

FORAGING HABITATS OF WOODPECKERS IN SOUTHWESTERN VIRGINIA

BY RICHARD N. CONNER

Recently much attention has been given to nesting habitat requirements of woodpeckers (Bull, 1978; Conner, 1978). Although nesting requirements may be the most important management consideration in some geographical regions, foraging habitat requirements should not be overlooked. At present, few quantitative data exist that would permit forest managers to provide suitable habitat for woodpecker foraging. Several recent studies have described aspects of woodpecker foraging habitat (Conner and Crawford, 1974; Balda, 1975; Hardin and Evans, 1977; McClelland, 1979). The present investigation provides information on foraging habitats used by six woodpecker species in southwestern Virginia.

STUDY AREAS

Most of the study area consisted of a 20-km² plot located on the upper Craig and Poverty Creek drainages of the Jefferson National Forest. Chestnut (*Quercus prinus*) and red (*Q. rubra*) oaks and hickories (*Carya* spp.) covered 60% of the area and stands consisting primarily of oaks and pines (*Pinus* spp.) covered another 20% of the area. Stands of yellow poplar (*Liriodendron tulipifera*), white oak (*Q. alba*), and northern red oak, and stands of Virginia (*P. virginiana*), white (*P. strobus*), and pitch (*P. rigida*) pine, both occupied approximately another 10% of the area. A wide range of cover types and successional stages resulting from clear-cutting was present (see Conner et al., 1975, for detailed description of the study areas).

The second part of the study area was located adjacent to the town of Blacksburg and the Virginia Polytechnic Institute and State University campus. This nonforest area was primarily in pasture and included six mature woodlots (250–350 yr old and 0.5–20 ha) of oaks and hickories. In most of the woodlots grass was the only ground cover. Red-headed Woodpeckers (*Melanerpes erythrocephalus*) nested and foraged regularly in these areas (Conner, 1976), whereas the other five woodpecker species nested or foraged there occasionally.

METHODS

Foraging habitats of Downy (*Picoides pubescens*), Hairy (*P. villosus*), Pileated (*Dryocopus pileatus*), Red-bellied (*Melanerpes carolinus*), and Red-headed woodpeckers and Common Flickers (*Colaptes auratus*) were studied from September 1972 through July 1976. Data were collected during the breeding season (15 April through 15 June), postbreeding season (July through October), and winter (December through February). Where woodpeckers were observed foraging, I recorded basal area (m²/ha measured with a prism), density of stems (no. stems >6 cm diameter

TABLE 1.

Percentages of timber types used by different woodpeckers with corresponding H' values (Shannon, 1948).

Habitat type	DW ¹	HW	PW	CF	RBW	RHW
Oak-hickory	53	62	72	5	76	96
Pitch pine-oak	7	5	9	4	2	
Yellow poplar-red & white oak	8	10	7		4	
Suburb-low brush and open lawns	11	2		77	18	2
Chestnut oak	9	10	4			
White pine-oak	8	3	4	1		
Scarlet oak	1	5				
Fields				13		2
Pitch pine	1		4			
Hemlock-hardwood	1	3				
Table Mt. pine	1					
Diversity Index (H')	1.57	1.35	1.03	0.79	0.72	0.20

¹ DW—Downy (n = 153), HW—Hairy (n = 133), PW—Pileated (n = 110), CF—Common Flicker (n = 90), RBW—Red-bellied (n = 21), RHW—Red-headed (n = 73).

at breast height (DBH) per $1/25$ -ha circular plot), and vegetation height (m) in three circular $1/25$ -ha plots arranged in a triangular formation. I also recorded relative age and condition of the timber stand and timber type (Soc. of Amer. Foresters, 1954). The density of underbrush (twigs) in the zone between the ground and 3 m above the ground was estimated visually in a $3 \times 3 \times 10$ m volume in the four cardinal directions and placed into one of four categories ranging from least to most dense. A more precise determination of the last parameter was impossible because of the seasonal presence and absence of leaves. Also measured were quality (live, dead, dead portion of live, stump, or fallen log) and species of the tree in which foraging occurred.

RESULTS AND DISCUSSION

Differences in the foraging habitats of the six species were noted. All species except the Common Flicker used the oak-hickory forest type most frequently. Flickers typically selected the park-like habitat of open campus areas (Table 1).

