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Cavities in Trees Around Spring Seeps in the Maple-beech-birch Forest Type

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Abstract

We examined 913 trees of 15 species in the vicinity of eight spring seeps in a second-growth maple-beech-birch forest. We found that 18 percent of the trees had large dead limbs that indicated top rot. We found 37 cavities in 27 trees (3.0 percent). However, only seven cavities were being used by wildlife in September and mice (*Peromyscus* sp.) used these as dens. The low density of cavities was not sufficient to maintain "fair" populations of cavity-nesting birds, and cutting trees to improve the seeps for wildlife would have little overall effect on cavity-using wildlife.

Introduction

Cavities and Wildlife

Cavities in trees provide shelter for 60 species of central Appalachian birds and mammals. Animals such as pileated woodpeckers (*Dryocopus pileatus*), raccoons (*Procyon lotor*), great-creasted flycatchers (*Myiarchus crinitus*), and southern flying squirrels (*Glaucomys volans*) use tree cavities for roosts, nests, dens, or food caches.

Formation of a tree cavity begins with an injury or the natural pruning of a branch. Infections by fungi and other microorganisms follow, and eventually an animal excavates the decayed wood to produce the cavity (Baumgartner 1939 and Hansen 1966). Despite the importance of tree cavities to wildlife, little is known about the distribution and abundance of trees that contain cavities or the decayed wood substrate for cavity-excavating wildlife.

More information is available on cavities and decay in the oak-hickory forest type (Hepting et al. 1940, Dalke 1948, Uhlig 1956, Gysel 1961, Trimble 1963, Hansen 1966, Berry 1969, Berry and Beaton 1972, Sanderson et al. 1975, and Berry and Lombard 1978) than for maple-beech-birch forests (Uhlig 1956), which comprise 14 percent of the forests in central Appalachia. The available information on cavities and decay was not collected for quantifying a feature of wildlife habitat, and thus, it is inadequate.

Data on cavities and decay as elements of wildlife habitat are now being collected by the USDA Forest Service, Northeastern Forest Experiment Station's forest survey teams (Barnes 1979). But specific information is still needed for sites with exceptionally high value for wildlife.

Spring Seeps

Spring seeps are important components of the winter habitat of wild turkeys (*Meleagris gallopavo*) and to a lesser extent benefit many other species of wildlife in the maple-beech-birch forest. Yet, there are few guidelines for managing this important resource. The major value of seeps is that they increase snowmelt, thereby providing snow-free areas to turkeys and many other ground feeders when other areas are inaccessible. They also provide abundant food because their bowl shape serves as a seedtrap (Healy 1977). We have hypothesized that removing or reducing tree cover can enhance snowmelt, and thereby increase the value of seeps for many wildlife species.

Problem and Objectives

The age of a forest stand, distribution of tree diameters, amount of decaying wood, and prevalence of tree cavities are directly related. It takes from 30 to 60 years to produce dead limbs that are large enough to start the cavity-forming process (Baumgartner 1939). The presence of large dead limbs is a good external indicator of top rot (Baumgartner 1939 and Hepting et al. 1940) and, therefore, of substrate for cavity excavators and potential for cavity formation. However, rot is not always present when large dead limbs are present. Tree removal to enhance snowmelt could decrease the actual and potential number of cavities in the vicinity of the seep. Our objectives were to describe the distribution and abundance of potential cavity trees in second-growth maple-beech-birch forests and to determine if the removal of tree cover to enhance snowmelt would eliminate substantial numbers of cavities.

Study Area and Methods

A broad area of maple-beech-birch forest southeast of Elkins, West Virginia, was searched for seeps. A 25 x 40 m (0.1 ha) rectangular plot was surveyed around the head of each of eight randomly selected seeps. The seeps were located near the base of a major slope, aspect was generally southwest, and slope ranged from 9 to 28 percent. The stands were from 55 to 69 years old. Tree species, crown position, stem decay class, diameter breast height, and number of cavities visible from the ground were recorded for all trees over 5 cm dbh. Decay classes (indexes of potential for cavity formation) were: (1) no dead limbs 5 cm in diameter or greater, (2) one or two dead limbs 5 cm in diameter or greater, (3) three or more dead limbs 5 cm in diameter or greater, (4) portion of the tree trunk dead, and (5) tree dead. All trees were felled and examined for cavities. Interior dimensions, location, origin, and use by vertebrates was recorded for each cavity.

