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WOODPECKER NESTING HABITAT IN CUT AND UNCUT WOODLANDS IN VIRGINIA

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Abstract: In forest areas common flickers (*Colaptes auratus*) nested only in dead snags in 1- to 12-year-old clearcuts. Pileated woodpeckers (*Dryocopus pileatus*) nested in mature, dense stands with high basal area, and downy woodpeckers (*Dendrocopos pubescens*) nested in sparsely stocked stands with lower basal area. The hairy woodpecker (*D. villosus*) nested in stands intermediate to and overlapping the habitats selected by the pileated and downy woodpeckers. All nest cavities of the four species of woodpeckers were excavated in decayed wood of trees infected by fungal heart rots. Timber management may be detrimental to woodpeckers if all decayed trees are removed. Uncut filter strips along streams and roads appear to be of value as woodpecker nesting habitat.

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Optimum management of a forest for multiple benefits to humans requires intelligent coordination of practices. Little information exists for many nongame species of wildlife which will permit the forest manager to coordinate wildlife and timber management practices. This investigation was conducted to determine if the common flicker and the downy, hairy, and pileated woodpeckers on the Jefferson National Forest in Virginia had specific requirements for nest trees and the surrounding habitat or if they utilized a wide range of conditions.

STUDY AREAS

The field study was conducted on an area 20 km^2 (7.72 miles^2) located primarily on the upper Craig Creek and Poverty Creek drainages of the Blacksburg Ranger District of the Jefferson National Forest in southwestern Virginia. Stands consisting of mainly oaks (*Quercus* spp.) and hickories (*Carya* spp.) covered about 60 percent of the area, and yellow-poplar (*Liriodendron tulipifera*), white oak (*Q. alba*), and northern red oak (*Q. rubra*) stands occupied 10 percent. Stands of pines and hardwoods, primarily oaks and pitch pine (*Pinus rigida*) covered another 20 percent of the area. Approximately 10 percent of the area was covered by stands of Virginia pine (*P. virginiana*), white pine (*P. strobus*), and pitch pine. Site indexes, the height in feet to which oaks grow in 50 years (Olson 1959), averaged 60 with only 10 percent of the sites going over 70. Since mid-1960 more intensive even-aged timber management has been practiced. Under this system of management, stands are regenerated by clearcutting and are thinned periodically to encourage maximum growth of the crop trees (Roach and Gingrich 1968).

A second area that was investigated centered around the town of Blacksburg and the Virginia Polytechnic Institute and State University campus. This non-forest area, although primarily in pasture, included six mature woodlots of oaks and hickories (canopy height 25 to 35 m [76.2 to 106.7 ft]) which varied between 0.5 and 20 ha

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(1.24 and 49.4 acres). The distance between woodlots varied from 0.25 to 1.0 km (0.16 to 0.62 mile).

METHODS

The nesting study was conducted in 1972 and 1973. Stand-condition maps of the Ranger District were used to locate a complete spectrum of various habitat types and various-aged stands from new clearcuts to mature sawtimber. All habitat types available were searched systematically in an attempt to locate active woodpecker nest sites. Additional nests were located in the non-forest habitat near Blacksburg and the University campus to give a better idea of the ecological latitude of the woodpecker species in our geographic area.

Territories of woodpeckers were located by focusing on vocalizations and drumming during February through June of 1972 and 1973. After a territory was located, movements and calls of the nesting pair were used to pinpoint the nest tree. Observations of pairs feeding young, incubating, or using a freshly completed nest cavity were used as confirmation of an active nest tree.

The diameter of the tree at the nest cavity was measured with a split image range finder. The scale on the viewing window was calibrated to read centimeters in diameter when the observer was 30 m from the opening of the nest cavity. The height of the nest cavity and the total height of the nest tree were measured with an Abney level. The vigor of the nest tree was determined by subjectively estimating the percentage of live wood in the nest tree. The diameters of trees within a 20-m circle (0.13-ha) around the nest tree were measured at breast height and recorded in the following classes: 7–14, 15–22, 23–30, 31–38, 39–46, 47–54, 55–62, 63–70, 71–78, and 79+ cm. The distances from nest trees to the nearest water source were measured. Habitat variables of forest nest sites were tested with a one-way analysis of variance and Duncan's multiple range test to detect habitat differences among species of woodpecker.

