Pileated Woodpecker Use of Elm Trees Killed by Dutch Elm Disease in Northern Wisconsin

Describes Pileated Woodpecker use of elm trees killed by Dutch elm disease in a northern Wisconsin forest and the important role dead and dying trees play as a source of food and shelter for wildlife.

by Thomas H. Nicholls

Tree pathogens and insect pests are generally viewed as harmful to forest health, even when the damage they cause is not widespread or serious. However, many of these interacting agents and their effects on tree hosts enhance wildlife habitat and diversity in natural and managed ecosystems (Haack and Byler 1993; Ostry and Nicholls 1992a). The purpose of this paper is to show the importance of Dutch elm disease caused by *Ceratocystis ulmi,* a vascular wilt fungal pathogen, in providing foraging sites for the Pileated Woodpecker (*Dryocopus pileatus*) (Fig. 1) in a northern Wisconsin forest.

Dutch elm disease (DED) was first recorded in a number of countries in Europe shortly after the first World War. By the end of 1976, an estimated 9 million of 23 million elms had been killed in southern Britain (Gibbs et al. 1977). To date, many more trees have died in Europe. But despite its name, DED is thought to have originated in Asia. The name "Dutch" merely reflects early research carried out on the fungus in the Netherlands.

In this country, DED was first discovered in Ohio in 1930 and around the Port of New York in 1933 (Schreiber and Peacock 1975). The fungus was introduced elm-veneer logs imported from Europe and has since spread throughout most of the United States where susceptible elms grow; the once common American elm (*Ulmus americana*) was the most susceptible of the North American elms. Once an elm tree is infected through the feeding wounds of adult European elm bark beetles (*Scolytus multistriatus*) or native elm bark beetles (*Hylurgopinus rufipes*), or through root grafts between diseased and healthy trees, trees die quickly, sometimes in a matter of weeks. Millions of elms have died in the United States since the fungus was introduced. More trees continue to die

Figure 1. Pileated Woodpecker banded and ready for release on the study area in Price County, Wisconsin.

each year as a result of this rapidly spreading, virulent fungus.

DED was first reported in southeastern Wisconsin in 1956. It rapidly moved north and west primarily along waterways, in raw products like elm firewood, spreading statewide by 1975 (Wisconsin DNR 1983). It has killed thousands of elm trees in both urban and rural areas in Wisconsin. In 1969 this disease was first reported in Price County (Wisconsin DNR 1969), where our study was conducted.

The Pileated Woodpecker has a range that covers most of wooded North America. But by the turn of the 20th century, populations had decreased in many parts of its range. The decline in numbers was so alarming that many people felt this woodpecker was as doomed as the Ivory-billed Woodpecker (*Campephilus principalis*) (Hoyt 1957).

Pileated woodpeckers could be found throughout Wisconsin before the advancing plow in the southern part of the state and the intensive logging that decimated the northern forests (Robbins 1991). In some areas around the Baraboo bluffs and the Wisconsin River bottoms, birds disappeared around 1900 even though suitable forest habitats were most likely available. Stoddard (1947) believed this early decline was due more to shooting by woodsmen and fur trappers than to habitat destruction. In recent years Pileated Woodpeckers have been on the increase in Wisconsin as new forests, developed after turn-of-the-century logging, age into more suitable habitat (Robbins 1991).

The Pileated Woodpecker forages primarily on carpenter ants (*Camponotus pennsylvanicus*), wood borers, and other large-wood-inhabiting insects. Dying and dead trees attract these kinds of insects. Casual observations made while driving around the Wisconsin countryside alerted me to what appeared to be important opportunistic Pileated Woodpecker and other wildlife-use of elm trees killed by DED. This paper documents such use in a contiguous mixed conifer-deciduous forest in northern Wisconsin where most of the elm trees have been killed by DED.

