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# Southern Pine Beetle Handbook: Woodpeckers and the Southern Pine Beetle

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Southern Pine
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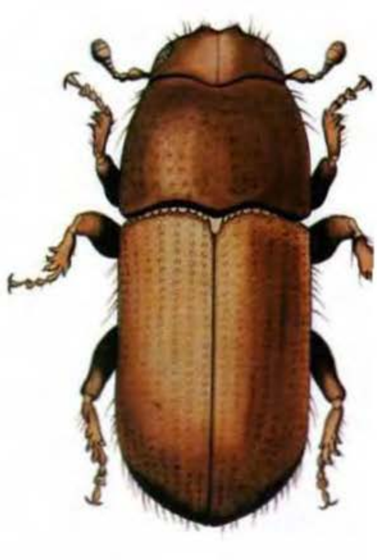

In 1974 the U.S. Department of Agriculture initiated the Combined Forest Pest Research and Development Program, an interagency effort that concentrated on the Douglas-fir tussock moth in the West, on the southern pine beetle in the South, and on the gypsy moth in the Northeast. The work reported in this publication was funded in part by the Program. This handbook is one in a series on the southern pine beetle.

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# Woodpeckers and the Southern Pine Beetle

by
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## Contents





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# Introduction

Woodpeckers may play an important role in stabilizing forest insect populations, including those of the southern pine beetle (*Dendroctonus frontalis* Zimmerman), the SPB. But to make the most effective use of predation by these birds, we must understand their habitat requirements and interactions with pine beetles. In this handbook, we discuss three primary predator species—downy, hairy, pileated—and one secondary species—red-bellied woodpeckers—that prey on SPB. Prior to the twentieth century, the endangered red-cockaded woodpecker (*Picoides borealis*) may have also been a significant predator of SPB. However, current low population levels have reduced the potential impact of this species on SPB. Habitat requirements and forest management considerations are also discussed. Our information is based on woodpecker responses to and impact on beetle infestations in individual trees.

# Life Cycle of SPB

Since woodpecker predation is closely related to SPB life stages, we will briefly review what is known about the SPB life cycle. Beetles overwinter within trees attacked the previous fall. In spring, most adults seek host trees susceptible to beetle attack as a result of disease, lightning strike, or other injury. Females then burrow into the tree and produce substances (pheromones) that attract more males and females. Mass attacks by large numbers of beetles usually follow. The mated pair burrow through the bark and into the cambium, where eggs are deposited in individual niches. Initial attack is at 10 –15 ft above ground. The tree is later attacked above and below this region, but beetles remain most abundant at this level, where larvae mature earlier than those at other levels in the tree.

Larvae pupate in the outer bark. Fully developed, emerging beetles or "brood adults," as well as reemerging parent adults, may attack adjacent trees or fly to other susceptible trees. Maturation from egg to adult may take as little as 4 weeks in summer or as long as 3 months in winter. In the Deep South, seven to eight overlapping generations may occur in a single year.

Although SPB attack all species of southern pines, the insect survives and reproduces best in loblolly (*Pinus taeda* L.) and shortleaf (*P. echinata* Mill.) pines.

# Identification and Habitat Requirements of Woodpeckers

## Hairy Woodpeckers

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Hairy woodpeckers (*Picoides villosus*) (fig. 1) are common in East Texas beetle infestations. These birds have a white breast, a white stripe down the back, completely white outer tail feathers, and white spots on black wings and body. They are roughly the size of robins (8–10 inches long), but have a much longer bill. Males and females look alike, except for a red patch on the back of the male's head. Their calls include a loud "peek" sound and kingfisherlike rattle.

Figure 1.—Hairy (above right) and downy (below left) woodpeckers.

Hairy woodpeckers live and nest in a wide variety of habitats, ranging from pure pine to pure hardwood. They are common along stream banks and in lowland areas principally occupied by hardwoods. Hairies prefer stands with total basal areas (BA) of about 85 $ft^2$ per acre and stand densities of 150–200 trees per acre. They excavate nest holes in living or dead coniferous or hardwood trees with heartrot. They prefer nest trees and broken snags ranging 30–45 ft in height with at least 12 inches d.b.h. in older stands (70+ years). A pair of hairy woodpeckers requires about 30 acres of territory.