RESULTS

Characteristics of Nest Trees

One common characteristic of all woodpecker nests was that cavities were excavated in softened wood resulting from growth of fungal mycelium. Fungal fruiting bodies, or conks, were present on one-third of the nest trees.

Woodpecker nest trees differed in general appearance. Fourteen of the 19 nest trees of the downy woodpecker were dead. Most nest trees for this species had fungal conks on the trunk, indicating advanced stages of decay. No nest cavities were observed which had been excavated through living cambium, although Bent (1939) indicated that it does occur. Five nest cavities of the hairy woodpecker were found in dead snags and five in dead sections of live trees. Lawrence (1966) found that hairy woodpeckers preferred to nest in live trees. The wood into which the cavity had been excavated by hairy woodpeckers appeared firmer than that used by the downy woodpecker. Thirteen of the 18 nest trees of the pileated woodpecker were dead. One pileated woodpecker nest cavity had been excavated through live cambium into a decayed inner core, while four cavities had been excavated in dead sections of live trees. Nest cavities excavated by the pileated woodpecker were typically located in the main trunk of the tree. Only 8 of the 22 flicker nests were in dead trees. The other 14 nests were in dead sections of live trees. The flicker was the only species we observed to excavate a cavity where a decayed branch had been. Three flicker nests were excavated in trees killed by silvicide

Table 1. Average measurements of woodpecker nest trees. Ranges are indicated parenthetically.

Type of measurement	Habitat	Species			
		Downy	Hairy	Flicker	Pileated
No. of nests	Forest	15	10	6	14
	Non-forest[a]	4	0	16	4
dbh nest tree (cm)	Forest	31.8 (15–66)	40.6 (20–64)	36.8 (30–46)	54.6 (33–91)
	Non-forest	27.2 (15–46)		87.9 (38–139)	47.5 (38–46)
Diameter nest tree at cavity (cm)	Forest	20.8 (13–41)	25.2 (20–46)	27.9 (23–36)	37.9 (30–51)
	Non-forest	18.3 (13–23)		40.6 (23–76)	33.0 (28–41)
Height of nest tree (m)	Forest	8.3 (1.5–19.8)	13.0 (4.0–26.5)	12.4 (9.1–15.8)	20.3 (10.7–36.6)
	Non-forest	5.8 (4.3–9.4)		22.5 (10.7–36.0)	9.8 (7.3–11.6)
Height of nest (m)	Forest	4.7 (1.0–11.6)	8.8 (2.4–19.8)	8.5 (6.1–11.9)	13.6 (9.1–19.2)
	Non-forest	4.9 (3.0–9.1)		13.7 (2.7–21.9)	7.5 (5.5–10.7)

[a] Includes farm woodlots, suburban areas, and campus.

injections administered during timber harvests.

Generally, the larger the species of woodpecker, the larger the nest tree used (Table 1). In the National Forest study areas, the pileated woodpecker selected significantly taller trees with the largest dbh and nested at a greater height above ground in a larger diameter stem than did the smaller woodpecker species (Table 2). The smallest, the downy woodpecker, selected the shortest trees with the least dbh and nested at the lowest height in the smallest stem (Table 1). The hairy woodpecker, intermediate in size to the downy and pileated woodpeckers, was also intermediate to these two species in height of nest and of nest tree, and diameter of the nest tree. Most of the flicker nests were found in mature woodlots. There, flickers nested in trees up to 139 cm dbh (Table 1). The flicker nest trees in the forest study areas were located in clearcuts where the choice of trees was limited to a few dead snags.

Table 2. Duncan's multiple range test of woodpecker nesting habitat preferences in forest areas. A common line indicates no significant difference ($P = 0.05$).

