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FORAGING HABITAT OF THE RED-COCKADED WOODPECKER ON THE D'ARBONNE NATIONAL WILDLIFE REFUGE, LOUISIANA

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Abstract.—Red-cockaded Woodpecker (RCW) recovery plan guidelines were evaluated by examining habitat use of foraging RCWs on the D'Arbonne National Wildlife Refuge, Louisiana. During the non-breeding period, RCWs used the largest available live pines (≥17 m in height), in the oldest stands (mean age >72 yr), with the highest pine frequency (90–100%), and lowest hardwood basal area (<1 m^2/ha). Foraging in dense stands of large pines may allow RCWs to maximize available foraging surface and minimize travel time between foraging patches. During the breeding period, RCWs foraged on smaller pines in stands with a higher proportion of hardwoods. Thinning of selected stands to increase pine basal area and acquisition of an additional 347 ha of upland pine habitat is recommended to meet recovery plan foraging habitat guidelines and to facilitate maintenance of this small isolated RCW population.

HABITAT DE FORRAJEO DE *PICOIDES BOREALIS* EN EL REFUGIO SILVESTRE NACIONAL D'ARBONNE, LOUISIANA

Sinopsis.—Se evaluaron las directrices del plan de recuperación de *Picoides borealis* (RCW) al examinar el uso del habitat por RCW activos en el Refugio Silvestre Nacional D'Arbonne, Louisiana. Durante el período no reproductivo, RCW utilizaron los pinos más grandes disponibles (≥17 m altura) en los lotes más antiguos (edad promedio >72 años), con la mayor frecuencia de pinos (90–100%) y la menor área basal maderera (<1 m^2/ha). Alimentarse en lotes densos de pinos grandes puede permitir que los RCW maximicen la superficie de forrajeo disponible y minimicen el tiempo de viaje entre parchos de alimentación. Los RCW forrajearon en pinos más pequeños de lotes con una mayor proporción de dicotiledoneas maderables en períodos reproductivos. Se recomienda la limpieza de lotes selectos de pinos para aumentar el área basal del pino y la adquisición de 347 ha adicionales para satisfacer los requisitos de hábitat de forrajeo del plan de recuperación y para hacer fácil que se mantenga esta pequeña pobiación aislada de RCW.

The Red-cockaded Woodpecker (*Picoides borealis*) is declining throughout its range, including parts of Florida (James 1991), Texas (Mitchell et al. 1991), and south Arkansas (James and Neal 1989). Population increases have been reported in Louisiana. However, these apparent increases are probably the result of increased survey effort, not actual population increases (Smith and Martin, in press). The number of Red-cockaded Woodpeckers (RCW) in Louisiana is almost certainly substantially lower than during pre-European times (Smith and Martin, in press).

Although RCWs prefer mature live pines in open upland stands (Hooper and Lennartz 1981, Morse 1972, Porter and Labisky 1986), habitat selection varies regionally. In central Florida, RCWs preferred pines from 12–16 cm dbh (diameter at breast height) and spent 19% of their time foraging in cypress domes during the fall (Delotelle et al. 1983). During the winter in Mississippi, RCWs forage in dead pines and hardwoods up

to 33% of the time (Ramey 1980). Observations on the D'Arbonne National Wildlife Refuge in Louisiana suggest significant RCW use of bottomland hardwoods (L. Fulton, refuge manager; J. A. Jackson, pers. comm.) Because of regional variation in habitat use, site-specific studies are needed to determine the applicability of habitat management guidelines in the RCW recovery plan (U.S. Fish and Wildlife Service 1985).

STUDY AREA

The 265-ha study area is located on the eastern edge of D'Arbonne Nation Wildlife Refuge (DNWR) in northeast Louisiana. DNWR is dominated by loblolly pine (*Pinus taeda*) with sweet gum (*Liquidambar styraciflua*), shortleaf pine (*Pinus echinata*), willow oak (*Quercus phellos*), and water oak (*Q. nigra*) as subdominants. Although most of the study area is upland, seasonally flooded bottomlands dominated by hardwoods occur along the western and southern boundaries of the study area and in finger-like drainages that periodically divide the uplands.

