Habitat Management For Hole-Nesting Birds In Forests Of Western Larch And Douglas-fir

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ABSTRACT—During a 3-year study in western larch (Larix occidentalis)*–Douglas-fir* (Pseudotsuga menziesii) *forests of northwestern Montana, 273 active nest trees of 20 hole-nesting bird species were located. Stands with major components of old-growth western larch, ponderosa pine* (Pinus ponderosa), *or black cottonwood* (Populus trichocarpa) *supported the highest density and diversity of hole-nesters. On commercial forests, managers should maintain units of old growth and prepare silvicultural prescriptions that will provide continuing replacement in the future.*

In forests of western larch and Douglas-fir, woodpeckers prefer large broken-top western larch snags.

Hole-nesters constitute about 25 percent of the bird species breeding in many northern Rocky Mountain forests. The birds in this diverse group are important simply because they are a natural part of ecosystems (Ehrenfeld 1976), but they may be of special significance to forest managers because most species consume large numbers of insects (Beebe 1974).

The availability of cavities or snags has been considered the limiting factor for populations of hole-nesting birds (Haartman 1957). Primary hole-nesters (woodpeckers) excavate cavities within snags or decaying trees. With few exceptions, they make new nest holes each spring. Most secondary hole-nesters are incapable of excavation and must use cavities that result from decay or woodpecker work. Examples are bluebirds, tree swallows, and several species of ducks and owls (scientific names of birds mentioned in this article are given in *table 2*). Chickadees and nuthatches are opportunistic. They sometimes excavate in soft wood but often use available holes. Tree holes are also important for roost sites at night and during stormy weather.

In 1974, we began a habitat study on the 7,460-acre Coram Experimental Forest in northwestern Montana (20 miles northeast of Kalispell) and nearby areas of the Flathead National Forest and Glacier National Park. Elevations on the experimental forest ranged from 3,500 to 6,300 feet. Stands were chiefly of the western larch-Douglas-fir type. Conifers on sample plots on the experimental forest were, in order of decreasing abundance: Douglas-fir, subalpine fir *(Abies lasiocarpa)*, Engelmann spruce *(Picea engelmannii)*, western larch, western hemlock *(Tsuga heterophylla)*, lodgepole pine *(Pinus contorta)*, western white pine *(Pinus monticola)*, and western redcedar *(Thuja plicata)*. Whitebark pine *(Pinus albicaulis)* is present at the higher elevations and ponderosa pine in some of the lower elevations. Paper birch *(Betula papyrifera)*, black cottonwood, and aspen *(Populus tremuloides)* are locally abundant. McClelland and Frissell (1975) reported preliminary study results, focusing on characteristics of snags preferred by hole-nesting birds. In this report we summarize the three-year study (1974-76) and present management implications.

Methods

Forest stands of various ages and compositions were searched for active hole nests—i.e., those containing eggs or young. During the three field seasons, 273 active nest trees were located. After attempting various schemes for classifying snags and trees according to growth, form, amount of deadwood, and "hard" or "soft" exterior (Gale 1973), we adopted a method based on two criteria: (1) whether the tree was totally dead or at least partly live, and (2) whether the top was broken, intact and dead, or intact and live *(table 1)*.

Results and Discussion

Hole-nesters clearly preferred western larch even though Douglas-fir was five times more abundant. Larch nest trees outnumbered Douglas-fir nest trees 154 to 8, a highly significant difference (X^2, $p \leq .01$). This selectivity is due, at least in part, to the difference in decay characteristics of the two species. The slow decay of larch heartwood, while the sapwood remains comparatively intact as a protective shell, creates an ideal site for cavity construction in both live trees and snags. In Douglas-fir snags, heartwood and sapwood both decay more rapidly; no solid outer shell of sapwood remains. Douglas-fir snags, however, are important feeding sites for woodpeckers and are used for

Table 1. Nest trees listed by tree species and condition (all bird species combined).

Tree species	Snag: Intact top	Snag: Broken top	Live: Broken top	Live: Intact dead top	Live: Intact live top	Total	Total
	Number						Percent
Western larch	11	59	51	18	15	154	56
Aspen	3	13	7	1	13	37	14
Paper birch	0	14	22	0	0	36	13
Ponderosa pine	1	8	0	0	0	9	3
Douglas-fir	3	5	0	0	0	8	3
Black cottonwood	0	7	0	1	0	8	3
All other species	3	13	2	3	0	21	8
Total	21	119	82	23	28	273	100
Percent	8	44	30	8	10		

Table 2. Measurements of active nest trees, arranged in order of decreasing mean d.b.h.