Downy and Hairy woodpeckers showed the most diverse selection of timber types, whereas Red-headed Woodpeckers showed the least (Table 1). Downy and Pileated woodpeckers used habitats with pines (18 and 17%, respectively) more than Hairy Woodpeckers (11%).

All species except Common Flickers used mature stands of timber most frequently (Table 2). Flickers used lawns, young clearcuts, and edge habitat, areas with adequate access to the ground for foraging. Red-headed Woodpeckers were found in mature timber 87% of the time (Table 2). Typically, Red-heads foraged in or near park-like woodlots where grasses and forbs were the only ground cover.

TABLE 2.

Percentages of timber classes used by different woodpeckers (see Table 1 for sample sizes and species code).

Timber class	DW	HW	PW	CF	RBW	RHW
Non-stocked clearcut	3		2	27	4	2
2-6-yr-old clearcut	2	1		29		
6-12-yr-old clearcut	3	5	5	10	12	
Pole stand timber	22	23	18		4	
Mature timber	66	70	72	14	72	87
Edge of mature timber	4	1	2	20	8	11

Use of areas with an open understory by Red-headed Woodpeckers and Common Flickers became most apparent with a subjective estimate of vegetation density within 3 m of the ground (Table 3). Downy, Hairy, and Pileated woodpeckers used habitats with relatively dense vegetation near the ground. Red-bellied Woodpeckers foraged in areas with the most dense understory vegetation.

Although woodpeckers overlapped in habitat measurements of basal area, density of tree stems, and vegetation height (Fig. 1), some significant differences were found (Table 4). Pileated Woodpeckers used stands with the highest average basal area and density of stems. Conner et al. (1975) reported a similar phenomenon in Pileated Woodpecker selection of nesting habitat. Red-headed Woodpeckers used habitat with the highest mean canopy height, a high basal area, and a low density of tree stems, demonstrating their preference for an old mature forest. The Common Flicker's use of relatively open, unvegetated areas was evident in its selection of areas with the lowest average basal area, density of tree stems, and canopy height. Downy, Hairy, and Red-bellied woodpeckers consistently used habitats intermediate to the other woodpecker

TABLE 3.

Visual estimates of density of understory vegetation (twigs) in woodpecker foraging areas (see Table 1 for sample sizes).

Species	Percent density category selected				
	Least dense		→	Most dense	
	1	2		3	4
Downy	21	49		23	7
Hairy	12	31		29	29
Pileated	9	65		19	7
Flicker	62	17		8	13
Red-bellied	20	24		8	48
Red-headed	98	2		0	0

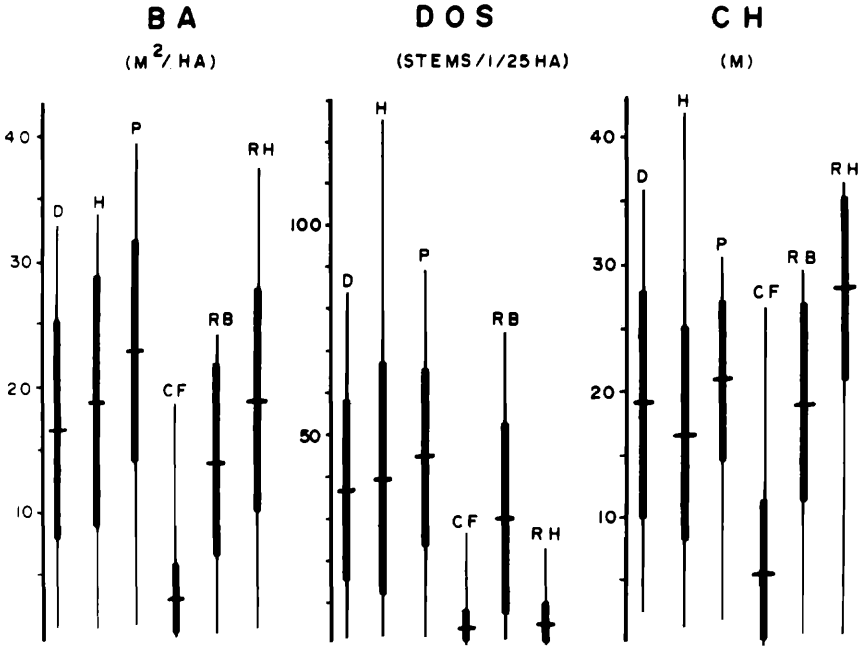


FIGURE 1. Ranges, standard deviations, and means for variables measured at woodpecker foraging sites. (D—Downy, $n = 468$; H—Hairy, $n = 411$; P—Pileated, $n = 348$; CF—flicker, $n = 270$; RB—Red-bellied, $n = 78$; RH—Red-headed, $n = 219$; BA—basal area; DOS—density of tree stems; CH—canopy height.

species (Fig. 1). In contrast to the report of Anderson and Shugart (1974), Downy Woodpeckers used habitats with a higher average canopy height than did Hairy Woodpeckers.