The RCW population on the DNWR consists of 18–22 birds including 4–5 breeding pairs located in two upland tracts along the eastern edge of the refuge. The study area included only the larger southern tract with 12–14 birds representing three breeding pairs. No data were available on the number of RCWs on private timber-producing lands to east of the refuge. However, the occasional observation of unbanded adults on the refuge suggests that some RCWs exist on surrounding private lands. Since 1981, prescribed burns, physical removal of understory, and thinning of selected stands has been conducted in accordance with habitat guidelines in the RCW recovery plan.

METHODS

We delineated forest stands based upon similarity in species composition, dbh, and density (Hansen and Churchill 1964). Transect lines 120 m apart were established through all suitable RCW habitat within 1600 m of active clusters except where major highways, private timber lands, or perennial flooding precluded access. In each stand, 20 sampling points were established at random intervals along transect lines and the point-centered quarter method (Mueller-Dombois and Ellenberg 1974) used to quantify tree species occurrence, height, height to lowest limb, dbh, and crown shape (cone, parabola, cylinder). Each week all transect lines were walked sequentially from a randomly selected starting point. Each census consisted of a 5-h morning and 5-h evening period on 2 successive days. Each time a foraging RCW was observed, location, tree species, height, height to lowest limb, tree dbh, crown shape, RCW position in tree (limb,

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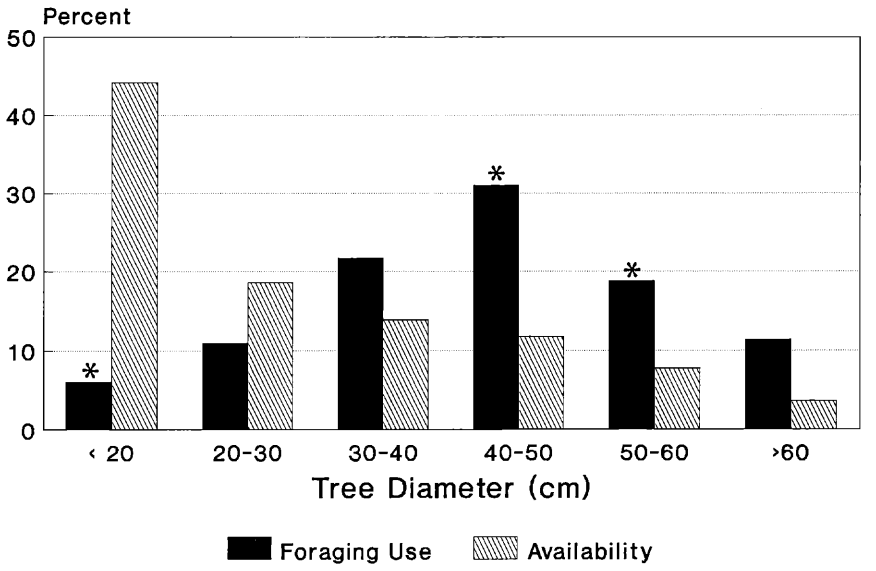
FIGURE 1. Red-cockaded Woodpecker use and availability of trees by height class and diameter at D'Arbonne National Wildlife Refuge, Louisiana, 1992–1993. An asterisk indicates that use differed significantly from availability ($P \leq 0.05$).