Methods

Fifty-three recently DED-killed elm trees were randomly selected for study in 1985 on a 40-acre tract of a 40- to 65-year-old mixed conifer-deciduous forest near Fifield in Price County (S12 T39N R1W), Wisconsin. The

dead trees were numbered, tagged, and periodically monitored for Pileated Woodpecker activity from 1985 through 1992. Freshly created and frequently used foraging excavations could be identified by the tan color of the exposed wood; older excavations turned gray within 1 year from lack of use and weathering. This color difference was helpful in identifying trees that were actively being used for foraging. Binoculars were used to locate roundheaded wood borer (Ceramycidae) exit holes above 10 feet.

The following information was recorded for each tree on the initial visit in 1985: diameter at breast height (DBH), number of active (tan) and inactive (gray) Pileated Woodpecker foraging excavations present, and number of trees with pencil-sized exit holes of roundheaded cerambycid wood borers (USDA Forest Service 1985). Subsequent visits in April 1986, October 1987, April 1988, and May 1992 were made to each tree to record the cumulative number of Pileated Woodpecker foraging excavations, presence of large wood-borer exit holes, and change in tree condition compared to previous visits. Casual observations of wildlife use by other species were also made. Data were analyzed using the likelihood ratio chi-square statistic.

Results

The initial 1985 data revealed that Pileated Woodpeckers had foraged on 22 of the 53 dead trees (Table 1). Although other insects such as ants and flatheaded wood borers (Buprestidae) were present in some trees, the roundheaded cerambycid wood borer of the genus Trigonarthris appeared to be the primary food target of Pileated Woodpeckers in DED-killed trees (Fig. 2). The woodpeckers focused their foraging activity on trees infested with wood borers (Fig. 3). All foraging holes were on trees with cerambycid exit holes. But not all trees (21%) with cerambycid exit holes had foraging holes. Most cerambycid exit holes were found within 15 feet of the ground on 28 of the 53 dead trees (Table 1). Wood borers preferred trees larger than 9 inches DBH ($P = .009$). Although woodpeckers were more active on larger diameter trees ($P = .03$), their preference for the larger trees reflects the presence of wood borers in those trees rather than tree diameter alone ($P = .96$).

From 1985 to 1992, the number of dead trees used by the Pileated Woodpecker increased from 42% in 1985 (22 of 53) to 72% by 1992 (38 of 53) and the total number of foraging holes increased 128% from 164 in 1985 to 374 in 1992 (Fig. 4). Initial exploratory foraging holes were round, but if woodpeckers found insect larvae, such

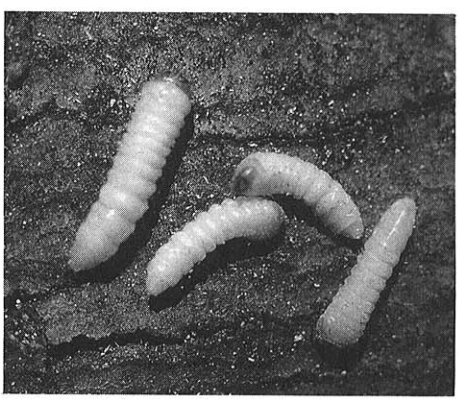

Figure 2. Larvae of roundheaded wood borers, a primary food source of Pileated Woodpeckers in dead elms.

Figure 3. Pileated Woodpeckers target dead elm wood infested with cerambycid wood borers as indicated by woodpecker activity around beetle exit holes.

trees became favored foraging sites as indicated by the duration of use, high number of elongate excavations deep into the heartwood (Fig. 5), and large piles of wood chips on the ground. The wood borer larvae tunnel into the sapwood and heartwood of large limbs and trunks. Compared to other woodpeckers, the Pileated is highly adapted to effectively extract such larvae from deep within the heartwood of large diameter trees. In addition to their using dead trees for foraging, Pileated Woodpeckers also used standing dead trees to advertise their territories by periodic "drumming."