**Downy Woodpeckers**

Downy woodpeckers (*P. pubescens*) (fig. 1) are about the size of house sparrows (6–7 inches long). Their bills are shorter and slenderer than those of hairy woodpeckers, and horizontal black bars are present on the white outer tail feathers. Like hairy woodpeckers, males of this species have a red patch on the back of the head. Downy woodpeckers make a call that sounds like "pick" and also a whinny call descending in pitch.

This species uses younger trees (45–60 years) for nesting than any other southern woodpecker. Such trees often occur on dry, upland sites, although downy woodpeckers are occasionally found in creek and stream bottoms; however, they seem to prefer stands less dense (140–150 trees per acre) than hairies do. Basal area of preferred stands is roughly 50 $ft^2$ per acre. Nests are constructed in trees or broken snags ranging 15–25 ft in height and about 8 inches d.b.h. About 10 acres of territory is needed for each pair of downies.

## Pileated Woodpeckers

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Figure 2.—Pileated woodpecker.

The pileated woodpecker (*Dryocopus pileatus*) (fig. 2) is the largest woodpecker in southern forests and is easily identified because of its size (17–20 inches long). It also has a conspicuous red crest and white wing patches. The male's cheeks have red marks not present on the female. These woodpeckers will nest in beetle-killed pines and feed on both SPB and larger insects.

Pileated woodpeckers like lowland wet areas but also nest in upland mixed pine-hardwood stands. They prefer old-growth stands (80+ years), and nest tree or snag heights of 40 ft or more in trees exceeding 22 inches d.b.h. Trees used for nest sites are larger than surrounding trees, and are often broken at the top. Basal area of preferred stands is around 130 $ft^2$ per acre; stand density is 190 trees or more per acre. Pileated woodpeckers need a great deal of territory, usually about 175–400 acres per pair.

## Red-Bellied Woodpeckers

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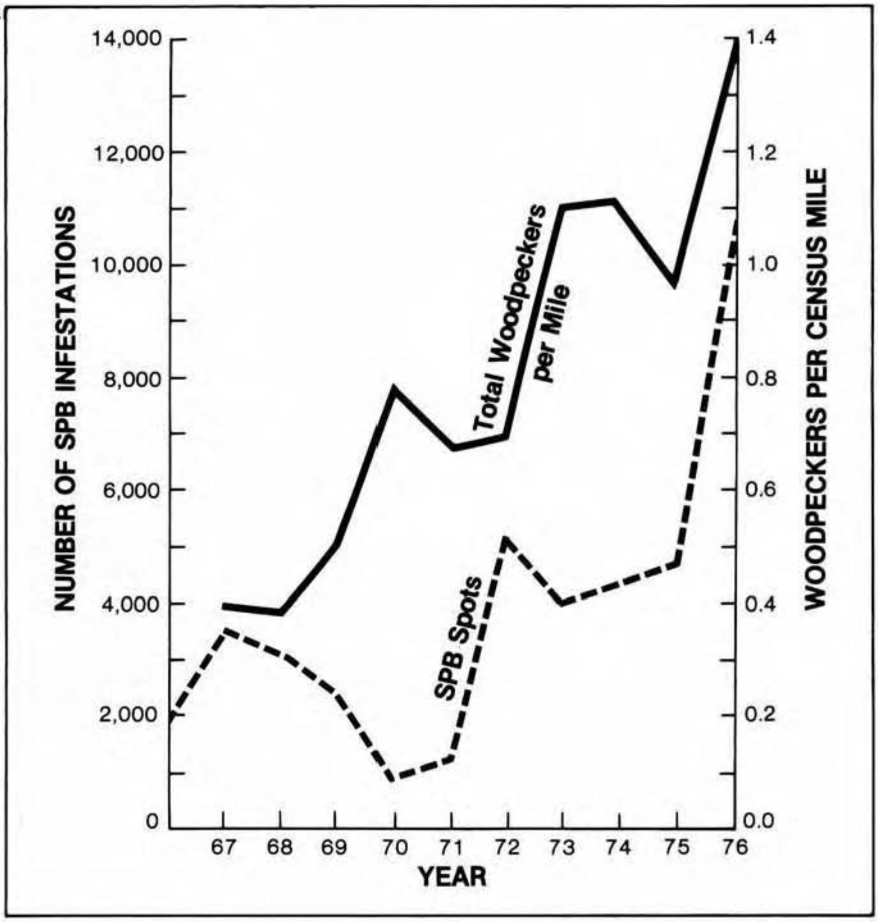
The red-bellied woodpecker (*Melanerpes carolinus*) (fig. 3) is about the size of a blue jay (9–10 inches long). They have black and white stripes on their back and the entire top of the male's head is red while the female's head is red only in back. They make a "flicker" sound and a hoarse "churr" or "chive." Red-bellied woodpeckers often feed on insects larger than the SPB, and consume more fruits and nuts than the other three woodpecker species.

