United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

General Technical
Report NE-101

1985

Managing Cavity Trees for Wildlife in the Northeast

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Manuscript received for publication 20 September 1984

Abstract

This paper is a guide for woodland owners, managers, or arborists who want to provide key habitat components for northeastern cavity-nesting birds and mammals that use tree dens. Methods for creating and maintaining cavity trees, snags, and den trees are described.

Introduction

Dead trees and trees that contain decayed wood provide shelter for approximately a fourth of the forest wildlife species of the Northeast (Fig. 1). Both birds and mammals use cavities in such trees for shelter from the weather, to escape from predators, for foraging and caching food, and most importantly for producing and rearing young.

For years, cavity and den trees have been removed routinely both during timber management operations because they were thought to harbor diseases and insect pests, and in cities and towns because they were thought to be unsightly or hazardous. Wolf trees, likewise, have been removed routinely during timber management because their wide-spreading crowns suppressed other trees. These practices are starting to change because land managers and arborists now realize that most species of birds that use cavity trees feed primarily on insects, and thereby help prevent insect outbreaks. Also, public concern for the welfare of cavity-nesting wildlife has increased in recent years.

Figure 1.—Cavities in living, dead, and dying trees are used by many species of wildlife. These sugar maple trees have provided dens for many mammals.

How Cavities Form in Trees

Natural cavities develop when part of a tree dies or is injured. Death or injury can result from fire, insect attack, wind, snow or ice storms, logging wounds, herbicides, or other causes. Decay-causing fungi become established in tree wounds. Woodpeckers also create cavities when they excavate nesting, feeding, or roosting holes.

When a branch or a root dies, or when a tree is injured and infected, the tree responds by forming firmer boundaries to contain the injured and infected tissues or to resist the spread of infecting organisms. This defense process of boundary-setting is called compartmentalization. Boundaries and boundary-setting are the keys to understanding the development of cavities in trees.

The barrier zone is the tree's major defense boundary because it separates the older infected wood from the recently formed healthy wood. For example, if a tree is injured and infected when it is 4 inches in diameter, the greatest diameter of decayed wood will be 4 inches—about the right size for nest excavation by a downy woodpecker (*Picoides pubescens*). Organisms seldom spread beyond the barrier zone.

After branches and roots die, and after wood is injured by mechanical wounds, many organisms infect the dying and exposed tissues. Bacteria, nondecay-causing fungi, and decay-causing fungi are the major microorganisms that first interact with the tree. Discoloration and decay form as wood cell walls are broken down by microorganisms. As the decay process proceeds, many other organisms enter, such as insects and nematodes. The wood within the boundary set by the tree is slowly digested until a hollow results (Figs. 2, 3, 4).

Figure 2.—Dissection of a hemlock that was wounded by a black bear (see Figure 7). The wood sections show that the diameter of the tree at the time of wounding was the greatest diameter of decayed wood. As the wood breaks down, a cavity approximately 10 inches in diameter will develop in the tree.

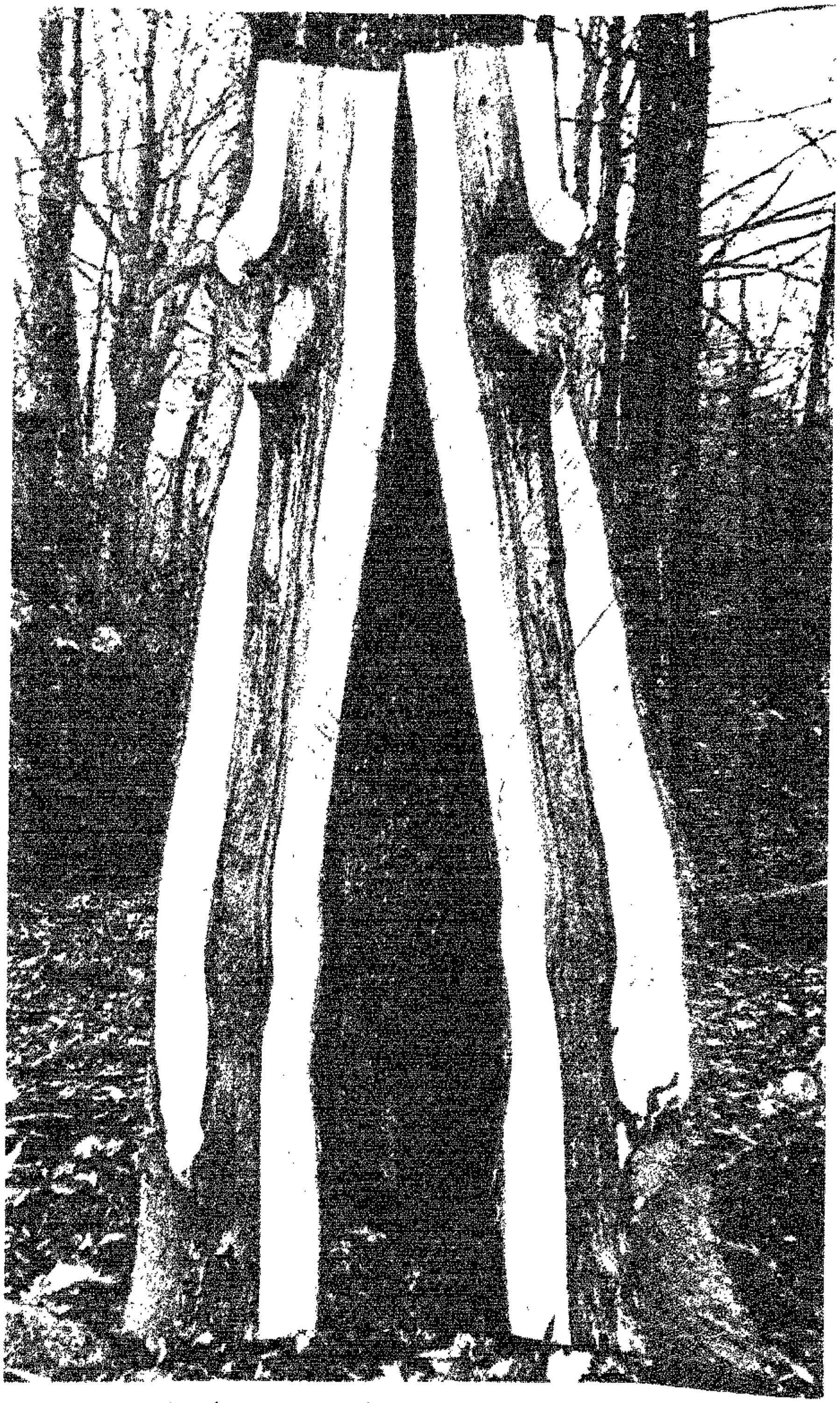

Figure 3.—Dissection of a sugar maple shows the internal column of decayed wood. The diameter of the internal column was the diameter of the tree at the time of wounding at the base and above at 8 feet.

