SPECIES USING RED-COCKADED WOODPECKER CAVITIES IN EASTERN TEXAS

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ABSTRACT.—Because of its ability to excavate cavities in living pines, the Red-cockaded Woodpecker (*Picoides borealis*) is a keystone species in the fire-disclimax, pine ecosystems of the southeastern United States. Many species representing multiple taxonomic classes are dependent on this woodpecker species for the cavities it creates. We examined the occupants of Red-cockaded Woodpecker cavities during spring, late summer, and winter. Cavities enlarged by other species of woodpeckers and unenlarged cavities were examined in two habitat conditions: loblolly (*Pinus taeda*)-shortleaf (P. *echinata*) pine and longleaf pine (P. *palustris*) habitats. Red-cockaded Woodpecker cavities provided cavity habitat for seven species of birds, two species of squirrels, skinks, frogs, spiders, moths, and numerous species of Hymcnoptera.

The Red-cockaded Woodpecker (*Picoides borealis*) is a cooperative breeder (Ligon 1970) that lives in family groups composed of a breeding pair and one to several helpers (Walters et al. 1988; Walters 1990). It excavates cavities into the heartwood of pines that typically are infected with red heart fungus (*Phellinus pini*) (Conner and Locke 1982; Hooper 1988; Hooper et al. 1991; Rudolph et al. 1995). Red-cockaded Woodpeckers are a keystone species of the fire-disclimax, pine ecosystem of the South because they are the primary species to excavate cavities in what can be an otherwise cavity-barren environment (Conner and Rudolph 1995). Cavity excavation by Red-cockaded Woodpeckers in live pines requires a relatively long period of time averaging 1.8 y in loblolly pines (*Pinus taeda*), 2.4 y in shortleaf pines (*P. echinnta),* and 6.3 y in longleaf pines (*P. palustris*) (Conner and Rudolph 1995). Thus, the cavities they create tend to be in high demand by other species (Dennis 1971; Rudolph et al. 1990b; Loeb 1993; Conner et al. 1996).

Red-cockaded Woodpeckers peck shallow excavations, termed resin wells, around their cavity entrances. Daily pecking at these sites causes a copious flow of pine resin from resin wells down the trunk of the pine (Ligon 1970). The combined effects of bark scaling and resin flow create a barrier against climbing rat snakes (*Elaphe obsoleta*) (Jackson 1974; Rudolph et al. 1990a), but this barrier has little deterrent effect against southern flying squirrels (*Glaucomys volans*), which are frequent users of unenlarged cavities (Rudolph et al. 1990b; Loeb 1993).

Pileated Woodpeckers (*Dryocopus pileatus*) enlarge many Red-cockaded Woodpecker cavities by expanding the cavity entrance tube and sometimes the cavity chamber by excavation. Occasionally, Pileated Woodpeckers fully excavate

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the cavity chamber and nest in what used to be a Red-cockaded Woodpecker cavity (Conner et al. 1991). Over a 9 year period Pileated Woodpeckers enlarged 55 Red-cockaded Woodpecker cavities on the Angelina National Forest in eastern Texas (Conner and Rudolph 1995). An average of 6.1 cavities were enlarged per year, representing 2.4 percent of the cavity trees present each year on the forest. The enlarged cavities created by this woodpecker provide cavity habitat for many other relatively large secondary cavity users.

Approximately 24 species of vertebrates are known to use Red-cockaded Woodpecker cavities (Dennis 197 1; Baker 197 1; Beckett 197 1; Hopkins and Lynn 1971; Jackson 1978; Harlow and Lennartz 1983; Rudolph et al. 1990b; Loeb 1993; Kappes and Harris 1995). Although the majority of these vertebrates use either enlarged or abandoned cavities, several such as Red-bellied (*Melanerpes carolinus*) and Red-headed (*M. erythrocephalus*) woodpeckers and southern flying squirrels appear to actively compete with Red-cockaded Woodpeckers for normal, unenlarged cavities. Previous studies typically evaluated cavity occupants during the woodpecker breeding season and not late summer and winter.

