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The Potential of Girdled and 2,4-D-Injected Southern Red Oaks As Woodpecker Nesting And Foraging Sites

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The Potential of Girdled and 2,4-D-Injected Southern Red Oaks As Woodpecker Nesting And Foraging Sites

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ABSTRACT. Comparisons of extent of decay in southern red oaks (Quercus falcata *Michx.*) *revealed that trees injected with 2,4-D decayed sooner than girdled trees. Internal examinations of treated trees revealed that girdling and injection permitted growth of heartwood- and sapwood-decaying fungi, a condition necessary for woodpecker nest cavity excavation. As a result of the delayed decay, girdling produces better woodpecker habitat in southern red oak. Girdled southern red oaks remain standing longer for woodpeckers to use as foraging and nesting sites. Numbers of snags required to support various percentages of woodpecker population maximums are presented.*

Woodpeckers are an important component of forest ecosystems. They feed regularly on insects that damage both pines and hardwoods (Kroll et al. 1980) and provide cavities for many other wildlife species (Evans and Conner 1979). Important problems in woodpecker management are determining how many snags woodpeckers require for nesting and foraging, and how these snags can be provided.

Girdling or herbicide injection of hardwood trees during timber stand improvement (TSI) creates dead trees suitable as nesting and foraging sites for woodpeckers. Conner et al. (1981) examined the fruiting bodies (conks) of fungi that fruited on four species of 2,4-D-killed hardwood trees in east Texas. They determined that the herbicide did not prevent heartwood- and sapwood-decaying fungi from growing in the trees, but they did not determine if the trees were sufficiently decayed for woodpecker nest cavity excavation. Woodpeckers require a decayed heartwood in hardwood trees in order to excavate next cavities (Conner et al. 1976).

Preliminary observations also suggested that trees injected with the herbicide fell sooner (three to four years) than trees killed by natural causes, making them of only short-term use for cavity nesters (Conner et al. 1981). Any snag, such as an injected or girdled tree, that has a decayed heartwood is a potential cavity site for woodpeckers (Conner 1978). All snags are also important as foraging substrata for woodpeckers during all stages of decay (Evans and Conner 1979).

We compared the internal conditions of both 2,4-D-injected and girdled southern red oaks to determine which TSI technique would best create trees suitable for woodpecker nest sites.

METHODS

Thirty-six southern red oaks with similar heights ($\times$ = 17.3 m), d.b.h. (28.4 cm), and bole lengths (8.9 m) were selected on a 130 ha mixed loblolly (*Pinus taeda*)-shortleaf (*P. echinata*) pine-hardwood forest on the Temple-EasTex Inc., North Boggy Slough Hunting and Fishing Club in Houston County, Texas. Twelve of these trees were randomly assigned to herbicide treatment (basal injection of 2,4-D amine),[1] 12 trees to girdling (basal girdling to a minimum depth of approximately 7 cm with a chainsaw), and 12 trees as controls (no treatment). Trees were treated from 2 to 13 October 1978.

All trees were divided into five standardized sampling zones dividing the total tree height by 5. Subsequently, two increment cores were removed from each sampling zone at one month and two cores at 12 months after treatment. Increment cores were stored in plastic soda straws, labeled, and frozen until analyzed. We filled each hole with an alcohol-(95-percent ethanol) sterilized wooden dowel rod to assure that decaying organisms could not invade the trees via the increment core wounds. Increment boring equipment was washed with 95 percent ethanol prior to each use. Changes in specific gravity of the increment cores over time

[1] Weeder 64®, Union Carbide

were used to indicate presence and extent of decay. Increment cores from the five standardized heights were combined to produce a composite sample because no significant differences in heights were detected. The maximum moisture content method (Smith 1954) was used to determine specific gravities of increment cores. Specific gravity data did not differ significantly from normality (Kolmogorov-Smirnov one sample test, $P < .05$) and treatments and control data were compared with a one-way analysis of variance for each sampling period.