Densely stocked stands with mast-producing trees are favorite habitats for these woodpeckers. They excavate nest cavities in trees or broken snags ranging 40 -60 ft in height and at least 18 inches d.b.h. and prefer older stands than those used by hairy and downy woodpeckers. Both mixed pine-hardwood and bottomland sites provide suitable habitat for these birds. Each pair of red-bellied woodpeckers needs about 20–30 acres of territory.

Figure 3.—Red-bellied woodpecker.

## Woodpecker Responses to SPB Infestations




From 1967–1976 numbers of woodpeckers and of SPB infestations increased substantially in East Texas (fig. 4). Woodpeckers may have been responding to increasing SPB infestations or to increasing acreage in older, denser stands. This may be an oversimplification, however, since woodpeckers eat both hard and soft mast and other insects.

A recent study (table 1) comparing woodpecker population densities in SPB-infested and noninfested stands showed that woodpecker feeding concentrated on pines within infestations. Woodpeckers probably flew from nearby stands to feed on the beetles. Downy,

Figure 4.—Growth of woodpecker populations and SPB populations in East Texas, 1967-1976.

Table 1.—*Percent of activity by four commonly occurring woodpeckers within pine and hardwood stands in SPB-infested and noninfested East Texas forests during 1975-76. (Sample sizes are given in parentheses.)*

| | Percent of Observation | |
|---|---|---|
| **Woodpecker Species** | **Noninfested Stands** | **Infested Stands** |
| **Downy woodpecker** | | |
| Pines | 41 (20) | 88 (79) |
| Hardwoods | 59 (29) | 12 (11) |
| **Hairy woodpecker** | | |
| Pines | 72 (18) | 98 (80) |
| Hardwoods | 28 (7) | 2 (2) |
| **Pileated woodpecker** | | |
| Pines | 60 (33) | 90 (69) |
| Hardwoods | 40 (22) | 10 (8) |
| **Red-bellied woodpecker** | | |
| Pines | 66 (70) | 60 (25) |
| Hardwoods | 34 (36) | 40 (17) |

hairy, and pileated woodpeckers, the primary SPB predators, were 8 to 58 times more abundant within infestations than in noninfested areas (fig. 5). Densities of red-bellied woodpeckers also increased, but to a lesser extent (3–20 times). The three primary predators increased their activity on pine trees within beetle infestations and reduced their use of hardwood species; red-bellied woodpeckers showed little change in feeding activity on pine and hardwood trees.