Differences in the species of trees used by woodpeckers were also found (Table 5). Hairy (total observation time = 260 min), Red-headed (444 min), and Pileated (982 min) woodpeckers selected oaks more than 60% of the time, whereas Downy Woodpeckers (271 min) selected oaks less than 50%. Conifers were used by Pileated and Downy woodpeckers (19 and 12% respectively) more than by Hairy Woodpeckers (4%). Kisiel (1972) also reported that Hairy Woodpeckers used conifers less than Downy Woodpeckers. However, regional differences in the use of conifers by Hairy and Downy woodpeckers do exist. Hairy Woodpeckers use conifers extensively in Colorado (Stallcup, 1968), whereas Downy Woodpeckers in the same region are mainly a deciduous forest species.

Common Flickers (671 min) spent most of their time on the ground (76%). When foraging in trees, they selected dogwoods (*Cornus florida*) most often (11%). Dogwoods were used by flickers mostly in the post-breeding season when they ate the fruits.

TABLE 4.

Duncan's New Multiple Range Test of woodpecker foraging habitat data. Common line indicates non-significant differences, $P < 0.05$ (see Table 1 for species code).

Variable	Species order in descending means					
	PW	RHW	HW	DW	RBW	CF
Basal area (m ² /ha)	22.7	19.8	18.5	16.5	14.2	2.6
Density of stems (no. of stems >6 cm DBH ^{1/25} ha)	43.8	39.5	36.8	30.0	5.8	3.1
Vegetation height (m)	28.4	21.0	19.0	18.5	16.7	5.9

Downy Woodpeckers foraged on hickories more than any other species (Table 5). This may have been because of the bark pattern which provided many places for insects to hide. Downy Woodpeckers used superficial foraging methods more than any of the other woodpecker species (Conner, 1977); these methods were well suited to exploit the foraging substrate available on hickories. Downy Woodpeckers prefer certain species of trees in other geographical areas, also apparently because of their use of surface gleaning techniques (Kilham, 1961, 1970). Downy Woodpeckers demonstrated the most diverse selection of tree species and Common Flickers the least (Table 5). Because of insufficient sample size, species and conditions of trees used by Red-bellied Woodpeckers were not evaluated.

Differences in the conditions of trees used by woodpeckers were evident (Table 6). Pileated Woodpeckers foraged mostly on dead wood (62%); in Oregon they showed a similar trend (Bull and Meslow, 1977). Downy and Hairy woodpeckers foraged mainly on live wood (70 and 56%, respectively), a fact that agrees closely with Kisiel's (1972) observation in New York. When not foraging on the ground, flickers foraged about the same amount of time in dead trees as in living. Red-headed Woodpeckers foraged mainly in live trees.

Seasonal differences in woodpecker foraging habitats were detected with analyses of variance and Duncan's New Multiple Range Test ($P < .05$). Downy Woodpeckers foraged in habitats with a significantly lower basal area (11.3 m²/ha) in the breeding season than in the postbreeding (21.4 m²/ha) and winter (17.2 m²/ha) seasons. Hairy Woodpeckers used habitat with a higher basal area in the postbreeding season (23.0 m²/ha) than in the breeding (13.7 m²/ha) and winter (15.2 m²/ha) seasons. Red-headed Woodpeckers used stands with a lower basal area during the breeding season (17.1 m²/ha) than in the postbreeding season (27.1 m²/ha).

TABLE 5.

Percentages of tree species used by foraging woodpeckers with corresponding H' values (Shannon, 1948) (see Table 1 for sample sizes and species code).