Type of measurement	Species			
	Pileated	Hairy	Flicker	Downy
DBH nest tree (cm)	54.6	40.6	36.8	31.8
Diameter at the nest (cm)	37.9	27.9	25.2	20.8
Height of the nest tree (m)	20.3	13.0	12.4	8.3
Nest height (m)	13.6	8.8	8.5	4.7
	Pileated	Hairy	Downy	Flicker
Basal area (m^2/ha)	31.5	19.7	11.9	1.2
Density of stems[a]	139.8	117.3	113.9	19.3

[a] Stems > 7 cm, no./ha.

Nest cavities were located in 22 different species of trees. Seventy-four percent of the nests were in oaks (*Quercus* spp.), which were the most abundant species in both the forest and town study areas (Table 3). Sample sizes within each species of woodpecker were too small to detect any real preference for a tree species.

Pileated woodpeckers demonstrated a strong preference for a certain type of nest tree. Twelve of the 18 pileated woodpecker nest trees were dead, about 14 to 17 m tall, and 36 to 51 cm dbh; most of these trees retained a large percentage of their bark. Fungal activity and nest cavities from previous years had weakened all 12 of these trees and their tops had broken off. Typical

Table 3. Species of trees used for woodpecker nest cavities.[a]

Tree species	Number of nests excavated by			
	Downy	Hairy	Flicker	Pileated
Quercus rubra	3	3	3	4
Q. prinus	4	2	1	3
Q. alba			6	2
Carya spp.			3	5
Acer rubrum	1	2	1	
Pinus virginiana	1	1	2	
Robinia pseudoacacia	2	1	1	
Pinus strobus	3			1
Malus spp.			2	

[a] In addition to nest excavations given in the table, one nest only was made in each of the following tree species: downy woodpecker—*Ulmus americana, Cornus florida, Crataegus* sp., *Tsuga canadensis,* and *Betula alleghaniensis*; hairy woodpecker—*Nyssa sylvatica*; flicker—*Betula nigra, Salix alba,* and *Pyrus communis*; pileated woodpecker—*Platanus occidentalis, Acer saccharum,* and *Liriodendron tulipifera.*

nest trees are difficult to describe for the flicker, downy, and hairy woodpeckers. These species used a variety of nest trees ranging from dead snags to dead branches on live trees.

Characteristics of Habitat around Nest Trees

Basal area, the cross section area of tree trunks at 1.37 m above the ground, averaged 31.5 m^2/ha (137.3 ft^2/acre) for stands at pileated woodpecker nest sites, 19.7 m^2/ha for stands at hairy woodpecker nest sites, and 11.9 m^2/ha for stands at downy woodpecker nest sites in the forest study area. Stands at flicker nest sites in clearcuts averaged only 1.2 m^2/ha. Mean basal areas of stands at nest sites for all species of woodpeckers were significantly different from each other (Table 2). The distribution of basal area by diameter classes showed a shift from highest basal areas in the lower diameter classes for downy woodpeckers to highest basal areas in the large diameter classes for pileated woodpeckers (Fig. 1). Hairy woodpeckers nested in habitats intermediate to downy and pileated woodpeckers.

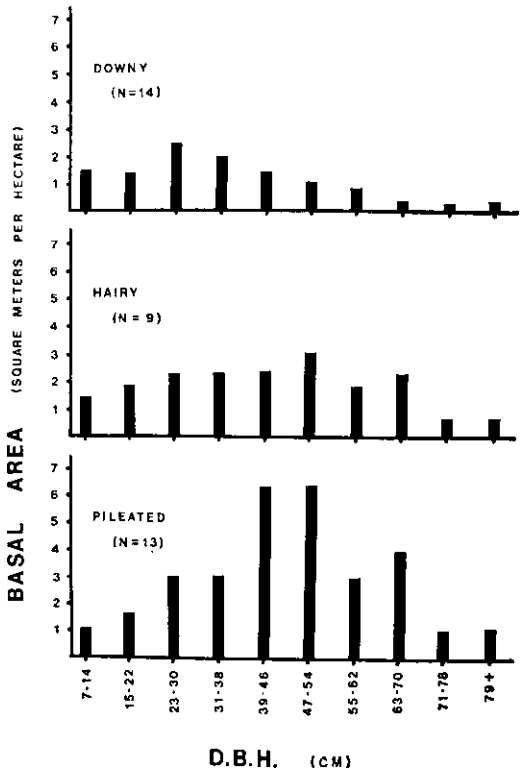

Fig. 1. Mean basal area by diameter class of live trees within a 20-m radius of woodpecker nest trees. Nests in clearcuts and non-forest nests excluded.