Our objective was to determine which species used enlarged and unenlarged Red-cockaded Woodpecker cavities during spring, late summer, and winter in Texas.

STUDY AREAS AND METHODS

The study was conducted on the Angelina (62,423 ha; 31°15′N, 94°15′W) and Davy Crockett (65,329 ha; 3 1°2 1 ‘N, 95°07′W) National Forests from March 1990 to October 199 1. We examined 11 Red-cockaded Woodpecker cavity-tree clusters in longleaf pine habitat and 17 clusters in loblolly-shortleaf pine habitat during daylight hours. Using Swedish climbing ladders, we climbed and examined approximately 230 cavity trees for occupancy during the spring (April and May) of 1990 and 199 1, the late summer (August to early October) of 1990 and 1991, and the winter of 1990-1991 (December 1990 to February 1991). Each cavity was examined once during each season. We lowered a small, high intensity light into each cavity chamber and determined cavity occupancy with an oval mechanics mirror mounted on a extendable handle. The presence of bird eggs of a particular species was assumed to indicate use by adults of the same species. We used presence of chewed pine needles and fresh flying squirrel feces as an indicator of flying squirrel use. Unchewed pine needles in an enlarged cavity indicated use by fox squirrels (*Sciurus niger*). We measured the entrance diameters of cavities for comparison with species use. Based on previous studies (Rudolph et al. 1990b, Loeb 1993), cavities were divided into those suitable for Red-cockaded Woodpecker use (entrance diameters < 7 cm in diameter) and those too enlarged to be of value to Red-cockaded Woodpeckers (entrances > 7 cm in diameter).

RESULTS AND DISCUSSION

A variety of vertebrates and invertebrates were observed using enlarged and unenlarged Red-cockaded Woodpecker cavities (Table 1). Although numerous species used Red-cockaded Woodpecker cavities, unoccupied (empty) enlarged and unenlarged cavities were still available in most clusters during spring, late summer, and winter (Table 2). Red-cockaded Woodpeckers preferred unenlarged cavities during all seasons. In only two of 369 instances did they use enlarged

Table 1. Wildlife species observed using enlarged and unenlarged Red-cockaded Woodpecker cavities in loblolly-shortleaf pine and longleaf pine forest types in eastern Texas during 1990 and 1991.

	Loblolly-shortleaf pine				Longleaf pine			
	Cavity entrance diameter				Cavity entrance diameter			
	< 7 cm (n = 502)		≥ 7 cm (n = 183)		< 7 cm (n = 295)		≥ 7 cm (n = 111)	
Cavity occupant	% use	(no.)	% use	(no.)	% use	(no.)	% use	(no.)
Southern Hying squirrel	19.3	(97)	26.8	(49)	29.5	(87)	16.2	(18)
Fox squirrel	0.0	(0)	3.3	(6)	0.0	(0)	1.2	(8)
Red-cockaded Woodpecker	48.0	(241)	0.5	(1)	42.7	(126)	0.9	(1)
Pileated Woodpecker	0.0	(0)	1.1	(2)	0.0	(0)	0.9	(1)
Red-bellied Woodpecker	0.8	(4)	0.0	(0)	0.3	(1)	0.0	(0)
Wood Duck	0.0	(0)	2.2	(4)	0.0	(0)	0.9	(1)
Eastern Screech-Owl	0.2	(1)	3.3	(6)	0.7	(2)	4.5	(5)
American Kestrel	0.0	(0)	0.0	(0)	0.0	(0)	0.9	(1)
Great Crested Flycatcher	0.2	(1)	0.0	(0)	0.0	(0)	0.0	(0)
Tufted Titmouse	2.0	(10)	3.3	(6)	0.0	(0)	0.9	(1)
Broad-headed skink	0.0	(0)	0.5	(1)	0.0	(0)	0.0	(0)
Gray treefrog	0.6	(3)	0.5	(1)	0.0	(0)	0.9	(1)
Spiders	0.2	(1)	0.5	(1)	0.0	(0)	0.0	(0)
Moths	0.2	(1)	1.1	(2)	0.0	(0)	0.0	(0)
Ants	0.2	(1)	0.5	(1)	0.3	(1)	1.8	(2)
Bees	0.0	(0)	0.5	(1)	0.0	(0)	0.9	(1)
Mud daubers	1.0	(5)	1.1	(2)	1.4	(4)	0.9	(1)
Wasps	1.6	(8)	1.6	(3)	2.4	(7)	1.8	(2)
Water in cavity	2.2	(11)	7.7	(14)	0.3	(1)	7.2	(8)
Empty	23.5	(118)	45.4	(83)	22.4	(66)	54.1	(60)