When the dead elm trees were first tagged in 1985, most had their larger branches and bark intact indicating recent death. As time went on, bark sloughed off and larger branches began to break off. Brown Creepers (*Certhia americana*) nested in bark cavities created by shriveled-up bark before it was sloughed off. Creepers and nuthatches were commonly seen searching for insects in the bark and on the surface of the deadwood. Birds used some of the larger woodpecker excavations as night roosts as indicated by droppings left inside. Other species of woodpeckers and squirrels were attracted to the dead elm trees and used them for foraging and nesting. Fungi invaded the dead wood and produced fruiting bodies that were eaten by squirrels and other animals. DED-killed elm trees were evidently used by many organisms.

By 1992, 13 of the original 53 trees had rotted near ground level and fallen to the ground. Pileated Woodpeckers continued to forage for insects on some of these downed logs as shown by fresh excavations (Fig. 6). The fallen

Table 1. Number of DED-killed American elm trees (N = 53) in 1985 with exit holes of cerambycid wood borers and foraging holes of Pileated Woodpeckers, by diameter class, in Price County, WI.

	Diameter at Breast Height (inches)					
	3–5.9	6–8.9	9–14.9	15–20.9	21–26.9	Total
No. elm trees by DBH class	1	7	31	11	3	53
No. trees with borers	0	0	15	11	2	28
No. trees with foraging holes	0	0	12	8	2	22

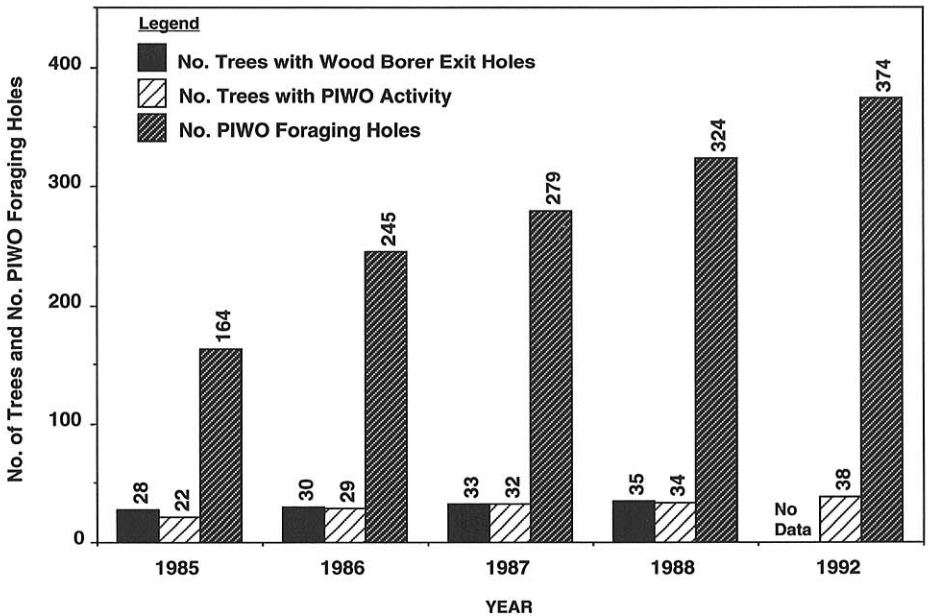

Figure 4. Number of DED-killed American elm trees (N = 53) with exit holes of cerambycid wood borers, number of trees with Pileated Woodpecker (PIWO) activity, and cumulative number of PIWO foraging holes during the period 1985–1992 in Price County, WI.

trees also created habitat for small rodents, reptiles, amphibians, and other plants and animals.