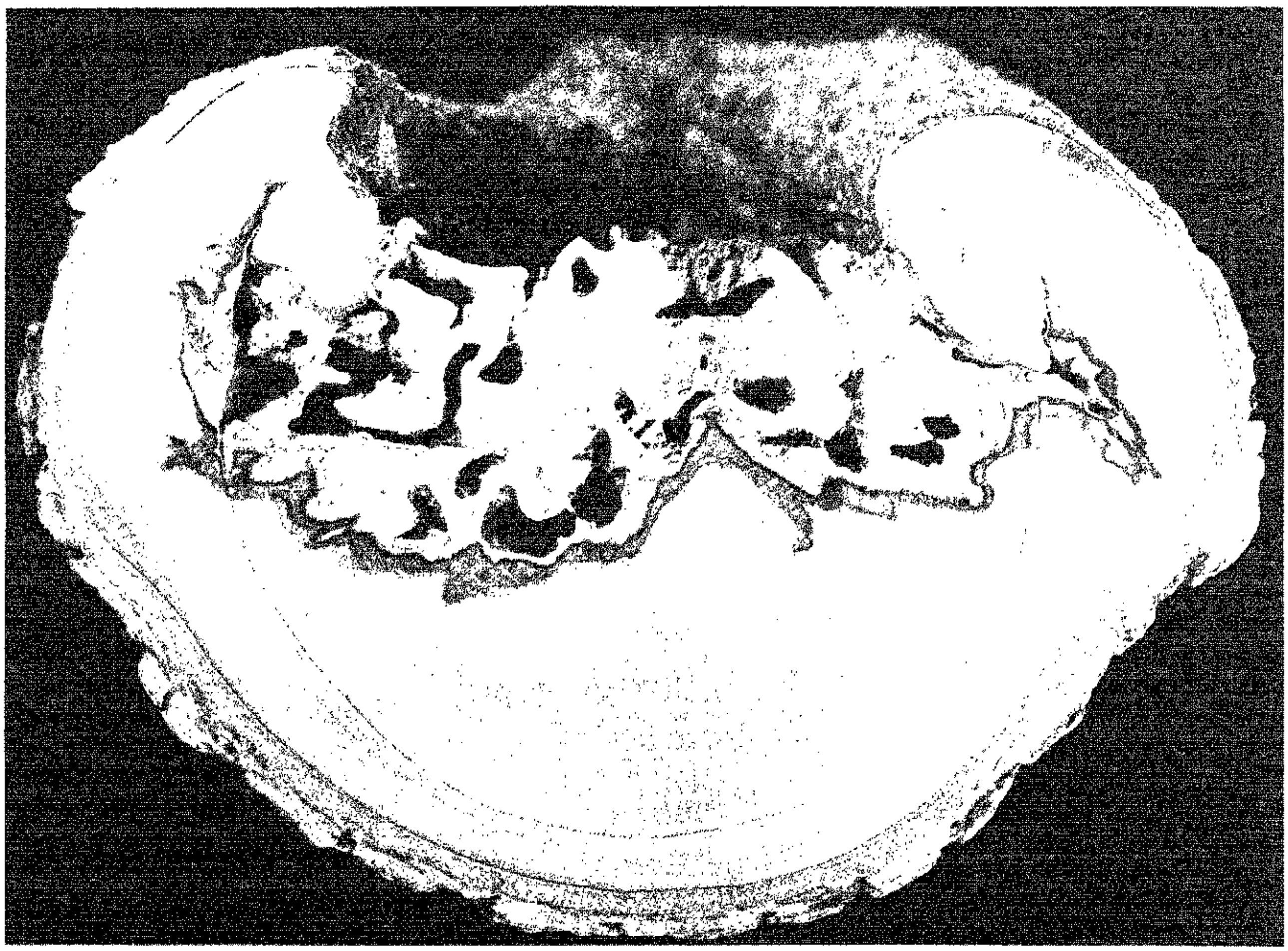

Figure 4.—The wound in this sweetgum was caused by a beaver. The decayed wood was within the diameter of the tree at the time of wounding. Note the barrier zone that formed completely around the trunk. The decay in time would have developed within the limits of the barrier zone. The barrier zones make cavities possible in trees.

But long before hollows form, in many trees woodpeckers may begin to either excavate the infected wood to form a cavity, or to drill into sound wood that surrounds the column of infected wood, and then into the infected wood (Fig. 5).

When leaders or main stems break or die on trees, a new leader may develop from a lower branch that is still alive. The stub of the old leader is called a stem stub. The column of decayed wood associated with stem stubs will be the diameter of the leader at the time of death, and the column will develop downward. As columns of decayed wood progress to hollows, they become ideal dens for many mammals. The cavities are most suitable when the leader was bent before it died—water does not flow into such cavities (Fig 6).

Often wounds occur at the base of large trees (Figs. 7 and 8). When the tree has the capacity to continue to grow, the diameter of the tree at the time of wounding will be the diameter of the defect. Such a situation can lead to the development of a cavity tree.

Trees survive after injury and infection because they wall off the infected wood. The boundary-setting process makes cavities possible in living trees. Knowing this, it is possible to regulate number and size of desired cavities for wildlife. For example, if an animal must have a cavity 4 inches in diameter, then some wounding must occur when the tree is 4 inches in diameter. Compartmentalization does give us new opportunities for wildlife management.