cavities, and these two instances occurred only during the late summer when group size is largest due to the presence of young of the year (Table 2).

Southern flying squirrels used unenlarged and enlarged Red-cockaded Woodpecker cavities regularly. Southern flying squirrel use of Red-cockaded Woodpecker cavities was highest during the woodpecker breeding season, dwindled by late summer, and increased slightly during winter (Table 2). The highest number of flying squirrels found in a cavity at one time was eleven and this occurred during the spring of 1990. The average number of southern flying squirrels observed in unenlarged cavities was 3.6 squirrels compared with 0.3 squirrels in enlarged cavities. Rudolph et al. (1990) and Loeb (1993) noted that southern flying squirrels preferred unenlarged Red-cockaded Woodpecker cavities.

American Kestrels (*Falco sparverius*), Eastern Screech-Owls (*Otus asio*), Wood Ducks (*Aix sponsa*), and fox squirrels were observed using cavities infrequently and typically used cavities which had both the entrance and cavity chamber enlarged. Kestrels, screech-owls, and Wood Ducks used cavities only during the spring for nesting whereas fox squirrels used cavities during all three seasons (Table 2). Cavities used by Eastern Screech-Owls and fox squirrels usually contained whole pine needles. Eastern Screech-Owls were observed in three cavities with entrances <7 cm in diameter, but the entrances of these three cavities had been slightly enlarged and were between 6.5 and 7 cm in diameter.

Pileated Woodpeckers, the species responsible for most of the cavity enlargement (Conner et al. 1991), were observed using enlarged cavities infrequently during spring and late summer (Tables 1 and 2). During spring 1990 Pileated

Table 2. Wildlife species observed using enlarged and unenlarged Red-cockaded Woodpecker cavities during spring, late summer, and winter in eastern Texas during 1990 and 1991.