Results

Tree Species Abundance

We examined a total of 913 trees of 15 species (Table 1). In descending order, the abundant species were: sugar maple, red maple, black cherry, American beech, yellow birch, red spruce, and serviceberry. Although the forest has been under even-age management, the distribution of tree dbh was J-shaped (Leak 1964, 1965). The J-shaped distribution was due to the relative abundances of tree species with different silvical characteristics, particularly shade tolerance and growth rates. Shade tolerant, slow-growth species (sugar maple, red maple, American beech) (Trimble 1975) were more abundant than the faster growing species of intermediate (yellow birch) and low (black cherry) shade tolerance, in addition, serviceberry is not only intermediate in shade tolerance, but also does not grow as large as the other species. The tolerant species tended to follow the J distribution; most of these trees had dbh's of less than 10 cm (for example, 60 percent of the American beech). Black cherry diameters followed a symmetrical distribution with a mean dbh of 23.3 ±8.2 (SD) cm. The resulting joint distribution was J-shaped (Fig. 1).

Table 1.—Numbers and diameters of tree species examined around spring seeps in West Virginia in 1979

Species	Number of trees >5 cm dbh	dbh (cm) $\overline{X}$	SD	Maximum
Sugar maple *Acer saccharum*	233	11.3	5.7	47.5
Red maple *Acer rubrum*	173	13.4	5.9	40.0
Black cherry *Prunus serotina*	116	23.3	8.2	47.3
American beech *Fagus grandifolia*	111	13.1	10.3	51.9
Yellow birch *Betula alleghaniensis*	98	16.3	11.2	87.5
Red spruce *Picea rubens*	54	26.1	12.4	54.6
Serviceberry *Amelanchier* spp.	48	10.5	3.9	19.1
White ash *Fraxinus americana*	21	15.7	7.4	34.2
Eastern hemlock *Tsuga canadensis*	16	13.9	9.3	38.4
Sweet birch *Betula lenta*	16	16.8	6.5	30.0
Pin cherry *Prunus pensylvanica*	8	9.7	3.8	15.8
Cucumbertree *Magnolia acuminata*	8	21.8	9.1	35.5
Witch-hazel *Hamamelis virginiana*	6	5.5	0.4	6.1
Striped maple *Acer pensylvanicum*	3	8.2	3.1	11.8
Fraser magnolia *Magnolia fraseri*	2	11.2	0.4	11.4

Variability Among Seeps

Among the seeps, mean dbh ranged from 11.2 to 20.4 cm; the number of trees greater than 5 cm dbh ranged from 840 to 1700 per ha; and the relative abundance of the tree species differed (Table 2). The seeps selected for study were randomly chosen from a large number of known seeps that were generally found in a characteristic topographic position. We feel that the variability observed among the study seeps was characteristic of the maple-beech-birch forest in central Appalachia and was not a result of selecting particular seeps.

Decay Class dbh Distributions

The distribution of the dbh of trees without large dead limbs (Fig. 2A) was J-shaped and similar to the overall dbh distribution (Fig. 1). Sugar maple (195 trees), red maple (140 trees), and American beech (90 trees), all shade-tolerant species, were the most abundant species in this class. Trees with one or two large dead limbs were fewer, roughly distributed by dbh (Fig. 2B), and most were black cherry (52 of the 133 trees in the class). Trees with three or more large dead limbs were few (32 trees) (Fig. 2C), and most were black cherry; a few large American beech and yellow birch, left after the regeneration cut, were also in this class. Only six trees had portions of their trunks dead; these trees were all suppressed and less than 12 cm dbh. The dbh of dead trees (105 trees) followed a J-shaped distribution; most (99) were less than 15 cm dbh.

Trees with Cavities

We found 37 tree cavities: 23 trees had 1 cavity, 2 had 2 cavities, 1 had 4 cavities, and 1 had 6 cavities (some in large branches). Twenty-four cavities were due to natural pruning of branches, five were due to mechanical damage, one to fire, and seven to heart rot of unknown etiology. Twenty-five cavities were too small to be used by vertebrates, three were useful as refuges, two had been used as dens, and seven were being used as dens by white-footed mice. When one large American beech (50.6 cm dbh) with four cavities was felled, at least five white-footed mice fled the tree. Twenty-five trees with cavity entrances less than 8 cm in diameter had a mean dbh of 22.4 cm; one tree (American beech) with a

(Text con't on pg. 6)

Figure 1.—Distribution of dbh for 913 trees examined around eight seeps in a 55 to 70-year-old maple-beech-birch forest.

