinometer, pine and hardwood basal areas with a l-factor metric prism (Avery 1967), and estimated percent canopy closure and percent ground cover with a 12 cm hollow tube (James and Shugart 1970). Live tree and snag density were measured within 0.04 ha circular plots centered on each box site.

Table 2. A 6 year cumulative total of occupants of 240 nest boxes in four forest types (UH-upland hardwood, BH-bottomland hardwood, PP-pure pine, and PH-pine hardwood) during spring, fall, and winter from 1987 to 1992 on the Stephen F. Austin Experimental Forest, Nacogdoches County, in eastern Texas.

	Cumulative total of nest boxes in which occupants were observed				
	Forest type				
Fauna	UH	BH	PP	PH	Total
Eastern Screech Owl *Otus asio*	0	0	4	0	4
Tufted Titmouse *Parus bicolor*	5	0	0	2	7
Carolina Wren *Thryothorus Iudovicianus*	1	1	0	0	2
Bird subtotal	6	1	4	2	13
Virginia opossum *Didelphis virginiana*	0	1	0	0	1
Eastern gray squirrel *Sciurus carolinensis*	1	3	0	0	4
Fox squirrel *Sciurus niger*	0	0	2	6	8
Southern flying squirrel *Glaucomys volans*	8	6	11	39	64
Mice *Peromyscus* spp.	0	2	1	0	3
Mammal subtotal	9	12	14	45	80
Broad-headed skink *Eumeces laticeps*	1	0	0	0	1
Texas rat snake *Elaphe obsoleta*	0	0	0	2	2
Gray tree frog *Hyla* spp.	4	8	2	0	14
Herptile subtotal	5	8	2	2	17
Spiders Araneae	483	398	351	311	1,543
Red wasps *Polistes* spp.	251	248	331	294	1,124
Mud daubers Sphecidae	17	60	54	37	168
Roaches Blattidae	42	59	32	20	153
Ants Formicidae	3	23	1	1	28
Other arthropods	14	6	7	3	30
Arthropod subtotal	810	794	776	666	3,046
Total occupants	830	815	796	715	3,156

Results

The 240 nest boxes received minimal use by birds (Table 2). Out of a possible 4,320 chances (240 boxes × 3 seasons × 6 years) to detect avian use of the boxes, birds were observed only 13 times. Eastern Screech Owls, Tufted Titmice, and Carolina Wrens were the only avian species observed using the nest boxes. These three species are fairly abundant in forest habitats of eastern Texas. Mammals, primarily southern flying squirrels (64 boxes used), were detected more often than

birds (80 out of 4,320 chances). Gray tree frogs (14 frogs) were the most frequently observed herptile (Table 2).

Spiders and red wasps were the most commonly observed species, occurring in 1,543 and 1,124 box checks, respectively (Table 2). Mud daubers and roaches were also fairly common box occupants. Other arthropods observed inside nest boxes included bumble bees, yellow jackets, hornets, moths, termites, harvestmen, millipedes, and centipedes.

For most fauna, there appeared to be very little difference in box use among forest types (Table 2). Southern flying squirrels appeared to make use of boxes to a greater extent in the pine-hardwood type than in other forest types. We did not compare avian use of boxes with different entrance sizes or forest types because so few birds were detected and because squirrels and woodpeckers quickly modified box entrance diameters on approximately 30 of the boxes.

Discussion

The utility of nest boxes for common species of birds within mature forests of eastern Texas appears to be low. Our mature forest study areas were not intensively managed and contained a substantial number of dead trees (Table 1). These snags usually contained cavities excavated by woodpeckers and likely provided habitat for many of the secondary cavity-nesting birds that were present. The nest boxes appeared to be very acceptable to red wasps and spiders as they were rapidly occupied by these arthropods.

Relative to cost, the overall value of our nest box effort for cavity-nesting birds was minimal. Materials and labor for each nest box plus installation costs totaled approximately $6.00. Thus, the initial cost for the creation of all four nest box trails was approximately $1,440. This cost does not include annual checking and cleaning of boxes nor trail maintenance. By the end of the sixth year of the study, many nest boxes were beginning to show signs of decay. Several boxes had to be replaced during the fifth year because of damage caused by falling limbs.

Use of nest boxes in forest stands where natural cavities are absent or limiting still has potential value for secondary cavity-nesting birds. Nest boxes are often used by secondary cavity nesters in regenerating pine plantations following clear-cutting (MacKenzie 1952; Dunn et al. 1975; Caine and Marion 199 1). American Kestrels (*Falco sparverius)* and swallows benefit from the addition of nest boxes if natural cavity sites are limiting (Hammerstrom et al. 1973; Holroyd 1975). Rare species that are cavity nesters may benefit from nest boxes even if cavities are relatively abundant in mature forests. Occasional use of a nest box by a rare species may yield significant benefits to the population. The use of nest boxes as a possible means to provide nest sites for birds and mammals that compete with Red-cockaded Woodpeckers *(Picoides borealis)* for cavities in mature pine habitat has the potential to be beneficial to the endangered woodpecker and needs investigation (Rudolph et al. 1990).

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