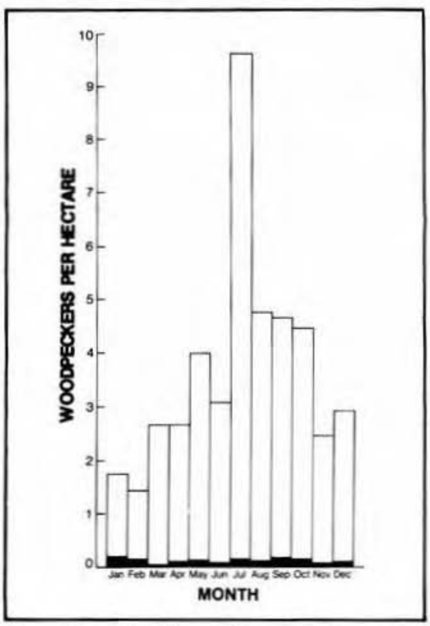



Figure 5.—Densities of downy, hairy, and pileated woodpeckers in SPB-infested (open bars) and noninfested stands (shaded bars).

## Impact of Woodpeckers on SPB Populations

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As we mentioned, initial attack by SPB occurs at about 10–15 ft and proceeds toward the crown and base of the tree. The first sign of woodpecker predation also appears at the initial SPB attack height, where birds strip away bark and expose immature beetles (fig. 6). The area of bark stripping expands as woodpeckers seek more SPB above and below the original point of attack.

Predation by woodpeckers is greater in trees containing more advanced beetle life stages, such as pupal and emerging adult stages. Although the birds prey on all life stages, they prefer larger forms of the insect, like pupae and adults. These stages are easier to locate and excavate from the bark than eggs and larvae. Over all seasons, woodpeckers cause an average SPB mortality ranging from 3.5 percent for eggs to 63.5 percent for emerging adults in East Texas. Winter mortality for emerging adults averages 23 percent.

Figure 6.—Initial woodpecker feeding at or near midbole (above), and later feeding above and below this region as the beetles mature (below).

Table 2.—*Comparison of winter population densities of southern pine beetle and insect associates by standardized tree height, for screened and unscreened trees.*

| Standardized tree heights | SPB life stage or associate | Mean density (per $dm^2$) | |
|---|---|---|---|
| | | Screened trees | Unscreened trees |
| **Lower bole** | Larvae | 36.1 | 28.9 |
| | Pupae | 13.1 | 1.1 |
| | Brood adults | 9.8 | 11.4 |
| | Predators | 0.0 | 0.9* |
| | Parasites | 0.1 | 0.2 |
| **Middle bole** | Larvae | 16.1 | 11.8 |
| | Pupae | 24.6 | 0.8* |
| | Brood adults | 16.6 | 14.1* |
| | Predators | 0.5 | 0.4 |
| | Parasites | 0.1 | 0.3 |
| **Upper bole** | Larvae | 19.5 | 24.8 |
| | Pupae | 7.6 | 1.0 |
| | Brood adults | 16.3 | 9.6 |
| | Predators | 0.0 | 0.4* |
| | Parasites | 0.4 | 0.4 |

*Significantly different at the 0.05 level. (From Kroll and Fleet 1979.)

East Texas studies, in which woodpeckers were excluded from portions of SPB-infested trees by screens (fig. 7), indicated that significant beetle impact occurred only at midbole (table 2). Differences in predation were not significantly different between screened and unscreened portions of lower and upper boles, respectively.