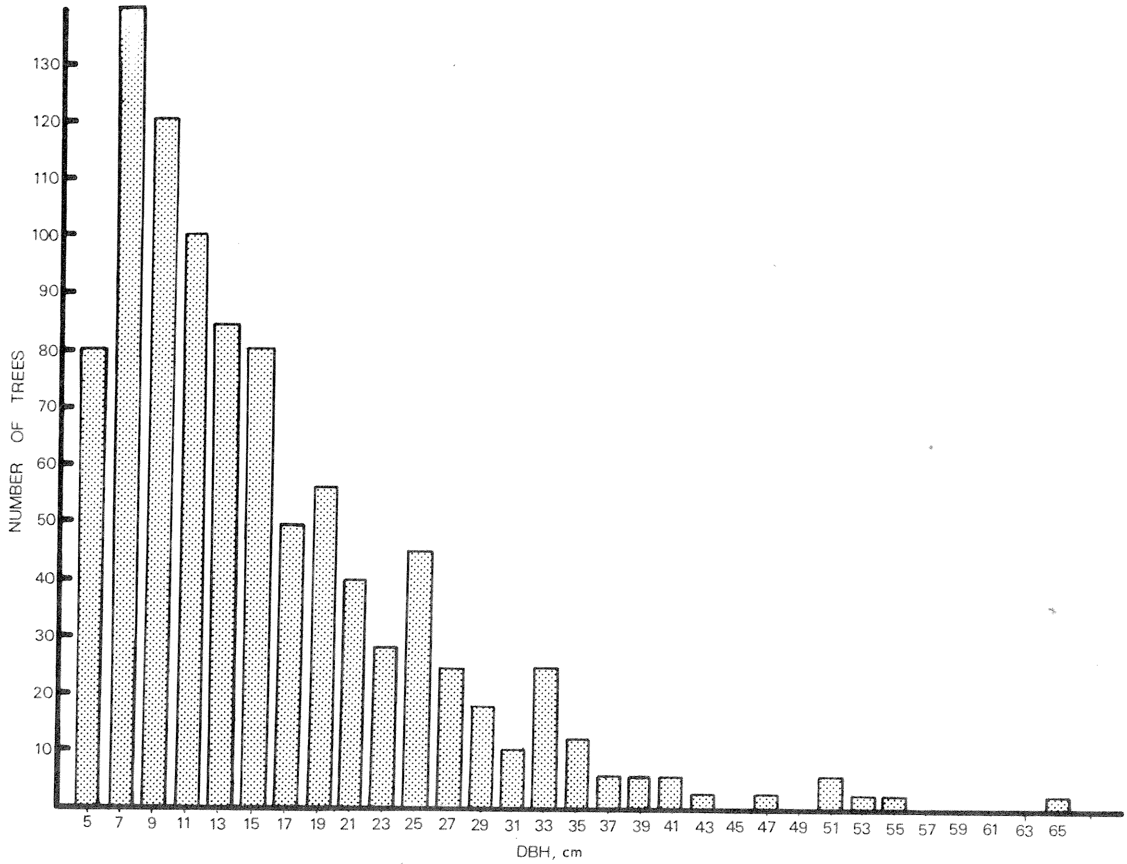
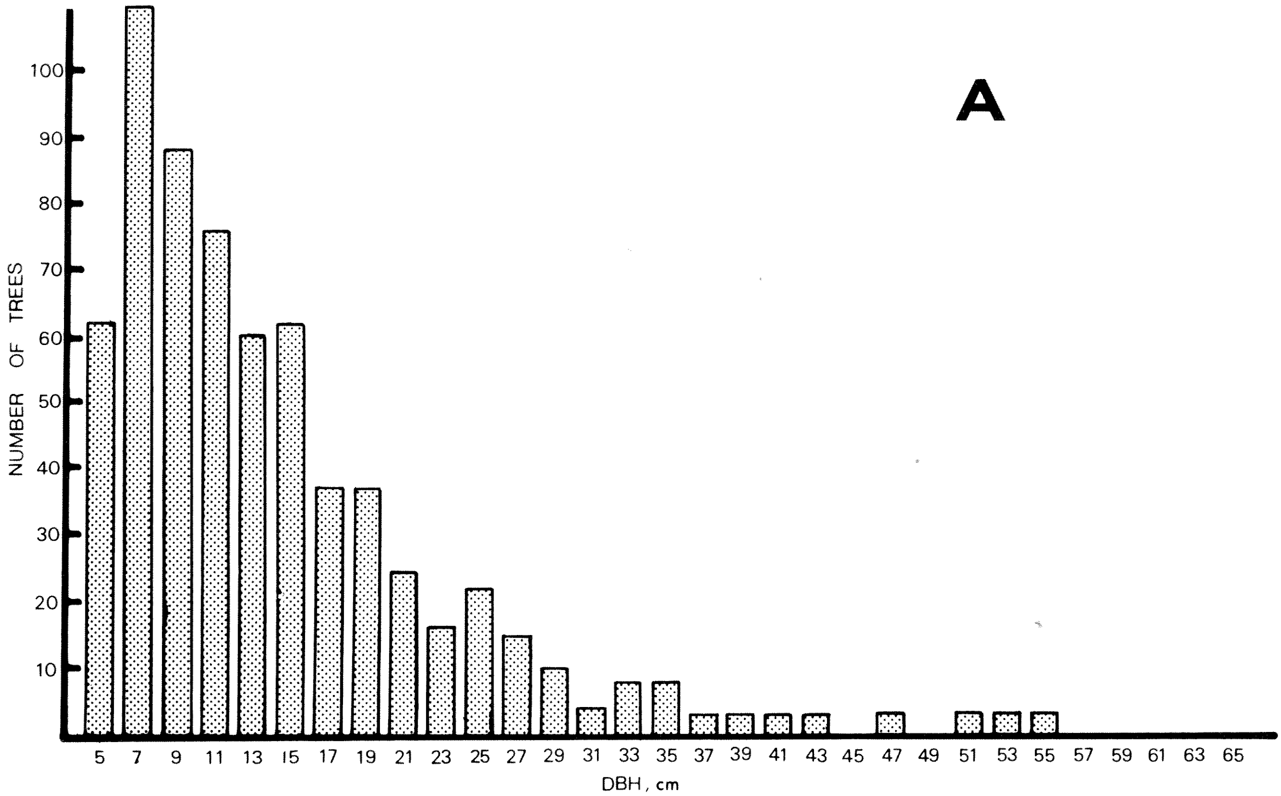