Discussion

Even though the death of millions of elms has been devastating and costly in aesthetic and economic terms, especially in urban areas, dead and dying elms in the forest are clearly not wasted in the biological and ecological sense. They are beneficial to a host of organisms, and the results of this study clearly show that Pileated Woodpeckers made good use of DED-killed trees. Kilham (1961) found DED important to the ecology of woodpeckers in the vicinity of Seneca, Maryland, where he found nest holes of Pileated, Red-bellied (*Centurus carolinus*) and Downy and Hairy Woodpeckers (*Dendrocopus pubescens* and *D. villosus*) in trees killed by DED. In addition, Downy and Hairy Woodpeckers were observed to consistently feed on various stages of the bark beetle vector of DED, which can occur in great concentration in the bark of some elms.

A whole series of successionAl events begins when a tree dies. As a tree dies, it sends out chemical "signals" that attract opportunistic bark- and wood-boring insects (Haack and Slansky 1987). Eventually, Pileated Woodpeckers and other animals are attracted to the dead and dying trees for shelter, food, and nesting, and the trees are used over a long period of time. There is no doubt that Pileated Woodpeckers play an important ecological role by excavating cavities that are later used by a host of other birds

Figure 5. Typical Pileated Woodpecker foraging excavation holes observed on dead elms infested with wood borers.

and small mammals (Thomas et al. 1979).

Most tree-damaging insects and diseases are looked upon in a negative sense when the primary management objectives are tree health and forest products. However, we shouldn't overlook the many positive aspects of forest pests in terms of their contributions to biodiversity and ecosystem health. For example, the Pileated Woodpecker clearly benefits from the activity of other pathogenic fungi. Bull et al. (1992) reported locating 123 roost trees used by 22 Pileated Woodpeckers in northeastern Oregon. Most of the roosts (62%) were in live and dead grand fir (*Abies grandis*) trees that had been decayed by the Indian paint fungus, *Echinodontiumn tinctorium.* This fungus had created hollow chambers inside trees where the birds roosted at night. Like the DED-killed elm trees in this study, infected grand fir trees were not wasted in the ecological sense because they provided shelter for this unique woodpecker.

Many wildlife biologists are concerned over the welfare of the Pileated Woodpecker because this species is one of the most sensitive to intensive forest management (Bull 1987). This woodpecker depends on large, dead trees and downed deadwood as reconfirmed by a recent study in Missouri (Renken and Wiggers 1993). Sometimes intensive forest management selects against the Pileated Woodpeckers by harvesting trees before they attain sizes suitable for this bird to carry out

Figure 6. A downed elm log used for foraging by the Pileated Woodpecker. Note the pile of wood chips excavated by the bird.

its life cycle. Such harvesting practices not only affect Pileated Woodpeckers, but could also affect other life forms such as the Boreal Owl (*Aegolius funereus*) that depend upon large live and dead trees (Lane et al. 1993).

Healthy trees alone do not make a healthy forest; dead and dying trees are crucial to maintaining biological diversity and ecosystem health (Ostry and Nicholls 1992b). The death of a tree does not spell an end to its usefulness in the ecosystem; its role simply changes. In the United States, at least 30% of the birds, mammals, reptiles, and amphibians depend upon snags and fallen trees to meet their life needs (Salwasser 1988). That does not even account for the fish, plants, fungi, and other life that depend upon dead and decaying wood for food, cover, and nesting. In addition, more than 120 species of birds, 140 kinds of mammals, and 270 species of reptiles and amphibians nest or forage in deadwood (Ackerman 1993). Many of these vertebrates benefit from tree-invading pathogens and insects that create habitat and supply food. The DED epidemic, in its coming and going, has provided a window of opportunity for Pileated Woodpeckers and other wildlife that forage and nest in dead elm trees.

Conclusion

Elm trees killed by DED remain standing long after death and are regularly used by Pileated Woodpeckers as insect foraging sites and territorial drumming sites. The larger diameter

elm trees harbored more wood borers and other insects. These trees were subsequently used by Pileated Woodpeckers over the course of several years, even after some of the trees had fallen to the ground. Though we mourn the loss of millions of DED-killed elm trees in our cities, many of the dead trees in the forest and countryside have provided habitat and other benefits to a wide variety of life forms that contribute to biological diversity in our landscape.