Selection of certain habitat types for nesting probably reflects the prevalence of the habitat type more than a preference by any species of woodpecker for a particular habitat. In the forest habitat all species of woodpeckers nested (33 nests) most often in the abundant oak-hickory stands (60 percent of study area). Oak-pine was the second most utilized habitat type (9 nests, 20 percent of study area). A few flicker and downy woodpecker nests (three nests) were found in conifer stands, but this habitat type covered only 10 percent of the study area.

In the forested habitat, flicker nests were found only in clearcuts that varied from 1 to 12 years in age. Flickers preferred

the younger clearcuts, probably because of greater access to open ground for foraging. The height of the vegetation in the clearcuts varied from 1 to 5 m. Invariably, each clearcut area contained several decayed dead snags which could be utilized for nesting.

In addition to the flicker nests in clearcuts, one active nest tree of each of the other three woodpeckers was found in a clearcut. One downy woodpecker nested in a 3-year-old clearcut in an oak-hickory stand. Vegetation had regenerated to a height of about 1 m and consisted mainly of *Rubus* spp. and sprouting hardwoods. A hairy woodpecker nest was in a 1-year-old oak-hickory clearcut where little regeneration had occurred. Younger clearcuts provided little suitable nesting habitat for hairy and downy woodpeckers, which were commonly found foraging for insects in the abundant logging debris (Conner and Crawford 1974). The single pileated woodpecker nest found in a clearcut was in a 91-cm dbh sugar maple (*Acer saccharum*) that had survived an injection of silvicide following the timber harvest. The tree was 64 m from the edge of this 3-year-old clearcut of an oak-hickory stand. Vegetation was about 1 m high and consisted mainly of *Rubus* spp. and regenerating hardwood stems. Several other nest cavities higher up in the nest tree indicated the tree had been used prior to clearcutting. A brood was successfully fledged in 1972 but the tree was not used in 1973. A pair of pileated woodpeckers was active in the vicinity in 1973, but we were not able to locate their nest. Bent (1939) also reported pileated woodpeckers returning to a previously used nest tree after the surrounding trees had been cut. Of the remaining four pileated woodpecker nest trees not found in forest areas, one was a large dead snag located in a meadow, while the other three were located in narrow wooded strips between fields.

No pileated woodpecker nest trees were found farther than 150 m from water; our observations agree with those of Hoyt (1957). Most nests in our study were found less than 50 m from water. The mean distance between water sources in our study area was about 600 m. Pileated woodpeckers may have selected nest sites mainly in mesic environments, because mesic areas produce more large trees suitable for nesting more quickly than xeric sites.

DISCUSSION

Of the four species of woodpeckers observed, only the flicker readily used clearcut areas for nesting. Most flicker nest trees were in edge habitats such as woodlots and suburban areas, and the only nest trees found in forest areas were in clearcuts. Flickers feed frequently on or near the ground in relatively open habitats, and the selection of a nest tree near a field or cutover area with open-ground availability appears to be of equal importance to that of a suitable nest tree.

During the regeneration stage of even-aged timber management, stands have little potential for downy, hairy, and pileated woodpecker nesting. These three woodpeckers prefer older-aged stands that offer trees large enough for them to use for nests.