Figure 5.—Dissection of an aspen that was abandoned as a nesting tree by a yellow-bellied sapsucker. The sapsucker often selects aspen for nesting trees, especially trees that are greater than 10 inches d.b.h. Such trees often have large columns of firm decayed wood associated with canker rot fungi as shown here.

Figure 6.—Large cavity in a beech associated with a decayed stem stub that followed the decay of the leader when it was approximately 6 inches in diameter. The curved hollow is fine for cavity dwelling wildlife. Note also the sound roof to the cavity.

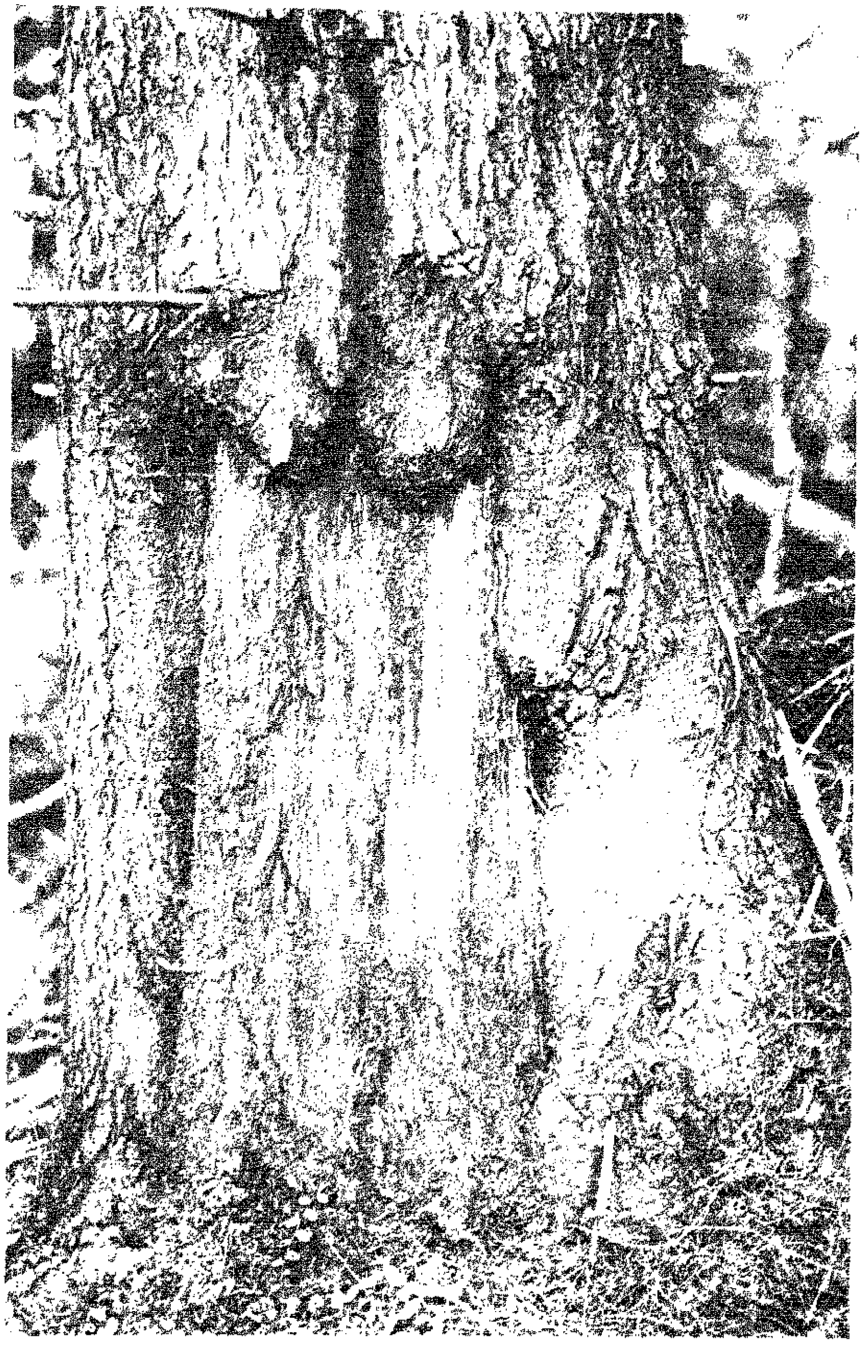

Figure 7.—Basal wound on western hemlock made by a black bear. Such wounds often start the processes that can lead to basal cavities.