Percent
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< 20
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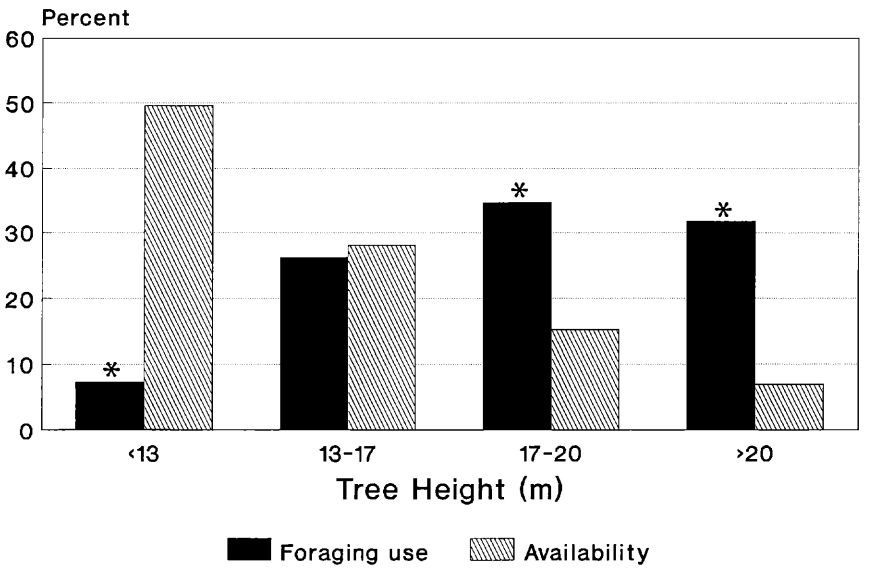
40-50
50-60
>60
Tree Diameter (cm)
Foraging Use
Availability


Percent
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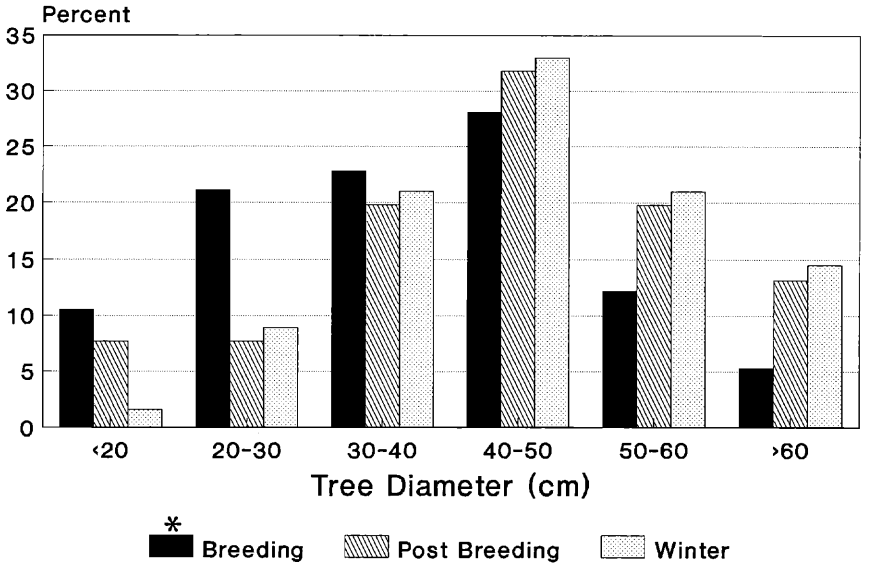
Tree Height (m)
Foraging use
Availability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Tree Diameter (cm)
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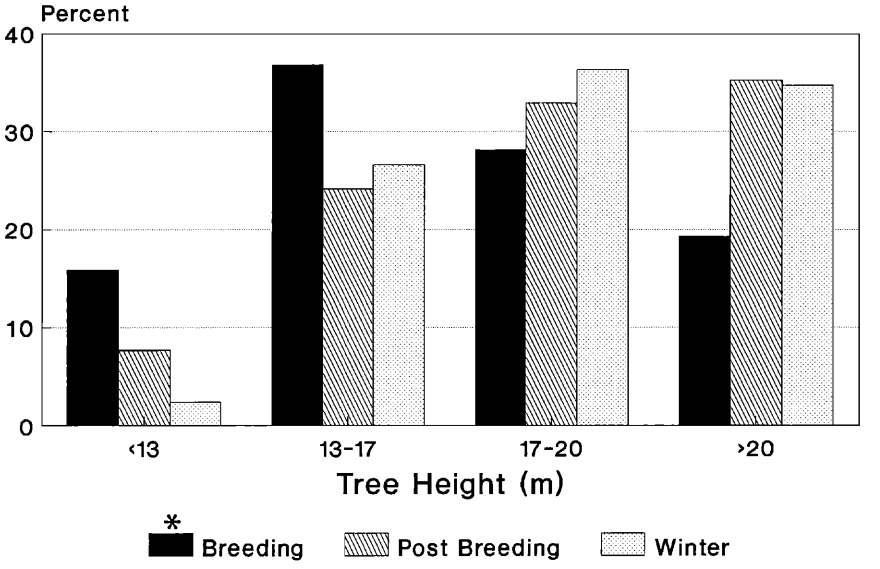
Breeding
Post Breeding
Winter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Tree Height (m)
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Breeding
Post Breeding
Winter