All woodpeckers exhibited a size preference in nest trees; however, they also showed a great range in the diameters of the trees in which they nested. Since a woodpecker has to select a tree large enough to contain its excavated nest cavity, the minimum size tree may be as important, in assessing the impact of timber management, as mean tree size. Pileated woodpeckers excavated cavities in trees that averaged 54.6 cm dbh, the smallest being 33

cm dbh. Our observations indicate that stands with medium size sawtimber of 38–46 cm dbh would provide adequate pileated woodpecker nest trees if some of these trees were decayed. Hairy and downy woodpeckers can use correspondingly smaller trees of about 30–46 and 20–30 cm dbh, respectively.

A basic objective of managing a forest for timber is to maintain a density of trees that fully utilizes growing space for the production of highest-quality stems in the shortest period of time. The four species of woodpeckers, however, showed definite preference for trees infected by heart rots. These infected trees normally result from injury (Shigo and Larson 1969) and natural stresses that occur because of competition for growing space. In forests managed for timber, trees with heart rots have little commercial value and, if still alive, occupy space that could be used by higher quality trees. As a result, many of these trees are removed during thinning operations.

Trees with heart rot are necessary not only for woodpecker nest trees but also for providing suitable habitat for the initial invasion of trees by carpenter ants (*Camponotus* sp.) (Sanders 1964). Carpenter ants are major prey of the pileated woodpecker (Hoyt 1957), especially during the winter season when other insects and fruits are not readily available (Conner unpublished data). Carpenter ants invade and carve caverns in decayed cores of trees and frequently extend their activities to portions of the trees not yet infected by fungal hyphae. The pileated woodpecker is the only species of the four that is strong enough to regularly penetrate and feed on ants in infested trees. Hence, silvicultural thinnings could have a critical impact on an important prey species of the pileated woodpecker. Downy and hairy woodpeckers prefer to forage for insects more on the surface and just under the bark of trees than the pileated woodpecker and normally secure their insect foods from both decayed and healthy trees (Jackson 1970, Kilham 1965). Thus, thinning has a less injurious effect on food sources of downy and hairy woodpeckers than of the pileated woodpecker.

In addition to selection for different conditions and size of the nest tree, the four species of woodpeckers exhibited preference for different degrees of basal area in the vicinity of their nests. Downy woodpeckers preferred sparsely-stocked stands commonly found along ridges. Understocked stands always will be present on the numerous xeric ridges, hence this preference poses no forest-management problem. Furthermore, such stands normally would be exempt from thinning, because they are understocked and not limited by competition for light. Natural thinning occurs in these stands in spite of their sparse stocking, because competition on xeric sites comes more from moisture stress than from light deficiency. Hairy woodpeckers exhibited greater latitude in the basal area around their nest trees, thus both understocked and fully-stocked stands should be suitable for this species if suitably decayed nest trees are available. The pileated woodpecker preferred nest sites with a high basal area and density of stems (Table 2). Part of their preference for heavily-stocked stands may be due to the occurrence of suitable nest trees. The occurrence of suitably decayed trees for pileated woodpecker nests may be enhanced in dense stands where long-continued competition weakens sawtimber-size trees.

All four species of woodpeckers would benefit by leaving dead snags and trees

with heart rot standing during both regeneration cuts and subsequent thinnings. The public often decries the presence of dead snags in clearcuts for aesthetic reasons, but such snags are used initially by flickers and bluebirds (*Sialia sialis*) (Conner and Adkisson 1974) for nest cavities and later by other woodpeckers. On medium sites, where upland oaks grow only to 12 to 17 m in 50 years, removing unwanted trees by thinning often will not be economical. The ideal practice on medium sites, from the standpoint of providing both woodpecker nest trees and foraging areas, would be to kill unwanted trees with a silvicide and to leave them standing. On good sites, however, where upland oaks grow to over 23 m in 50 years, and on the better medium sites, if heavily stocked, the sale of trees that are removed in stand thinnings can be an economical practice and thus conflicts with woodpecker management.

The practice of leaving uncut filter strips along streams and roadsides is recommended. Since pileated woodpeckers have a foraging territory of 40 to 80 ha and prefer to nest near water (Hoyt 1957), filter strips in their territories may provide suitable nest sites.

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