On April 8, 1980, 18 months after treatment, four girdled and three herbicide-injected trees were randomly selected and harvested. One 10 cm thick cylinder of wood was cut at each of the five standardized heights from each of the trees. These 35 cylinders were aseptically split and chips of wood from three locations in each cylinder (two from heartwood, one from sapwood) were cultured on malt agar (7.5 g malt + 10 g agar/500 ml H_{2O}). Species of higher fungi (basidiomycetes) growing from the wood chips were identified by macro- and microscopic examination (Davidson et al. 1942, Nobles 1965). Identifications were confirmed by K. Nakasone of the Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin. We also recorded imperfect fungi and bacteria growing out of the chips of wood.

RESULTS AND DISCUSSION

Bark began to split extensively up the sides of injected tree trunks within one month (Figure 1) and evidence of insect attack was conspicuous. Extensive bark splitting may have increased the susceptibility of injected trees to fungal infections. Girdled trees showed few signs of physiological difficulty until the following summer. Even though the phloem tissue of the girdled trees was completely severed, the trees partially refoliated in the following spring. Death did not occur in all of the girdled trees until about one year after treatment. Control trees exhibited no signs of stress or death during the study.

As fungi decay cellulose and lignin, the specific gravity of wood tissue decreases (Cartwright and Findlay 1958). Specific gravities of samples from injected trees were significantly lower than those of either girdled or control trees 12 months after treatment (Table 1). While not significant at $P < .05$, specific gravities from girdled trees were slightly lower than control tree samples after 12 months. This evidence indicates that 2,4-D injection permitted fungi to infect the oaks faster than girdling.

Cultures grown from wood chips taken from treated trees also indicated that fungi infected the

Figure 1. Bark on 2,4-D amine-injected southern red oaks split extensively up the sides of tree trunks, possibly increasing the susceptibility of the tree to fungal infections.

herbicide-injected trees sooner than girdled trees. While frequency of decay by heartwood- and sapwood- decaying fungi was quite similar in both treatments, injected trees had a much higher infection rate with imperfect fungi and bacteria (Table 2). Higher frequencies of imperfect fungi and bacteria reflect more advanced stages of decay in oaks (Conner et al. 1976).

Visual examination of the wood cylinders from

Table 1. Average specific gravities (± SE) of composite increment core samples taken from herbicide-injected, girdled, and control southern red oaks in east Texas (n = 120).

Treatment	Number of months after treatment	
	1	12
Herbicide-injected	0.6062(±0.0087)	0.5769(±0.0076)[1]
Girdled	0.6069(±0.0100)	0.5829(±0.0011)
Control	0.6095(±0.0103)	0.5956(±0.0091)

[1] *Significantly different from control and girdled trees (P < .05, Duncan's New Multiple Range test).*

Table 2. Cultures grown from wood chips taken from herbicide-injected and girdled southern red oaks. Values reflect the percent of samples in which each culture was detected per treatment.

Cultured organism	Treatment: 2,4-D-Injected n = 45	Treatment: Girdled n = 60
	Percent	
Stereum complicatum[1] (Fr.)Fr.	33	56
Coriolus versicolor[1] (L. ex Fr.) Quel.	42	25
Phellinus gilvus[1] (Schw.) Pat.	8	
Spongipellis pachyodon[2] (Pers.) Kotl. et Pouz.		6
Poria latemarginata[1] (Dur. et Mont.) Cke.	8	
Unidentified basidiomycete		6
Imperfect fungi	87	35
Bacteria	67	10

[1] *Capable of decaying dead sapwood and heartwood.*
[2] *Capable of decaying heartwood in live and dead trees.*

which fungi were cultured also indicated that the 2,4-D-injected trees were more extensively decayed than the girdled trees. At the time injected and girdled trees were being harvested, an external examination of the control trees showed no evidence of stress or decay.

All species of fungi identified from both injected and girdled trees were capable of decaying heartwood. Thus, both girdling and 2,4-D injection can create internal tree conditions suitable for woodpecker cavity excavation.

Conner et al. (1981) speculated that herbicide-killed trees might only provide nesting and foraging sites for woodpeckers for a short period of time because injected trees fall quickly. Our results suggest that red oaks killed by girdling would provide foraging and, possibly, nesting sites for woodpeckers and secondary cavity nesters (animals using woodpecker cavities) for a longer period of time than herbicide injection because the initiation of decay in girdled trees takes longer. Girdling, however, may be more costly than 2,4-D injection.