below crown, or in crown), group size, date, time, and weather were recorded. A use-availability ratio was used to compare RCW stand use with availability (Hooper and Harlow 1986).

Analysis of variance (ANOVA) and Tukey's range tests were used to compare RCW foraging site characteristics among seasons (breeding season = April–June, post-breeding = July–September, winter = October–March). The Kolmogorov-Smirnov two-tailed test was used to compare habitat use with availability. For analysis, forest stands were grouped into four age categories, 0–30, 31–40, 41–59, and >60 yr (Ramey 1980). The effect of weather and habitat characteristics on RCW stand use and habitat selection was determined by ANOVA and regression analysis. A Student's *t*-test was used to compare the mean distances from RCW foraging locations and from random points to the nearest road, stand edge, and gas well.

RESULTS

The 200.1 ha of upland and 80.7 ha of bottomland hardwood habitat within the study area were divided into 41 stands ranging in size from 0.53–24.00 ha and age from 10–90 yr. Between 11 Aug. 1992 and 14 Oct. 1993, 78 censuses resulted in 272 RCW foraging observations. RCWs selected pines in significantly greater proportion (90.0% vs. 64.0%) and hardwoods in significantly smaller proportion (6.9% vs. 36.0%) than their availability ($\chi^2 = 84.9$; df = 1; $P = 0.05$). Pines <17 m in height and 40–60 cm dbh received significantly higher use than their availability. Foraging tree selection by dbh ($F_{2,269} = 8.29$, $P = 0.0003$) and height class ($F_{2,269} = 6.8$, $P = 0.0013$) was significantly different by season (Fig. 1). During the breeding season, RCWs concentrated their foraging effort on relatively small trees <40 cm dbh and <17 m in height when compared to the post-breeding and wintering periods (Fig. 2). Dead trees were used in greater proportion (2.9% vs. 0.8%) than their availability.

RCWs were observed foraging in 36 of 41 available stands. Stand use frequency (corrected for unequal sampling effort across stands) increased with stand age ($F_{3,29} = 3.00$, $P = 0.046$) and pine frequency ($F_{1,31} = 4.23$, $P = 0.048$). Eight percent of the foraging observations were made in hardwood stands. The five stands that received no use were either young pine stands (<30 yr old) or mature hardwood stands. On nine occasions RCWs were observed foraging on privately owned timber lands along the eastern boundary of the study area.

During the breeding season, RCWs foraged at a mean distance of 292.5 m from the nearest cluster site, which was significantly closer ($t = -3.17$, df = 269, $P = 0.002$) than the non-breeding distance of 401.8 m. How-

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FIGURE 2. Red-cockaded Woodpecker use of trees by height and diameter class per season at D'Arbonne National Wildlife Refuge, Louisiana, 1992–1993. An asterisk indicates that use differed significantly by season ($P \leq 0.05$).

ever, no significant differences were found in stand distribution by age class with regard to distance from the nearest cluster. The mean distance from RCW foraging locations and an equal number of random points to the nearest gas well (116.9 m and 119.6 m, respectively) were not significantly different. However, RCW's foraged at a mean distance of 66.3 m from the nearest road, which was significantly less ($t = -3.43$, df = 532, $P = 0.0005$) than the mean distance of 82.9 m from random points. The mean distance of 33.9 m to the nearest stand edge was significantly closer ($t = -2.94$, df = 532, $P = 0.005$) than the mean of 41.0 m from random points.