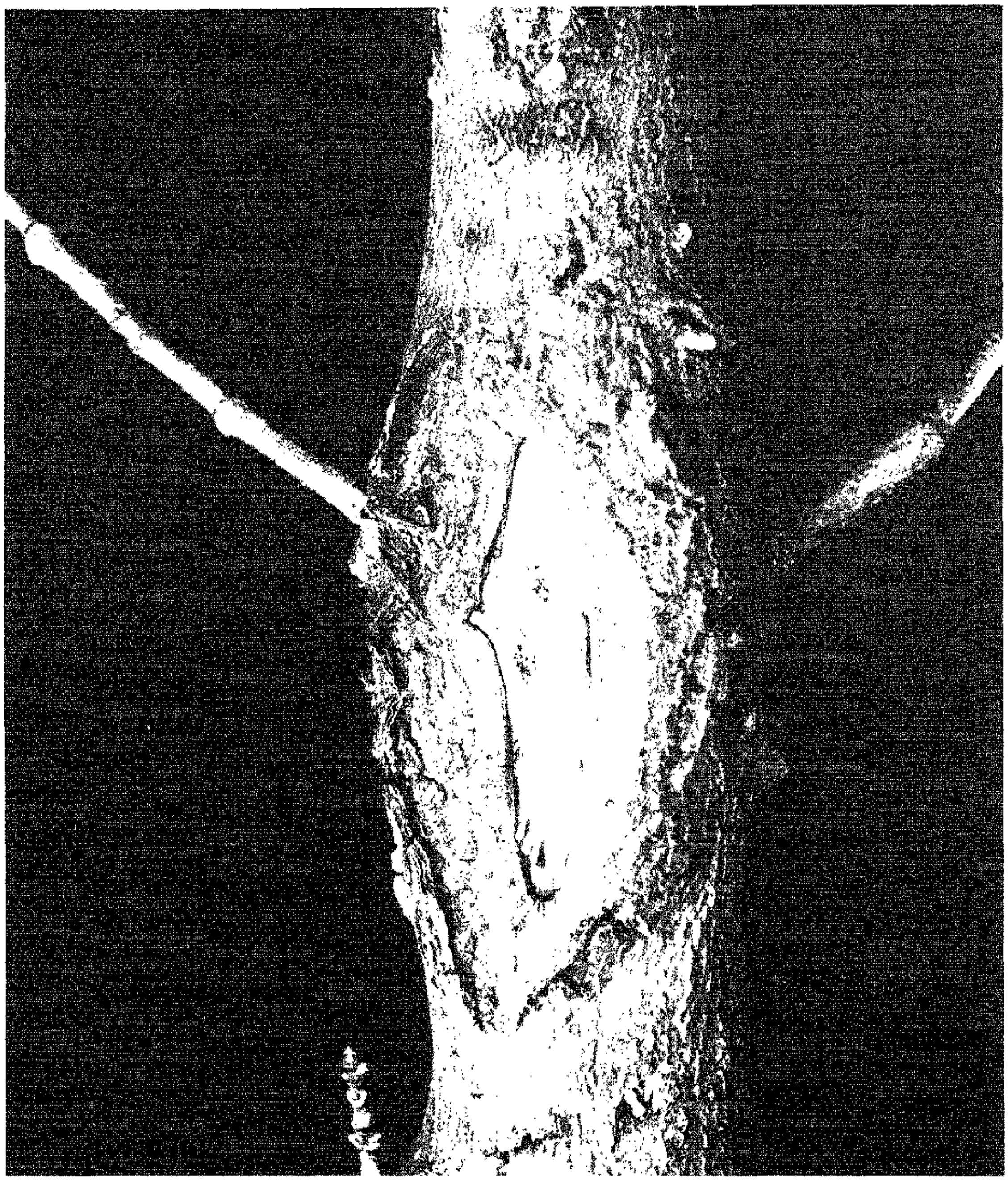

Figure 8.—The wound on this small sugar maple was caused by red squirrels gnawing the stem. The wound could be the start of a future cavity.

Effect of Degree of Decay

Depending on their size, degree of decay, cause of injury or death, and location, cavity trees are used by various wildlife species for several purposes (Table 1). As a tree slowly dies and decays, it goes through several successional stages that are used by different wildlife groups in turn (Fig. 9). After a tree dies, the bare branches provide perch sites for predators such as hawks and other raptors as well as flycatchers. Perches that project above the surrounding forest canopy or exist in clearings are used as lookouts for prey by birds such as American kestrels (*Falco sparverius*), Cooper's hawks (*Accipiter cooperii*), sharp-shinned hawks (*Accipiter striatus*), and broad-winged hawks (*Buteo platypterus*). The existence of such perches is a major factor in the use of a woodland by these birds. Flycatchers, likewise, use strategically located perches: Eastern phoebes (*Sayornis phoebe*), kingbirds (*Tyrannus tyrannus*), and great crested flycatchers (*Myiarchus crinitus*), least flycatchers (*Empidonax minimus*), and olive-sided flycatchers (*Contopus borealis*) catch or "hawk" flying insects, returning after each sally to the same perch. These perches, whether above or below the forest canopy, are important habitat components as they largely determine whether these species are present or absent.