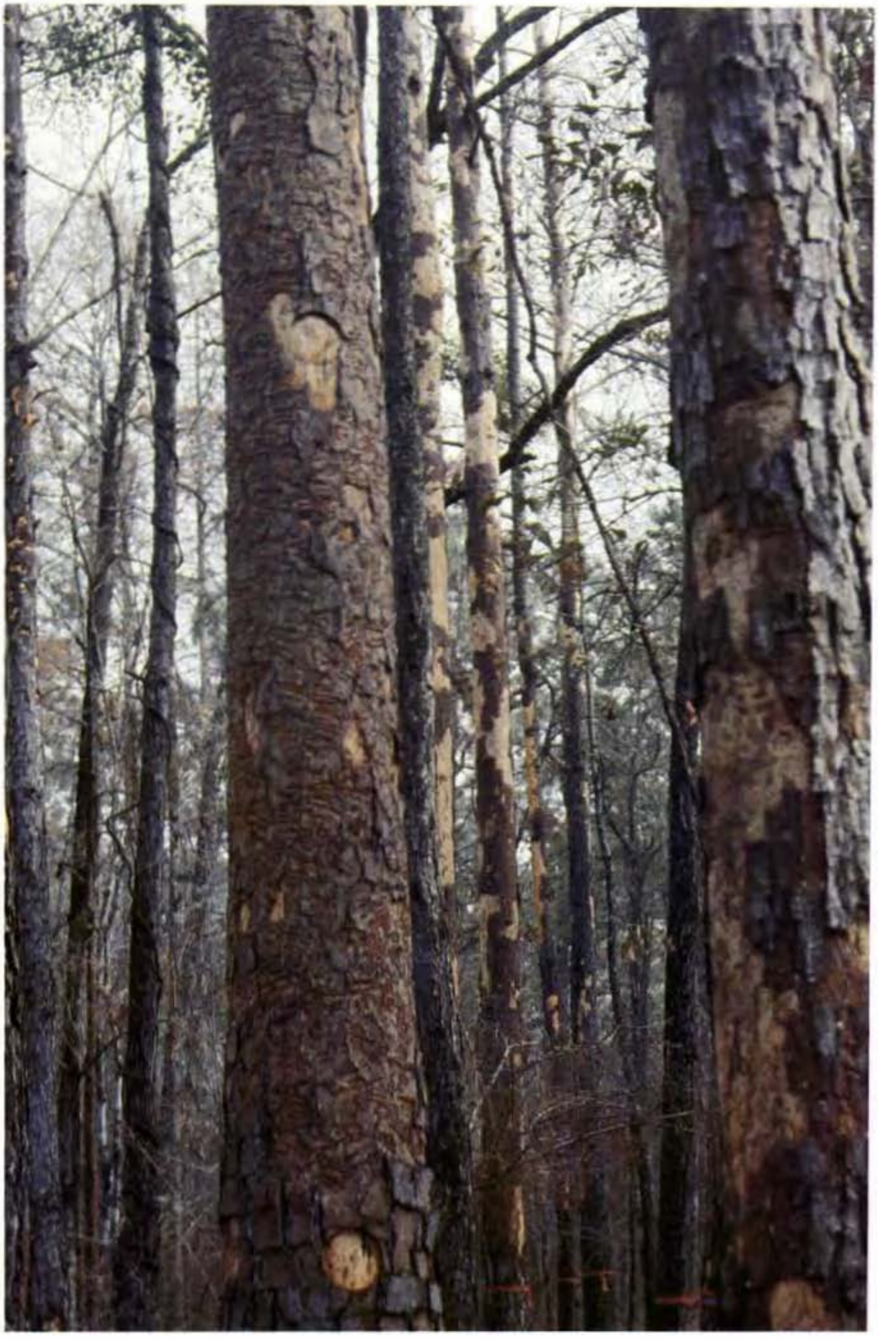
Woodpecker predation on SPB is controlled by several variables, including season and temperature, species of pine attacked, and species of woodpecker feeding in the area of beetle attack. In East Texas, for example, woodpecker populations vary seasonally, the highest numbers occurring in midsummer and the lowest in late winter. But the birds remove more beetles in winter and fewer in summer. In winter, because of cooler temperatures, beetles develop more slowly than in summer, so woodpeckers have more time to prey on a single generation. In the absence of other food sources, the birds probably concentrate on beetle-infested trees, too.

Figure 7.—Partial screening of beetle-infested bole to exclude woodpecker predation on SPB.

Researchers in Texas and Arkansas found that SPB have lower survival in shortleaf than in loblolly pine. This is probably a result of many factors, one of which seems to be the thinner bark on shortleaf pine. Studies also revealed that woodpeckers remove about twice as much bark from shortleaf pines as from loblolly pines (fig. 8).

Woodpeckers do not actually eat all the SPB they remove from trees. Some of the larvae and pupae wriggle free from the bark and fall to the ground in dislodged bark chips (fig. 9). Survival in dislodged bark is low for all seasons, ranging from 5 percent in winter to 23 percent in spring.