DISCUSSION

Red-cockaded Woodpeckers on DNWR concentrated their foraging effort in the largest and tallest available pines. Hooper and Lennartz (1981) hypothesized that RCWs select larger trees over smaller trees because (1) the larger bark flakes detach easily and are capable of supporting larger insect prey, and (2) larger trees have greater structural diversity and surface area capable of supporting larger insect populations. Jackson (1979) found that insect abundance on individual trees is associated with tree size and surface area, bark texture and thickness, and number of live and dead branches. Thus, older loblolly pines with their large surface area, bark flake size, and structural diversity probably maintain a higher insect biomass than younger pines. RCWs, by concentrating their foraging effort on larger pines, may minimize the time and energy spent searching for new foraging patches.

RCWs on DNWR concentrated their foraging effort in older stands with the highest (90.0%–100.0%) pine frequency. Hooper and Harlow (1986) also reported that RCW foraging use decreased in stands as hardwood basal area increased. By concentrating their foraging effort in pure pine stands, RCWs may minimize the time spent traveling and searching for new foraging trees.

During the breeding season, RCWs foraged more frequently on smaller pines and hardwoods than during the non-breeding periods. RCWs foraged more closely to cluster sites during the breeding season than during non-breeding periods. However, stand availability by age class was constant with regard to distance from the cluster. Use of smaller trees by RCWs may be associated with seasonal variation in insect abundance, as in Downy Woodpeckers (*Picoides pubescens*) (Conner 1981). Or, as social conflicts increase during the breeding season (Bent 1939), RCWs may use smaller trees for their value as open display sites near territory boundaries or nesting trees.

RCWs did not appear to avoid habitats near oil production sites. The lack of movable or motorized parts probably make well sites unobtrusive to foraging RCWs.

MANAGEMENT IMPLICATIONS

Foraging habitat used by RCWs on DNWR is consistent with that reported in other studies and summarized in the RCW recovery plan. Re-

covery plan guidelines based upon these habitat characteristics appear applicable to DNWR. However, comparison of these habitat guidelines to the foraging habitat characteristics at DNWR reveal two areas of concern: (1) limited availability of foraging habitat, and (2) low pine density and basal area in the available foraging habitat. According to the recovery plan, one RCW clan needs 81–162 ha of pine and pine-hardwood forest to meet its foraging and nesting needs (U.S. Fish & Wildlife Service 1985). The study site on DNWR contains only 139 ha of pine and pine-hardwood habitat to support three clans. RCWs are occasionally sighted on privately owned timber lands to the east of the refuge and in isolated pine stands to the north of the study area. The dependence of DNWR's RCW population on foraging habitat outside of the refuge makes it vulnerable to continued timber harvest on adjacent private lands. The acquisition of management rights through purchase or easement of an additional 347 ha of suitable pine foraging habitat adjacent to the north and east boundary of the refuge might provide adequate foraging habitat to support the current RCW population.

The recovery plan recommends that ≥ 45.2 m^2/ha of pine and pine-hardwood basal area be available in each RCW cluster, yet only 24.2 m^2/ha of pine and pine-hardwood basal area exist within the study area. The recovery plan also recommends that 21,250 pine stems are needed in the foraging area, yet there are only 6650 pine stems within the study area. An increase in pine density and basal area could be accomplished by removing hardwoods remaining after burning, thinning to increase pine growth rates, and acquiring additional upland acreage.

In addition to the lack of suitable foraging habitat, the small isolated RCW population on the DNWR may also be threatened by loss of allelic variation (Stangle et al. 1992) and lack of suitable cavity trees (Lennartz et al. 1983). Thus, the introduction of RCWs from other populations, the maintenance of suitable cavity trees, and the acquisition of additional foraging habitat may all be necessary to assure the long-term viability of this population.

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