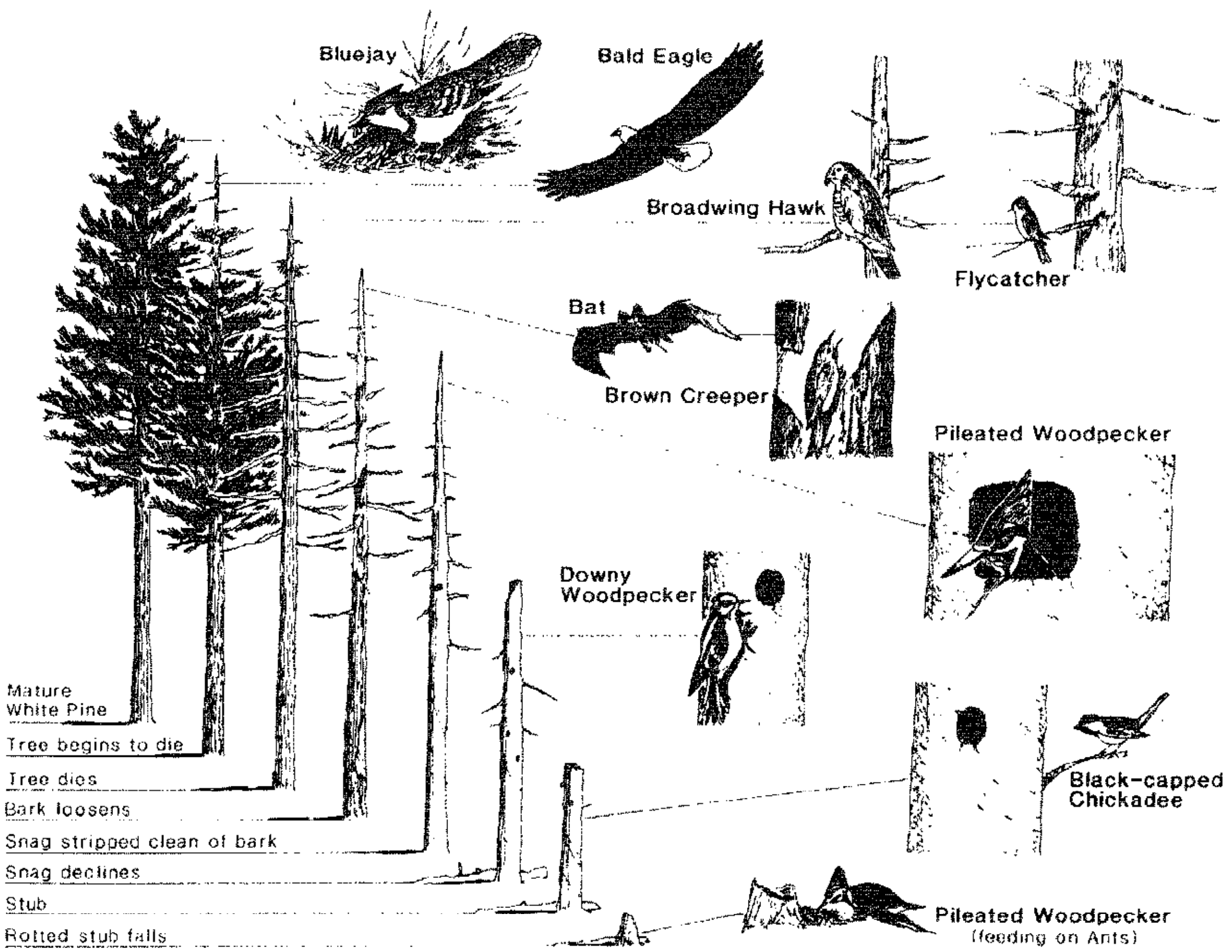

Figure 9.—Wildlife use changes as trees decay.

Table 1. Preferred habitat and use by cavity-nesting birds

Species	Tree				Use			
	Live, decayed	Dead, hard	Dead, soft	Best d.b.h.	Perch-ing	Feed-ing	Nest-ing	Roost-ing
				Inches				
PRIMARY EXCAVATOR								
Red-headed woodpecker *Melanerpes erythrocephalus*	X	X		20	X	X	X	X
Red-bellied woodpecker *Melanerpes carolinus*	X	X	X	16	X	X	X	X
Yellow-bellied sapsucker *Sphyrapicus varius*	X			12	X	X	X	X
Downy woodpecker *Picoides pubescens*	X		X	8	X	X	X	X
Hairy woodpecker *Picoides villosus*	X	X		12	X	X	X	X
Three-toed woodpecker *Picoides tridactylus*	X	X		10	X	X	X	X
Black-backed woodpecker *Picoides arcticus*	X			10	X	X	X	X
Northern flicker *Colaptes auratus*	X	X	X	12	X	X	X	X
Pileated woodpecker *Dryocopus pileatus*	X	X		20	X	X	X	X
Black-capped chickadee[a] *Parus atricapillus*			X	4			X	X
Boreal chickadee *Parus hudsonicus*			X	4			X	X
SECONDARY USER								
Wood duck *Aix sponsa*	X	X		20+			X	
Common goldeneye *Bucephala clangula*	X	X		20+			X	
Hooded merganser *Lophodytes cucullatus*	X	X	X	20			X	
Common merganser *Mergus merganser*	X	X		20			X	
Turkey vulture *Cathartes aura*	X	X	X	20+	X		X	
American kestrel *Falco sparverius*		X		12+	X		X	
Merlin *Falco columbarius*	X	X		20	X		X	
Common barn-owl *Tyto alba*	X	X		20+	X		X	X
Eastern Screech-owl Otus asio	X	X			X		X	X
Barred owl *Strix varia*			X	20			X	
Northern Saw-whet owl *Aegolius acadicus*		X	X	12+	X		X	X
Great-crested flycatcher *Myiarchus crinitus*	X			12+			X	
Purple martin *Progne subis*		X		12+			X	
Tree swallow *Tachycineta bicolor*		X		8	X		X	
Tufted titmouse *Parus bicolor*			X	6			X	X
Red-breasted nuthatch *Sitta canadensis*		X	X	12		X	X	X
White-breasted nuthatch *Sitta carolinensis*	X			12		X	X	X
Brown creeper *Certhia americana*	X	X		8+		X	X	X
House wren *Troglodytes aedon*	X	X	X	6+		X	X	X
Winter wren *Troglodytes troglodytes*			X	8+			X	
Eastern bluebird *Sialia sialis*		X	X	8+		X	X	
Prothonotary warbler *Protonotaria citrea*			X	8+			X	

[a] May also be a secondary cavity user

Further decomposition of the tree results in a transitory "loose bark" stage. This sloughing bark provides the nest site for the brown creeper (*Certhia americana*) and roosts for bats (Tables 1 and 2).

Primary excavators—essentially the woodpeckers—usually excavate cavities when decay is present in the stem. Trees with central columns of decay resulting from stem stubs are readily excavated by woodpeckers, especially downy, hairy (*Picoides villosus*), and pileated (*Dryocopus pileatus*) woodpeckers and northern flickers (*Colaptes auratus*). All species of woodpeckers that occur in the Northeast, except the yellow-bellied sapsucker (*Sphyrapicus varius*) and black-backed woodpecker (*Picoides arcticus*)—which use only live trees—excavate nest cavities in live or dead trees. But decay columns in live trees, especially those resulting from stem stubs, seem to be preferred. The hard exterior wood protects the easily excavated nest cavity. These excavated cavities are subsequently used by the so-called secondary cavity nesters—the birds that we commonly attract with nest boxes (Table 1).

After a standing dead tree has decayed to the point where most of the branches have fallen, it is called a snag if it is at least 20 feet tall, a stub if shorter. The soft, punky snag or stub in the final stages of decay is used as a foraging site by many insectivorous birds, and as a nest site by black-capped chickadees (*Parus atricapillus*), that do not chisel cavities as woodpeckers do, but merely pick out the soft punk to form a cavity.

Once the rotted stub falls, invading carpenter ants and other insects provide an important food source for pileated woodpeckers. Many species of amphibians and reptiles live and forage in and under the moist, soft, rotting wood. Many small mammals are also associated with down logs (Table 2).