Woodpecker feeding or scaling of bark also indirectly increases SPB mortality. Thinning of bark exposes various life stages to adverse environmental conditions like excessive heat or low humidity. As a result, larvae escaping woodpecker predation may later die from dehydration or heat stress. Exposure of the inner bark surface also permits the early establishment of fungi and bacteria, some of which reduce bark beetle survival.



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## Considerations for Forest Managers

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Woodpecker foraging favors predation and parasitism by such insects as clerid beetles and wasps. Clerid beetles, both as adults on the bark surface and larvae inside the bark, are well-known predators of SPB. Density of this predator increases in the bark remaining after woodpecker feeding. As the birds strip more and more bark, surviving clerid larvae seem to concentrate in the remaining bark. This increases the probability that an SPB will be consumed. In addition, bark thinning by woodpeckers makes SPB larvae more accessible to parasitic wasps. In East Texas, average within-tree insect predator densities and parasite densities were 38 to 87 percent more abundant, respectively, in bark remaining on trees after woodpecker foraging.

Figure 8.—Heavier bark removal from shortleaf pine (left) than from loblolly pine (right).

Figure 9.—Piles of beetle-infested bark debris around the base of infested tree following woodpecker foraging.

Outbreaks of SPB probably result from environmental imbalances favoring the beetle over its host pine trees and lessening natural mortality of the insect. In integrated forest pest management programs, populations of natural enemies should be maintained and enhanced whenever possible. Management practices that favor higher populations of SPB predators and parasites should increase their capability to buffer SPB population irruptions. If forest managers want to favor woodpeckers known to feed on SPB, certain management options are available. Some options, however, may not be compatible with all management situations and economic considerations.

## Limit Size of Clearcuts

Certain timber management practices may reduce the abundance of woodpeckers that feed on SPB. Clearcutting large tracts of land is detrimental; it takes large areas out of "woodpecker production" for 20–30 years. If beetle epidemics occur in such areas when trees mature, few woodpeckers would be present to help stop beetle increases. Clearcuts of 20–40 acres in size would have a smaller negative effect on woodpecker abundance.

Long, narrow clearcuts with an irregular shape might be preferred to square clearcuts. Using narrow cuts, a larger area could be harvested but the impact on woodpeckers would not be as great as in a similar-sized square cut.

## Consider Site Preparation Alternatives

Site preparation after clearcutting also influences woodpecker abundance. During all seasons, but mainly in summer and fall, woodpeckers supplement their insect diet with fruits, nuts, and berries of native wild plants. Chopping and using K-G blades to prepare sites for pine seedlings greatly decrease the abundance of deciduous plants producing these fruits in East Texas. If site preparation is necessary, winter burning is the preferred treatment, and certainly less expensive.

Not preparing a site after harvesting favors woodpeckers. Fruit-producing plants then remain relatively undisturbed and branch slash left on the ground provides foraging sites for downy and hairy woodpeckers for several years. However, such an approach would discourage tree establishment and survival on many sites.

## Manage for Snags

Table 3.—*Recommended sizes and numbers of snags to maintain selected densities of woodpecker populations (Evans and Conner 1979).*

| Species | Probable optimum d.b.h. ranges of nest trees in inches | Optimum ranges of nest tree heights in feet | Range in number of snags needed per 100 acres | | |
|---|---|---|---|---|---|
| | | | Good | Fair | Poor |
| Downy woodpecker | 6–10 | 10–30 | 400–320 | 240–160 | 80 |
| Hairy woodpecker | 10–14 | 20–45 | 200–160 | 120–80 | 40 |
| Pileated woodpecker | 18–26 | 40–70 | 24–19 | 14–10 | 5 |
| Red-bellied woodpecker | 14–22 | 40–60 | 270–220 | 160–110 | 55 |

Any trees remaining in clearcuts after site preparation should be left standing. They are valuable to woodpeckers as foraging sites and potential nest trees. If it is necessary to prevent competition with growing seedlings, live deciduous trees can be killed but left standing (fig. 10). They could be girdled or injected with a silvicide not harmful to non target life forms.