Species of tree	DW	HW	PW	CF	RHW
<i>Quercus prinus</i>	11	22	26	6	
<i>Q. rubra</i>	11	10	19	3	23
<i>Q. coccinea</i>		8	6		
<i>Q. alba</i>	25	28	10		41
<i>Q. velutina</i>	1				
<i>Carya</i> spp.	16	10	7		8
<i>Acer rubrum</i>	4		4		
<i>Pinus rigida</i>	2	2	13		
<i>P. strobus</i>		2	6		
<i>P. pungens</i>	9				
<i>Liriodendron tulipifera</i>	2	3	1		
<i>Magnolia acuminata</i>			4		
<i>Cornus florida</i>	4	1		11	3
<i>Platanus occidentalis</i>		4			
<i>Gaultheria procumbens</i>				3	
<i>Betula niger</i>	2				
<i>Rhus</i> spp.	1	1	1	1	
<i>Vitis</i> spp.	1		1		
<i>Oxydendrum arboreum</i>		1			
<i>Prunus serotina</i>	3	5	1		
<i>Robinia pseudoacacia</i>		1			3
<i>Ulmus americana</i>	1				
<i>Tsuga canadensis</i>	1				
<i>Salix babylonica</i>	2	1			
<i>Nyssa sylvatica</i>	3				
<i>Juglans nigra</i>					6
Other (ground, air)	1	1	1	76	16
Diversity index (H')	2.4	2.2	2.1	0.8	1.5

Most Common Flickers migrated south in the winter but the few that remained foraged in stands with significantly higher tree densities (9.8 trees >6 cm DBH^{1/25} ha) than in the breeding (2.6 trees^{1/25} ha) and postbreeding (1.9 trees^{1/25} ha) seasons.

No significant seasonal differences were detected in vegetation heights, basal areas, or densities of tree stems of stands used by Pileated and Red-bellied woodpeckers.

A few species demonstrated seasonal differences in the species and quality of trees they selected as foraging sites. Hairy and Pileated woodpeckers used all species of oaks to a greater extent (more than an 80% increase for both woodpeckers) in the postbreeding and winter seasons than in the breeding season. A seasonal abundance of insect pupae in oaks could be suggested as an explanation for the observed shift.

Hairy Woodpeckers used dead trees and dead portions of live trees to a greater extent in winter (69% of 94 min observation time) than in

TABLE 6.

Conditions of trees selected by foraging woodpeckers (percentages) (see Table 1 for species code and sample sizes).

Substrate	DW	HW	PW	CF	RHW
Live tree	70	56	36	14	53
Dead tree	4	14	49	10	6
Dead part of live tree	22	26	9	1	24
Stump			3		
Fallen log	1	2	1	5	
Not on tree	3	2	2	70	16

the breeding (44% of 75 min) and postbreeding (26% of 91 min) seasons. Downy Woodpeckers used dead portions of live trees to a greater extent in the breeding season (35% of 80 min) than in the postbreeding (21% of 98 min) and winter (24% of 93 min) seasons.

CONCLUSIONS

Foraging habitats of Downy, Hairy, and Red-bellied woodpeckers were basically similar. Downies, however, may have preferred younger forests than Hairy Woodpeckers because Downies selected stands with a lower mean basal area and density of tree stems (Fig. 1) and foraged mainly on live trees (Table 6). Foraging habitat for these three species will probably be provided by timber rotation ages (60–80 yr) and other management procedures currently practiced on national forests in Virginia.

Common Flicker foraging habitat was created by clearcutting (Fig. 1, Tables 2 and 3). During pre-Columbian times flickers probably had to rely on ice damage, wind throws, and silted-in beaver (*Castor canadensis*) ponds for suitable foraging habitat.

Red-headed Woodpecker foraging habitat in southwestern Virginia was not provided by current timber management on national forests. This species used old mature woodlots with open understories found only on suburban and agricultural areas. It is doubtful that timber management and habitat needs of this species could complement each other in the oak-hickory type of southwestern Virginia. However, in other geographical areas management for timber and Red-headed Woodpeckers may be possible. In east Texas Red-headed Woodpeckers nest and feed regularly in clearcut areas as long as suitable snags are available for nesting (Conner, unpubl. data). Reasons for this geographic difference in habitat selections are not readily apparent.

Pileated Woodpecker foraging habitat is potentially threatened by intensive timber management. Pileateds foraged in the more mature forest stands with highest mean basal area, density of stems, and canopy height (Red-headed excluded). This large woodpecker foraged in dead trees more than any of the other species; dead trees were typically more

abundant in older stands. Rotation times of 80 years would probably be sufficient to provide Pileated foraging habitat if "adequate" amounts of mature habitat are available at any given time. Rotation times to provide suitable nesting habitat may be as long as 150 years (Conner, 1978).