Table 2.—Tree den or roost characteristics of New England mammals

Species	Characteristic
Virginia opossum *Didelphis virginiana*	Tree cavity or hollow-log den
Little brown myotis *Myotis lucifugus*	Hollow-tree roost
Keen's myotis *Myotis keenii*	Roost under loose bark of dead tree
Indiana myotis *Myotis sodalis*	Bear young in hollow tree, or under loose bark
Silver-haired bat *Lasionycteris noctivagans*	Roost in tree cavity or under loose bark
Big brown bat *Eptesicus fuscus*	Roost in hollow tree
Eastern chipmunk *Tamias striatus*	Den in or under old logs
Gray squirrel *Sciurus carolinensis*	Den in cavities in tall hardwood trees
Red squirrel *Tamiasciurus hudsonicus*	Den in tree cavity—conifer preferred
Southern flying squirrel *Glaucomys volans*	Den in tree cavities or woodpecker holes in mature woodland
Northern flying squirrel *Glaucomys sabrinus*	Den in tree cavities or woodpecker holes in mature woodland
Southern red-backed vole *Clethrionomys gapperi*	Uses mossy logs, fallen trees for cover
Porcupine *Erethizon dorsatum*	Den in cavity in large trees
Gray fox *Urocyon cinereoargenteus*	Den in hollow logs, tree cavities
Black bear *Ursus americanus*	Den under fallen trees, in large hollow logs
Raccoon *Procyon lotor*	Den usually 10 ft. or more above ground in cavity or hollow tree
Marten *Martes americana*	Den in hollow tree or log
Fisher *Martes pennanti*	Den in hollow tree or log
Ermine *Mustela erminea*	Den in hollow tree or log
Long-tailed weasel *Mustela frenata*	Den in hollow tree or log
Mink *Mustela vison*	Den in hollow log, under stump
Striped skunk *Mephitis mephitis*	Den in hollow log, under stump
Lynx *Felis lynx*	Den under log overgrown with brush
Bobcat *Felis rufus*	Den under log overgrown with brush

Cavity Tree Characteristics and Wildlife Values

The preceding section describes how the degree of decay affects wildlife use. Other factors affecting wildlife are a tree's size, location, species or type (deciduous or coniferous), and how it was killed or injured. There are predictable groups of birds and other wildlife that use cavity trees depending on these interacting factors.

A general rule of cavity tree management is that bigger is better. This is so for several reasons. Large birds need large trees in which to excavate nesting and roosting holes—for example, the pileated woodpecker needs at least 20 inches in diameter at breast height (d.b.h.). Also, small birds can find nest sites in large trees, but not vice versa. And a large dead tree or snag will usually stand longer than a small one, and so be available longer. Table 3 is a guide to cavity tree or snag sizes and numbers needed by various woodpeckers for cavity excavation. Emphasis is placed on woodpeckers because habitat management for viable populations of these species will also provide nesting sites for the secondary cavity users.

Location is another factor that determines cavity tree use. Some species prefer such trees in the open, others within the forest. The flicker is a woodpecker that prefers to nest in open habitat: cavity trees, snags, or stubs at woodland edges, in pastures, or in clearcuts are preferred. Secondary users of flicker cavities are kestrels and eastern bluebirds (*Sialia sialis*), among others. Birds that prefer to excavate nests in more concealed trees are the hairy and pileated woodpeckers and the yellow-bellied sapsucker. Others are intermediate, using open stands or scattered trees: the red-headed (*Melanerpes erythrocephalus*) and red-bellied woodpeckers (*Melanerpes carolinus*) are examples.

Table 3.—Number of cavity trees[a] needed to sustain the hypothetical maximum populations of nine species of woodpeckers found in New England

Species	Territory size	Average nest tree[b]		(A) Cavity trees used, minimum	(B) Pairs/ 100 acres, maximum	Cavity trees needed/ 100 acres[c] (A X B)
		D.b.h.	Height			
	Acres	*Inches*	*Feet*	*Number*	*Number*	*Number*
Red-headed woodpecker	10	20	40	2	10	20
Red-bellied woodpecker	15	18	40	4	6.3	25
Yellow-bellied sapsucker	10	12	30	1	10	10
Downy woodpecker	10	8	20	4	10	40
Hairy woodpecker	20	12	30	4	5	20
Three-toed woodpecker	75	14	30	4	1.3	5
Black-backed woodpecker	75	15	30	4	1.3	5
Northern flicker	40	15	30	2	2.5	5
Pileated woodpecker	175	22	60	4	0.6	2.4

[a] After Evans and Conner (1979).
[b] Larger trees may be substituted for smaller trees.
[c] Number of cavity trees needed to sustain population at hypothetical maximum level.

Cavity trees at the banks of streams or edges of ponds or lakes seem to be preferred by virtually all primary cavity excavators. This may be explained party by the security provided—perhaps fewer nest predators can approach over water—and partly by the fact that trees near water may be larger and do tend to lean toward the water. Woodpeckers will usually excavate their nest hole on the underside of a leaning tree. Protection of the nest from rain and other elements seems to be the obvious function. Wood ducks (*Aix sponsa*) commonly use old pileated woodpecker holes excavated over water.

In addition to these factors, the extent and pattern of interior decay and the type of tree injury are probably very important factors in cavity trees selected by primary excavators. The ideal nesting substrate for most woodpeckers is a stem or limb (of suitable minimum diameter and height above ground) that is sound on the outside but that contains a central column of decayed wood in which the cavity will be excavated. This condition can result from several causes: decay spreading throughout the tree, decay spreading from a snapped off limb or top, or a compartmentalized area of decay from a wound.

The presence of decay that has been developing for a number of years can usually be detected by spore-bearing structures such as mushrooms or bracket-shaped conks on the trunk. Trees with compartmentalized decay or wounds high on the trunk or in the crown are more difficult to detect. When found, they should be marked for retention because many cavity-nesting birds use live trees.

Dead snags and stubs, while not always common in stands, are usually obvious; they should also be left for wildlife if they are at least 6 inches d.b.h. Snags and stubs that show a history of woodpecker use—new holes excavated sequentially lower as the upper portion breaks away—are especially valuable. Woodpeckers will usually continue to excavate cavities so long as relatively hard or firm outer wood supports a decay column the appropriate height. Finally, only the rotted stub will remain. The hollow formed in the tops of large broken stubs provides a nest site for barred owls (*Strix varia*), hooded (*Lophodytes cucullatus*) and common (*Mergus merganser*) mergansers, and turkey vultures (*Cathartes aura*). Smaller stubs are used by bluebirds and chickadees (Figs. 10 and 11).