In pine forest management, Timber Stand Improvement (TSI) generally results in removal of deciduous trees and trees with any signs of damage or decay. Removal of all deciduous vegetation is unfavorable to woodpeckers, since pure stands lack insects normally associated with deciduous vegetation. Selective killing of hardwoods in mixed pine-hardwood stands, however, can enhance the quality of woodpecker habitat (fig. 11). These trees could be killed and left standing as foraging sites and potential nest cavity sites.

Woodpeckers need trees with fungal heartrots for nest sites. The fungal decay softens the heartwood and facilitates nest cavity excavation. Removal of trees with existing holes, dead branches, or some other sign of decay can reduce availability of woodpecker nesting sites and seriously impair woodpecker reproduction. Remember, too, that many woodpecker nest trees have their tops broken off, so such trees should not be removed.

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Figure 10.—Snag containing a pileated woodpecker nest cavity.

## Lengthen Timber Rotation Ages

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Timber stand improvement *for woodpeckers* can be accomplished by providing a certain number of snags per acre for each species. Varying the number and size of snags can maintain woodpecker populations at desired population levels (table 3). Thus, it may be possible to influence woodpecker abundance within a managed area by regulating the number of snags.

Figure 11.—Selective killing of hardwoods of varying sizes to provide nesting and feeding sites for woodpeckers.

Short rotations can reduce woodpecker abundance. A rotation age of 70 years is a minimum for downy and hairy woodpeckers. In this time trees grow to sizes suitable for both nesting and foraging. In addition, fungi would have enough time to create suitable nest site conditions in some trees. Pileated woodpeckers require larger trees and more dead wood for foraging sites than do the smaller woodpeckers. Rotations that favor pileateds should exceed 80 years in pine forests. Optimum rotation ages should probably exceed 120 years. Rotation ages should be based on tree species, site, and management regime.

## Leave Some Mature Forest

Even small areas of mature forest provide valuable habitat for woodpeckers. If ¼ acre of each 5 acres cut was allowed to reach maturity and be maintained as such, this would help the smaller woodpecker species during early stages of timber regeneration. This method would not necessarily work for pileated woodpeckers, which require larger areas of mature forest. While the arrangement of these uncut areas could be somewhat flexible, maintaining winding but manageable corridors should be favored over small, unmanageable clumps. Such corridors (at least 150 ft wide) would provide opportunities for limited foraging and nesting sites immediately following clearcutting and would also be of value for longer periods of time.

On tracts of timber having prominent drainage patterns or inaccessible areas, corridors could be left and subsequently tied in with other uncut areas. An uncut area 20 times the width of streams, not to exceed a total width of 200 ft, could be left on both sides of water courses as a buffer strip. This uncut area would have the additional benefits of reducing erosion and siltation, as well as providing a forest canopy over streams where warming could harm fish populations and habitat.

## Cutting Technique and Beetle-Killed Trees

During cutting operations trees are cut as close to the ground as possible. The value of cut areas to pileated woodpeckers can be enhanced greatly by "high stumping" a few of the trees (fig. 12). The resulting 3-ft-high stumps would soon be invaded by termites or carpenter ants, both of which are eaten by pileated woodpeckers. However, in many situations, regulations, economics, and equipment limitations prevent the implementation of high stumping for large numbers of trees.

Beetle-killed pines can also be important to woodpeckers after the beetles are gone. A few of these trees should be left standing as nesting sites for woodpeckers. If an infested stand is to be salvaged, some trees should be left unharvested.

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Figure 12.—"High stumping" to provide excellent foraging for pileated woodpeckers.

## Summary

Woodpeckers are important predators of the southern pine beetle. The greatest control by these birds probably occurs during periods of low beetle populations. Once SPB populations reach epidemic levels, the buffering effect of woodpeckers is reduced. Woodpecker predation can be optimized by modifying current forest management practices. Since woodpeckers do not seem to fly long distances to SPB infestations, stand conditions favorable to nesting and foraging should be maintained in nearby stands. A number of woodpecker management options have been suggested in this booklet. Incorporation of one or more of these in forest management practices would favor woodpecker populations.

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