	Spring				Late summer				Winter			
	Cavity entrances				Cavity entrances				Cavity entrances			
	< 7 cm (n = 290)		≥ 7 cm (n = 131)		< 7 cm (n = 329)		≥ 7 cm (n = 106)		< 7 cm (n = 17X)		≥ 7 cm (I? = 57)	
Cavity occupant	% use	(no.)	% use	(no.)	% use	(no.)	% use	(no.)	% use	(no.)	% use	(no.)
Southern flying squirrel	36.6	(106)	38.2	(50)	12.2	(40)	11.3	(12)	21.3	(38)	8.8	(5)
Fox squirrel	0.0	(0)	3.1	(4)	0.0	(0)	3.x	(4)	0.0	(0)	10.5	(6)
Red-cockaded Woodpecker	42.4	(123)	0.0	(0)	52.0	(171)	1.9	(2)	40.0	(73)	0.0	(0)
Pileated Woodpecker	0.0	(0)	0.8	(1)	0.0	(0)	1.9	(2)	0.0	(0)	0.0	(0)
Red-bellied Woodpecker	0.3	(1)	0.0	(0)	0.0	(0)	0.0	(0)	2.2	(4)	0.0	(0)
Wood Duck	0.0	(0)	3.X	(5)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
Eastern Screech-Owl	1.0	(3)	x.4	(11)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
American Kestrel	0.0	(0)	0.8	(1)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
Great Crested Flycatcher	0.3	(1)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
Tufted Titmouse	2.4	(7)	5.3	(7)	0.0	(0)	0.0	(0)	1.7	(7)	0.0	(0)
Broad-headed skink	0.0	(0)	0.8	(1)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
Gray treefrog	0.0	(0)	0.0	(0)	0.9	(3)	1.9	(2)	0.0	(0)	0.0	(0)
Spiders	0.3	(1)	0.8	(1)	0.0	(0)	0.0	(0)	0.0	(0)	0.0	(0)
Moths	0.0	(0)	0.0	(0)	0.3	(1)	1.9	(2)	0.0	(0)	0.0	(0)
Ants	0.7	(2)	0.8	(1)	0.0	(0)	1.9	(2)	0.0	(0)	0.0	(0)
Bees	0.0	(0)	0.8	(1)	0.0	(0)	0.9	(1)	0.0	(0)	0.0	(0)
Mud daubers	0.3	(1)	0.0	(0)	1.5	(5)	0.0	(0)	1.7	(3)	5.3	(3)
Wasps	0.3	(1)	2.3	(3)	2.4	(8)	1.9	(2)	3.4	(6)	0.0	(0)
Water in cavity	1.4	(4)	7.6	(10)	0.9	(3)	2.x	(3)	2.x	(5)	15.8	(9)
Empty	13.X	(40)	26.7	(35)	29.X	(98)	69.X	(74)	25.8	(46)	61.4	(34)

Woodpeckers successfully fledged two young from an enlarged Red-cockaded Woodpecker cavity. Baker (1971) mentioned Pileated Woodpecker use of enlarged Red-cockaded Woodpecker cavities but did not mention whether nesting was involved. Red-bellied Woodpeckers used only unenlarged cavities during spring and winter. Tufted Titmice *(Parus bicolor)* used both unenlarged and enlarged cavities during spring for nesting and winter for nocturnal roosting. Great Crested Flycatchers (*Myiarchus crinitus*) were detected only once using an unenlarged cavity during spring as a nest site.

Mud-daubers (Sphecidae) were typically found in inactive cavities. Their mud chambers were tolerated or pecked off when Red-cockaded Woodpeckers began to use a cavity containing mud-dauber nests. The presence of mud-daubers or their nests did not appear to interfere with Red-cockaded Woodpecker use of cavities. However, the presence of paper wasps (Vespidae) with particularly large paper nests and honey bees *(Apis mellifera*) prevented Red-cockaded Woodpecker use of cavities.

Broad-headed skinks (*Eumeces laticeps)* and gray tree frogs *(Hyla versicolor/ chrysoscelis)* were observed occasionally within inactive enlarged and unenlarged cavities and, to our knowledge, have not been previously reported to use Red-cockaded Woodpecker cavities. In South Carolina, Dennis (1971) and Harlow and Lennartz (1983) reported that Red-headed Woodpeckers, Eastern Bluebirds *(Sialia sialis*), Northern Flickers *(Colaptes auratus*), White-breasted Nuthatches *(Sitta carolinensis),* and European Starlings (*Sturnus vulgaris)* used Red-cockaded Woodpecker cavities during **the** spring. We did not detect any of these species using Red-cockaded Woodpecker cavities during spring, **late** summer, or winter.

In summary, the Red-cockaded Woodpecker is a keystone species within southern pine ecosystems. It provides cavities for many secondary cavity users, and provides sites that Pileated Woodpeckers can enlarge which are in turn used by larger secondary cavity users. The continued existence of this endangered woodpecker in the South is crucial for the maintenance of cavity habitat. Without this woodpecker, the pine ecosystems of the South could suffer a substantial loss of biodiversity.

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