Cavity Tree Management

Maintaining existing cavity trees and snags, creating them when absent, and ensuring their continued future availability are wildlife management objectives. Table 3 provides a guide to the number of cavity trees per 100 acres needed to maintain maximum woodpecker population levels. Recall that larger trees can substitute for smaller ones.

On smaller ownerships, one should consider the availability of cavity trees on surrounding forest land. If adjacent lands have few cavity trees, those on a small parcel could be critical to cavity-dependent wildlife.

At each stand entry, maintaining cavity trees, and snags and stubs that are in the proper size classes and diameter should ensure a continuing supply of cavity trees in the condition required by the various wildlife users. These can be trees of inferior form or even noncommercial species. Foresters are able to identify trees with exterior signs of advanced internal decay—presence of fungal conks, and so on. Retention of these trees is the key to ensuring that snags and stubs are present in the future.

Figure 10.—Cavities were excavated in the dead top of this red maple.

Figure 11.—Cavity in black walnut associated with a 25-year-old flush-cut branch.

Generally, both intermediate cuttings (thinning, weeding, etc.) or regeneration cuttings (clearcuts, shelterwood, etc.) eliminate larger cavity trees and snags; these should be clearly marked for retention before any cutting is done. Where broken topped trees occur or result from logging, they should also be saved for wildlife if they do not present a safety hazard.

Natural processes and disturbances such as logging usually produce a sufficient number of cavity trees. However, some stands have few apparent cavity trees or snags. The usual procedure for the direct creation of snags has been to girdle large trees with a chainsaw, or to cut away a 3- to 4-inch band of bark and cambium around the entire circumference of the trunks with an axe or hatchet, or to inject them with herbicide.

Where no trees exhibit signs of decay, as in a young stand, nest boxes can be used to attrack secondary cavity nesters. Boxes should be constructed so that they can be opened for autumn cleaning. Nest box dimensions are given in Table 4. In the Northeast, nest boxes need not be stained or painted. They should be erected in autumn so that they weather before spring. Boxes can be erected on posts or fastened (aluminum nails) directly to the undersides of slightly leaning trees.

Den trees are living hollow trees that are used as homes by mammals (Fig. 12). Species using den trees vary greatly, ranging from mice (*Peromyscus* spp.) and flying squirrels (*Glaucomys* spp.), to gray squirrels (*Sciurus carolinensis*), rac-

Table 4.—Dimensions of nest boxes and placement heights for secondary cavity-nesting forest birds of New England

Species	Inside walls		Entrance hole		Height above ground	Placement
	Width	Height	Diameter	Height above floor		
	Inches				*Feet*	
Eastern bluebird	4.5	8	1-1/2	6	4–8	In fencerow, clearcut
Black-capped chickadee	4	8–10	1-1/8	6–8	6–15	Forest interior
Tufted titmouse	4	8–10	1-1/4	6–8	6–15	Edge of mixed woods
Nuthatches	4	8–10	1-1/4	6–8	12–20	Forest interior
House wren	4	6–8	1	1–6	6–10	Forest edges
Carolina wren	4	6–8	1-1/8	1–6	6–10	Forest edges
Tree swallow	5	6	1-1/2	1–5	10–15	Field and pond edges
Northern flicker[a]	7	16–18	2-1/2	14–16	6–20	Forest edges
Red-headed woodpecker[a]	6	12–15	2	9–12	12–20	Open woods, forest edges
Downy woodpecker[a]	4	8–10	1-1/4	6–8	6–10	Forest
Hairy woodpecker[a]	6	12–15	1-1/2	9–12	12–20	Forest interior
Screech-owl	8	12–15	3	9–12	10–36	Woodlots, forest edges, streamsides
Saw-whet owl	6	10–12	2-1/2	8–10	12–20	Forests, woodlots, swamps
American kestrel	8	12–15	3	9–12	10–36	On large dead tree in pasture, field
Wood duck[b]	12	24	4 x 3 (Horizontal oval)	18–20	10	In pond or wooded swamp

[a] Boxes for woodpeckers need be provided only if stands are uniformly polesized or if no cavity trees are present. The species included occasionally use nest boxes.
[b] For complete instructions, see USDI, Fish and Wildlife Service (1976).

Figure 12.—A small entrance hole in the center of the closed wound on this birch. A central column of decayed wood is behind the wound.

coons (*Procyon lotor*), and black bears (*Ursus americanus*) (Table 3). In New England, such trees are usually old boundary or "leave" trees, or large lone trees in fence rows or along old roads. Thus, they are not well distributed across the landscape. There are generally fewer than could be used by wildlife. For example, Southern New England contains 4,998,600 acres of commercial forest land (Kingsley 1974). Among large sawtimber hardwoods (15.0 inches and larger), 3.1 percent are rough and rotten trees[1] 21.0 to 28.9 inches d.b.h. Less than 0.5 percent of such trees are greater than 29 inches d.b.h. Together, these size classes contain the existing and potential den trees in Southern New England woodlands.

By area, then, southern New England contains 16.3 rough and rotten trees at least 21.0 inches d.b.h., per 100 acres of commercial forest land (Table 5).

Gray squirrels, for example, can occupy up to 25 or more den trees per 100 acres because their home range is often less than 2 acres (Doebel and McGinnes, 1974).

Cavity trees generally have central columns of decay in the limbs or trunk; den trees are hollow or have large hollow limbs, but are otherwise vigorous. Most den trees have rather conspicuous openings in sound wood—usually either a round hole on the trunk where a dead limb had dropped off or an opening at the base resulting from a fire scar or other wound. But some much-used den trees are large hardwoods whose top was snapped off previously. Even though the opening would seem to offer little protection from the elements, such trees are common den sites for racoons.

Den trees that grow in open areas—at old homesites, along roads or fences—tend to have large wide crowns. They are frequently very valuable for wildlife because they often produce more mast or fruit than trees with smaller, more erect crowns.