Timber stand improvement that includes basal injection of some trees and girdling of others might provide snags suitable for cavity excavation for a longer period of time than either method by itself. Basal injection would provide an initial supply of snags for nesting. When the injected snags fell or became too decayed to be useful, snags created by girdling would still be available to provide sites for cavity excavation and foraging.

Woodpeckers can benefit from TSI, if snags of sufficient numbers and sizes are provided. Snag requirements of woodpeckers in the South are quite similar to that reported by Evans and Conner (1979) for the north central and northeastern United States (Table 3). Since some snags are not suitably decayed for nesting (Conner et al. 1976), extra snags must be provided to meet minimum nesting and roosting requirements. A pair of woodpeckers requires at least four cavities during the year: one for nesting, and at least three others for roosting. Young woodpeckers of the year will also require roost cavities for their first winter. Individual woodpeckers typically have several roost cavites and frequently shift to different roost cavities throughout the year (Allen 1928, Hoyt 1957, Stickel 1964). Natural selection has apparently favored this behavior to reduce losses of roosting woodpeckers to nocturnal predators. Nine extra

Table 3. Recommended numbers of snags to maintain selected breeding densities of woodpecker populations in the southern United States (revised from Evans and Conner 1979 for southern forests).

Species	Optimum d.b.h. ranges of nest trees		Optimum ranges of nest tree heights		Snags needed per 4.0 ha (10 ac) to maintain listed percentages of population maximums: Excellent	Good		Fair	Poor
					100	80	60	40	20
	cm	*In.*	*m*	*Ft.*	*Number*				
Downy woodpecker (*Picoides pubescens*)	15–25	(6–10)	3–9	(10–30)	40	32	24	16	8
Hairy woodpecker (*P. villosus*)	25–35	(10–14)	6–12	(20–40)	20	16	12	8	4
Pileated woodpecker (*Dryocopus pileatus*)	45–65	(18–26)	12–21	(40–70)	5	4	3	2	1
Northern flicker (*Colaptes auratus*)	30–44	(12–18)	6–12	(20–40)	5	4	3	2	1
Red-bellied woodpecker (*Melanerpes carolinus*)	36–53	(14–22)	9–15	(30–50)	27	22	16	11	6
Red-headed woodpecker (*M. erythrocephalus*)	40–60	(16–24)	9–21	(30–70)	20	16	12	8	4

snags must be provided for each cavity required by woodpeckers for nesting and roosting to maintain maximum woodpecker populations (Evans and Conner 1979). The extra snags are in fact not a real surplus, since woodpeckers depend on them as foraging sites. Also, many nest cavities are usurped from woodpeckers by many species of secondary cavity nesters. If extra snags are not provided, populations of both primary and secondary cavity nesters will be reduced. The numbers of snags listed in Table 3 represent percentages of population maximums; excellent habitat (100 percent) should provide snags to maintain woodpeckers and secondary cavity nesters at maximum densities. These numbers of snags are obviously unattainable in forests managed for timber products. The lower percentages in Table 3 allow a forest manager to determine what density of snags must be maintained to support various woodpecker population levels. Even the lowest densities of snags listed in Table 3 should provide sufficient snags to maintain viable woodpecker populations.

The numbers of required snags listed in Table 3 apply mainly to later stages of forest regeneration. In early regeneration stages (0 to 15 years) more snags of appropriate sizes would be needed to meet the total foraging requirements of woodpeckers, since live trees in more mature forests also serve as foraging substrate. An appropriate strategy for regeneration cuts would be to leave as many snags of a variety of sizes as possible.

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Harvesting Productivity Information For Southern Pines

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ABSTRACT. Studies estimating production rates for harvesting southern pines are reviewed and summarized. Types of harvesting productivity information, limitations, and applications are discussed. Southern pine harvesting studies are classified by harvest function, tree species, data type, and harvest type. Other sources of harvesting productivity data are described.

Harvesting trees is one of the most capital-intensive and expensive of all forest management activities. The high cost of harvesting suggests the importance of harvesting productivity—the basis underlying average costs. But dissemination of studies on harvesting productivity has been relatively limited.

This article surveys selected studies which have been published on the productivity of harvesting southern pines. It is similar to review articles on