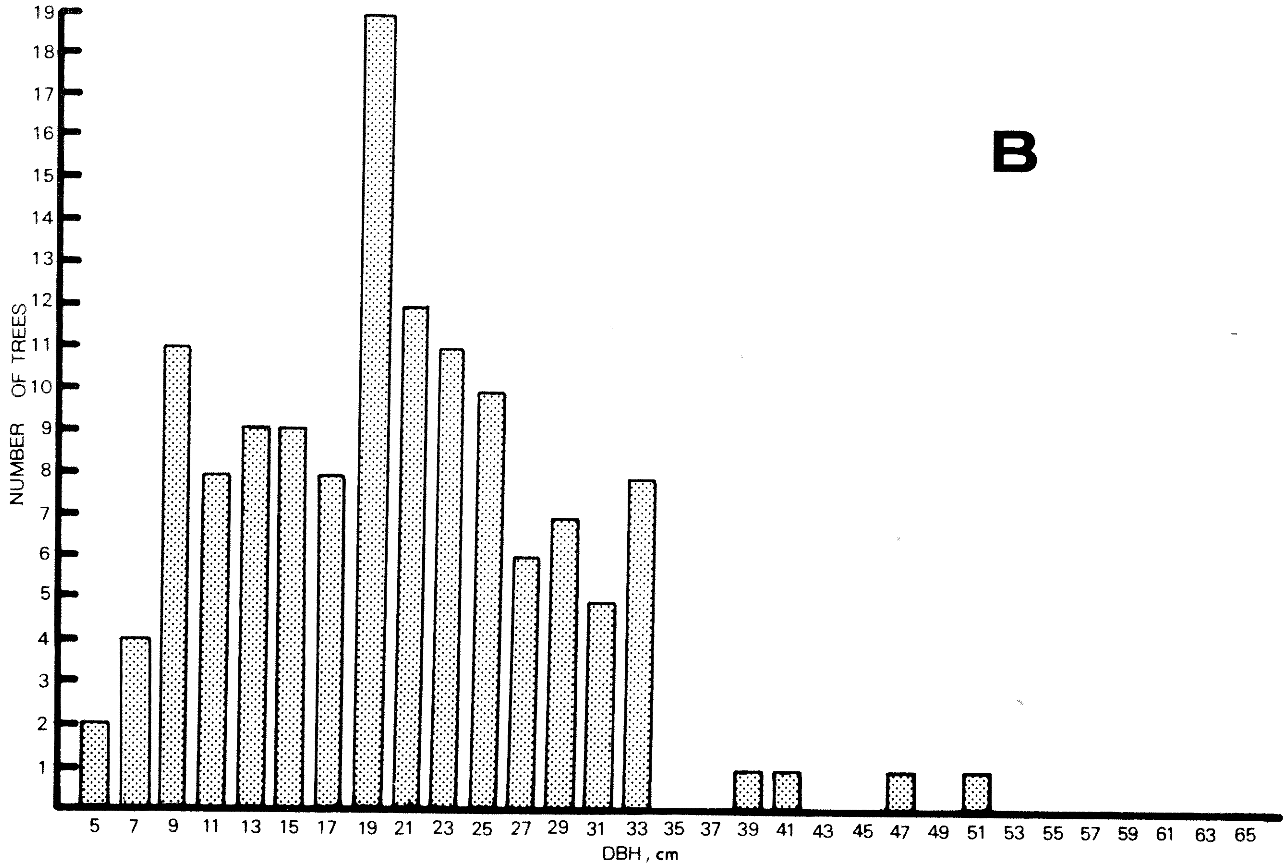