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Literature Cited

Ackerman, J. 1993. When the bough breaks. *Nature Conservancy* 43(3):8–9.

Bull, E. L. 1987. Ecology of the Pileated Woodpecker in northeastern Oregon. *Journal of Wildlife Management* 51(2):472–481.

Bull, E. L., R. S. Holthausen, and M. G. Henjum. 1992. Roost trees used by Pileated Woodpeckers in northeastern Oregon. *Journal of Wildlife Management* 56(4):786–793.

Gibbs, J. N., D. A. Burdekin, and C. M. Brasier. 1977. Dutch elm disease. Forestry Commission Forest Record 115, HMSO, Edinburgh. 12pp.

Haack, R. A. and J. W. Byler. 1993. Insects & pathogens—regulators of forest ecosystems. *Journal of Forestry* 91(9):32–37.

Haack, R. A. and F. Slansky. 1987. Nutritional ecology of wood-feeding Coleoptera, Lepidoptera, and Hymenoptera. Pp. 449–486. *In* F. Slansky and J. G. Rodriguez (eds.) *Nutritional Ecology of Insects, Mites, and Spiders, and Related Invertebrates.* John Wiley, New York, NY.

Hoyt, S. F. 1957. The ecology of the Pileated Woodpecker. *Ecology* 38(2):246–256.

Kilham, Lawrence. 1961. Downy Woodpeckers scaling bark on diseased elms. *Wilson Bulletin* 73(1):89.

Lane, W. H., T. H. Nicholls, and D. E. Andersen. 1993. Boreal owl and northern saw-whet owl cavity and nest-site characteristics in northeastern Minnesota. Abstract 84, 55th Midwest Fish and Wildlife Conference, Dec. 11–15, 1993, St. Louis, MO. p. 164.

Ostry, M. E. and T. H. Nicholls. 1992a. Do healthy trees make a healthy forest? *Phytopathology* 82(10):1135.

Ostry, M. E. and T. H. Nichols. 1992b. Do healthy trees make a healthy ecosystem? Pp. 129–130. *In* Proceedings of the 40th Western International Forest Disease Work Conference; July 13–17, 1992; Durango, CO.

Renken, R. B. and E. P. Wiggers. 1993. Habitat characteristics related to Pileated Woodpecker densities in Missouri. *Wilson Bulletin* 105(1):77–83.

Robbins, S. D., Jr. 1991. *Wisconsin Birdlife.* The University of Wisconsin Press, Madison. 702pp.

Salwasser, H. 1988. Animal inns: A key to diversity and partnerships. Pp. 9–11. *In* Proceedings, 1988 Animal Inn National Workshop. Chittenden, VT.

Schreiber, L. R. and J. W. Peacock. 1975. Dutch elm disease and its control. USDA Forest Service and Agricultural Research Service, Agriculture Information Bulletin 193. 15pp.

Stoddard, H. L., Sr. 1947. Reminiscences of Wisconsin birding. *Passenger Pigeon* 9(4):123–129.

Thomas, J. W., R. G. Anderson, C. Maser, and E. L. Bull. 1979. Snags. Pp. 60–77. *In* J. W. Thomas, ed. Wildlife habitats in managed forests—the Blue Mountains of Oregon and Washington. USDA Forest Service, Agricultural Handbook 553.

USDA Forest Service. 1985. Insects of eastern forests. USDA Forest Service Misc. Publication No. 1426. Washington, D.C. 608pp.

Wisconsin Department of Natural Resources. 1969. D. Renlund, ed. Forest pest conditions in Wisconsin, Annual Report 1969. 62pp.

Wisconsin Department of Natural Resources. 1983. A. Prey, D. Hall, and J. Cummings, eds. Forest pest conditions in Wisconsin, Annual Report 1983. 27pp.

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