Table 5.—Large sawtimber trees on commercial forest land by diameter class and condition, Southern New England, 1972[a] [In thousands of trees]

Species	Diameter class (inches at breast height)				
	Growing-stock trees			Rough and rotten trees	
	15.0–20.9	21.0–28.9	29+	21.0–28.9	29+
Eastern white pine	7,485	874	86		
Eastern hemlock	1,779	290	20		
Other softwoods	574	—	—		
Total softwoods	9,838	1,164	106	205	138
Select white oaks *Quercus alba, Q. bicolor*	1,490	195	11		
Select red oaks *Quercus rubra*	5,879	606	84		
Other white oaks	172	—	—		
Other red oaks	3,508	271	24		
Hickories	570	108	10		
Sugar maple	1,100	247	11		
Soft maples	2,201	216	31		
Beech	436	56	—		
White ash	639	132	—		
Other hardwoods	1,589	241	8		
Total hardwoods	17,584	2,072	179	735	115

[a]There are 4,998,600 acres of commercial forest land in New England.

Den Tree Management

In most cases, den trees need only be marked for retention. Probably all trees greater than 29 inches d.b.h. should be retained when possible, along with smaller living trees with major defects on the trunks—such as open or spiral seams, butt scars, or holes—retained as replacements. An ideal den tree distribution for wildlife would be two or more very large (> 29 inches d.b.h.) den trees per 100 acres for raccoons, opossums (*Didelphis virginiana*), porcupines (*Erethizon dorsatum*) and the like, and 25 such trees 21 to 28.9 inches

[1] Rotten trees.—Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees.—(a) The same as above, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees that are of noncommercial species.

d.b.h. per 100 acres for squirrels and other small mammals that use tree dens. Birds such as owls will use these trees also. Den trees have low stumpage values and then only once. The development of a very large den tree takes a century or more: some species such as red and white oaks and sugar maple can live for several centuries. When it falls, the hollow log can last another quarter-century, and later, the rotted stem is used by terrestrial reptiles and amphibians—for example, the ringneck snake (*Diadophis punctatus*) and redback salamander (*Plethodon cinereus*)—as breeding habitat. Finally, a barely discernible patch of dust, used by ruffed grouse (*Bonasa umbellus*) and other birds for dusting, is left. The process of den tree development and sequential use by wildlife can last for more than 400 years.

Where no den trees exist, the process can be started by cutting off a 4- to 6-inch limb of a tree 20 inches or more in diameter, leaving a stub about 6 inches from the trunk. Or chop out a section of bark and inner wood 6 x 6 inches at the base of a suitable wolf tree. These open wounds allow funal diseases to enter the tree and begin processes, which over several years will sometimes form a natural cavity surrounded by sound wood. Ash, beech, hemlock, and basswood are especially good trees to select for a future den tree because they readily form natural cavities.

Wildlife Use of "Sound" Trees

Although the wildlife values of cavity trees and den trees are considerable, it is also necessary to consider wildlife use of sound or apparently sound trees. Yellow-bellied sapsuckers nest in the firm decayed wood of soft hardwoods such as aspen. Often, the column o firm decayed wood is difficult to detect. Other woodpeckers also excavate cavities in trees, usually spruce or fir, that show no outward sign of decay.

Urban Hazard Trees — Wildlife Trees

It is possible to have wildlife trees in parks and other open spaces used by people. Rotted wood that is about to fall is unlikely to be used for nesting or denning and should be cut to prevent injury to people or property damage. However, proper pruning of large dead branches may help preserve a hazard tree for wildlife. The small diameter ends should be removed to reduce strain on the lower, thicker portion of the branch. Cavities will usually be in the thicker portions. Weak branches, dead or alive, can be cabled and braced to prevent breakage. In some situations, planted shrubs, or even a fence could be put around select wildlife trees to keep people away.

A Look to the Future

Will we have enough large trees for wildlife in the future? The trend on much managed forest land is toward smaller trees. We do know that the degree of compartmentalization is under moderate to strong genetic control. It is time to begin selecting trees for our forests and cities that are strong compartmentalizers. A strong compartmentalizing tree will not only provide us with more and better quality products, but also will, if not cut down, stay alive long enough to grow to a large size. Small, weak, unhealthy trees provide people and wildlife with few benefits. Even if cavities form in small unhealthy trees, they will be small and short-lived. The best type of tree for people and wildlife is the strong tree that will grow relatively quickly to a massive size and stand a long time. And, strong compartmentalizing ability will result in strong-boundaried cavities that will last. Tree species and their cavity values are shown in Table 6.

Table 6.—Characteristics of common New England trees that have high cavity values for wildlife

Tree species	Life span	Mature height	Mature d.b.h.	Comments
	Years	*Feet*	*Inches*	
E. white pine *Pinus strobus*	450	80–100	24–42	Trees with snapped-off tops most valuable for cavity excavation.
E. hemlock *Tsuga canadensis*	400–600	60–70	24–36	
White oak *Quercus alba*	500–600	50–100	36–48	Excellent shade and den trees.
N. red oak *Quercus rubra*	200–300	60–100	36	Excellent shade and den trees.
Black oak *Quercus velutina*	200	60–80	36	Usually loses to competition on good sites; common on dry, sandy sites.
Sugar maple *Acer saccharum*	200–300	60–100	24–36	Excellent shade tree. Readily forms branch core cavities.
American beech *Fagus grandifolia*	300–400	70–80	24–36	Valuable for cavity excavation, but dead wood decays rapidly.
White ash *Fraxinus americana*	100	70–100	24–48	Grows vigorously and readily forms trunk cavities if top broken.

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This paper is a guide for woodland owners, managers, or arborists who want to provide key habitat components for northeastern cavity-nesting birds and mammals that use tree dens. Methods for creating and maintaining cavity trees, snags, and den trees are described.

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Keywords: Compartmentalization, discoloration and decay, birds, mammals.

*U.S. GOVERNMENT PRINTING OFFICE: 1985-

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories are maintained at:

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