Table 2.—Characteristics of eight seeps (0.8 ha) in a 55-to-70-year-old maple-beech-birch forest

Seep	Trees >5 cm dbh, per 0.1 ha plot	dbh (cm) $\overline{X}$	SD	Maximum	Aspect (% slope)	The three most abundant species
52	102	11.2	5.3	33.6	SW (9)	serviceberry, yellow birch, red maple
55	126	15.9	8.6	47.3	SW (12)	sugar maple, black cherry, yellow birch
58	137	12.1	6.3	31.8	SW (10)	sugar maple, red maple, American beech
60	119	15.2	11.4	87.5	SSE (11)	sugar maple, yellow birch, red maple
81	84	18.2	10.5	41.1	WSW (18)	American beech, red spruce, black cherry
86	91	17.1	11.4	50.5	WSW (12)	American beech, red spruce, black cherry
94	84	20.4	11.7	54.6	SSE (28)	red spruce, red maple, American beech
97	170	13.9	6.7	38.4	S (20)	red maple, black cherry, sugar maple
Overall	913	15.1	9.3	87.5	SW (15)	sugar maple, red maple, black cherry

Figure 2.—Dbh distribution for three decay classes: A—No dead limbs >5 cm. B—One or two dead limbs >5 cm. C—Three or more dead limbs >5 cm.