All species relied substantially on dead trees or dead parts of live trees. Large scale removal of dead trees from forest lands may seriously decrease foraging substrate for woodpeckers, especially Pileateds, Hairies, and Downies. Collection of fire wood should be minimized on lands managed for woodpeckers.

ACKNOWLEDGMENTS

I thank C. S. Adkisson, T. A. Jenssen, J. C. Kroll, R. A. Paterson, and D. A. West for comments on an early draft of the manuscript.

LITERATURE CITED

- ANDERSON, S. H., AND H. H. SHUGART, JR. 1974. Habitat selection of breeding birds in an east Tennessee deciduous forest. *Ecology*, **55**: 828-837.
- BALDA, R. P. 1975. The relationship of secondary cavity nesters to snag densities in western coniferous forests. U.S. Dept. Agric., For. Serv., Southwest. Region Wildlife Hab. Tech. Bull., 1, 37 p.
- BULL, E. L. 1978. Specialized habitat requirements of birds: snag management, old growth, and riparian habitat. In Proceedings of the Workshop on Nongame Bird Habitat Management in the Coniferous Forests of the Western United States, R. M. DeGraaf (tech. coord.). U.S. Dept. Agric., For. Serv. GTR PNW-64. 100 p.
- BULL, E. L., AND E. C. MESLOW. 1977. Habitat requirements of the Pileated Woodpecker in northwestern Oregon. *J. Forestry*, **75**: 335-337.
- CONNER, R. N. 1976. Nesting habitat for Red-headed Woodpeckers in southwestern Virginia. *Bird-Banding*, **47**: 40-43.
- . 1977. Seasonal changes in the foraging methods and habitats of six sympatric woodpecker species in southwestern Virginia. Ph.D. Dissertation. Blacksburg, Virginia Polytechnic Institute and State University.
- . 1978. Snag management for cavity nesting birds. In Management of Southern Forests for Nongame Birds, R. M. DeGraaf (tech. coord.). U.S. Dept. Agric., For. Serv. GTR SE-14, 176 p.
- CONNER, R. N., AND H. S. CRAWFORD. 1974. Woodpecker foraging in Appalachian clearcuts. *J. Forestry*, **72**: 564-566.
- CONNER, R. N., R. G. HOOPER, H. S. CRAWFORD, AND H. S. MOSBY. 1975. Woodpecker nesting habitat in cut and uncut woodlands in Virginia. *J. Wildl. Manage.*, **39**: 144-150.
- HARDIN, K. I., AND K. E. EVANS. 1977. Cavity nesting bird habitat in oak-hickory forests . . . a review. U.S. Dept. Agric., For. Serv. Gen. Tech. Rep. NC-30, 23 p.
- KILHAM, L. 1961. Downy Woodpeckers scaling bark on diseased elms. *Wilson Bull.*, **73**: 89.
- . 1970. Feeding behavior of Downy Woodpeckers. I. Preference for paper birches and sexual differences. *Auk*, **87**: 544-556.
- KISIEL, D. S. 1972. Foraging behavior of *Dendrocopos villosus* and *D. pubescens* in Eastern New York State. *Condor*, **74**: 393-398.
- MCCLELLAND, B. R. 1979. The Pileated Woodpecker in forests of the northern Rocky Mountains. In The Role of Insectivorous Birds in Forest Ecosystems, J. G. Dickson, R. N. Conner, R. R. Fleet, J. A. Jackson, and J. C. Kroll (eds.), p. 283-299. New York, Academic Press.
- SHANNON, C. E. 1948. A mathematical theory of communication. *Bell Sys. Tech. J.*, **27**: 379-423, 623-656.

- SOCIETY OF AMERICAN FORESTERS. 1954. Forest cover types of North America (exclusive of Mexico). Washington, D.C., Soc. Am. Foresters. 67 p.
- STALLCUP, P. L. 1968. Spatio-temporal relationships of nuthatches and woodpeckers in ponderosa pine forests of Colorado. *Ecology*, **49**: 831-843.

Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. (Present Address: Southern Forest Experiment Station, U.S. Dep. Agric., For. Serv., Nacogdoches, TX 75962.) Received 21 September 1978, accepted 16 October 1979.