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NUMBER OF TREES
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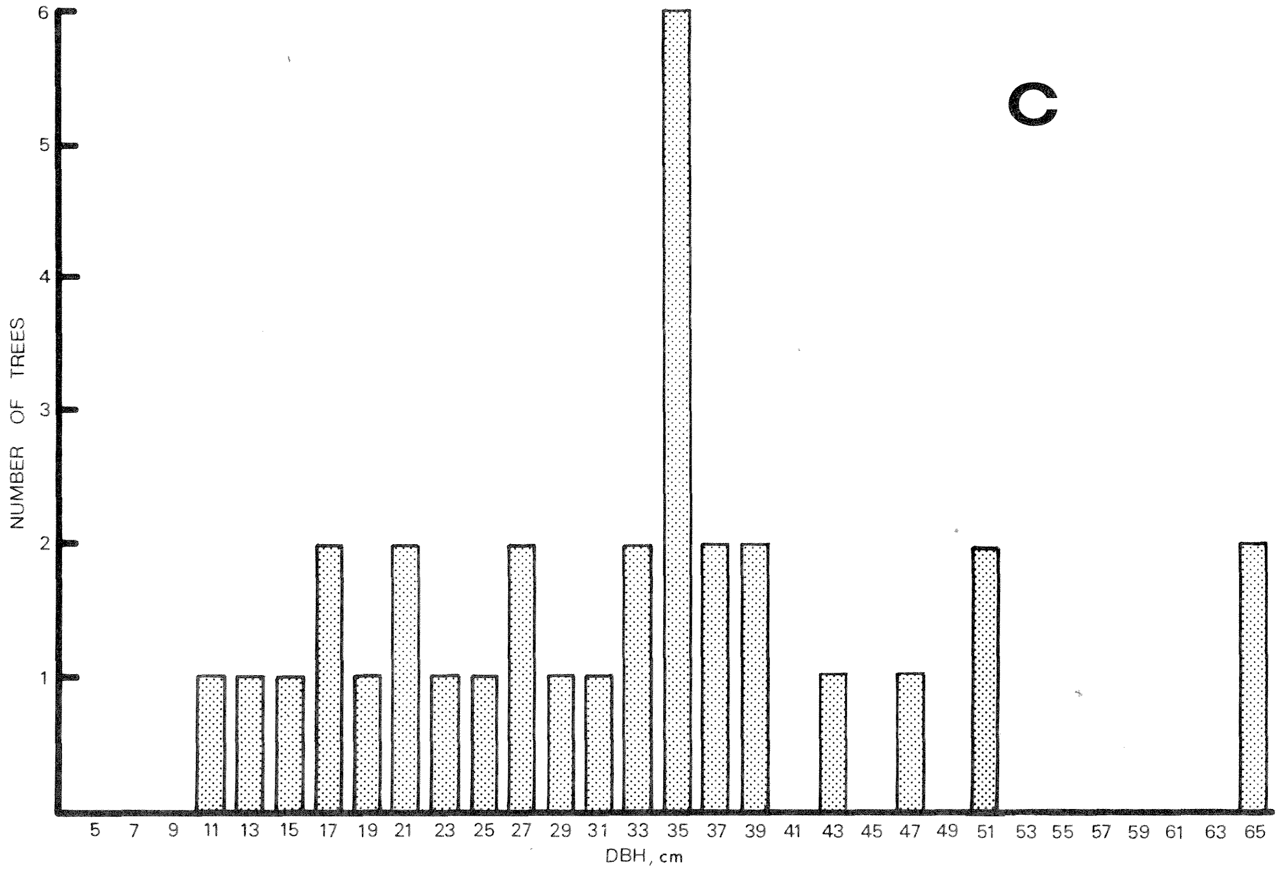
DBH, cm



cavity entrance between 8 and 15 cm in diameter was 28.6 cm dbh; and three trees (two yellow birch, one American beech) with cavity entrances larger than 15 cm in diameter averaged 69.5 cm dbh and had at least three dead limbs.

Conclusions

Cavities and Wildlife

Cavities and potential cavities were rare around seeps in the 55- to 70-year-old maple-beech-birch forest. The density of cavities was 46/ha, but only 15/ha were large enough to be used by vertebrates. Only 3 percent of the trees had three or more large dead limbs, and only 29 of the 913 trees contained useful or potentially useful cavities. If trees had not been left standing in the last regeneration cut, there would have been even fewer cavities. In addition, most of the standing dead trees were small, providing feeding, but not nesting, substrate for the insectivorous cavity-using birds. If we assume that seeps represent the general forest, there exists little opportunity for cavity-dependent wildlife in this forest. Our limited samples suggest that seeps comprise less than 1 percent of the general forest area, but occur at a frequency of 6 to 20 seeps per km^2. The density of trees with cavities or with decayed wood substrate suitable for cavity excavation is far below the 50 snags larger than 15 cm dbh per hectare required to maintain "fair" populations of cavity-using birds. Around 70 snags per ha are required for "good" populations (Evans and Conner 1979). We found no cavities suitable as dens for squirrel-sized or larger mammals. Seep management, therefore, would have little immediate effect on cavity-using wildlife, especially if the scattered residual trees were left.

Potential for Cavities

The distribution of dbh by decay class (Fig. 2) suggests that the 30 to 60 years suggested by Baumgartner (1939) as necessary for trees to produce rotten limbs that are large enough to initiate the cavity formation process may be too short a time for the maple-beech-birch forest type. After 55 to 70 years of growth, the fastest growing species, black cherry, had an average diameter of 23.3 cm, and 95 percent had a dbh less than 34 cm—the median size of trees with three or more large dead limbs. Baumgartner (1939) estimated that between 8 and 30 years are required from the death of a large limb to the final hollowing of the tree trunk. Thus, it would appear that another two decades of growth would be necessary before populations of cavity-using wildlife would be fair to good.

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Keywords: Cavities; seeps

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