Bird species	Nest trees	D.b.h. Av.	D.b.h. Range
	Number	*-- Inches --*	
Pileated woodpecker *(Dryocopus pileatus)* (nests)	22	32	23-41
Pileated woodpecker *(Dryocopus pileatus)* (roosts)	10	31	15-43
Goldeneye *(Bucephala* spp.)	2	30	21-39
Lewis' woodpecker *(Melanerpes lewis)*	1	27	—
American kestrel *(Falco sparverius)*	5	27	22-23
Williamson's sapsucker *(Sphyrapicus thyroideus)*	4	26	17-37
Chestnut-backed chickadee *(Parus rufescens)*	1	25	—
Mountain chickadee *(Parus gambeli)*	35	25	7-49
Yellow-bellied sapsucker *(Sphyrapicus varius)*	111	23	9-47
Mountain bluebird *(Sialia curricoides)*	4	23	1-29
Common flicker *(Colaptes auratus)*	28	21	10-51
Red-breasted nuthatch *(Sitta canadensis)*	31	21	4-35
Brown creeper *(Certhia familiaris)*	3	20	14-29
Saw-whet owl *(Aegolius acadius)* (roost)	1	20	—
Tree swallow *(Iridoprocne bicolor)*	20	16	9-39
Hairy woodpecker *(Picoides villosus)*	10	14	9-29
Downy woodpecker *(Picoides pubescens)*	3	10	7-14
Black-backed three-toed woodpecker *(Picoides arcticus)*	2	10	8-12
Northern three-toed woodpecker *(Picoides tridactylus)*	4	10	7-11
House wren *(Troglodytes aedon)*	1	9	—
Black-capped chickadee *(Parus atricapillus)*	10	8	4-12
	308	22.2	4-51

nesting by the "weak" excavators (e.g., red-breasted nuthatch). No hole nests were found in live Douglas-fir. Ponderosa pine appears to equal western larch as a preferred species, but it is not common in the study area. Paper birch and aspen often develop decay at an early age and are heavily used by hole nesters. Large black cottonwood snags are especially attractive to pileated woodpeckers.

Table 1 shows that nearly as many hole nests were in live trees (133 nest trees) as were in snags (140 nest trees). Heartwood decay was evident in live as well as dead nest trees. Broken tops were highly preferred, accounting for 74 percent of the total. Snags with intact tops were used least—even less than live trees with intact live tops; however, they are important as woodpecker drumming sites and raptor perches. The selection for broken-top larch snags (as opposed to intact-top larch snags or broken-top Douglas-fir snags) was highly significant.

It is debatable whether woodpeckers select for broken tops or for weakened wood. Although decayed heartwood combined with a firm sapwood shell seems to be the characteristic woodpeckers select, they may respond to a more obvious cue, such as a broken top (Kilham 1974).

A broken top may follow or precede decay, but we interpret our data (only 8 percent of the nest trees were intact-top snags) as indicating that decay suitable for nest-hole excavation usually occurs after, and not before, breakage of the top.

Trees (and snags) with large d.b.h. are preferred by most species *(table 2)*. Some cannot use small trees: the pileated woodpecker cannot often be accommodated in a tree much smaller than 20 inches d.b.h. It prefers much larger (old growth) nest trees. Some woodpeckers (downy and three-toed) appear to prefer smaller trees (but with heartwood decay) and may be avoiding difficult drilling through the thick sapwood of large trees. Yellow-bellied sapsuckers, the most common woodpecker in our study area, are capable of utilizing either large or small nest trees *(table 2)*.

In our study area, five species usually nested in open or semi-open sites: common flicker, Lewis' woodpecker, American kestrel, mountain bluebird, and tree swallow. All other species found optimum nesting habitat in stands with a major component of old growth, particularly larch. Mean basal area for pileated woodpecker nest sites was 150 square feet per acre. Productive sites, particularly in wet bottomlands where trees tend to grow large and fast and decay may progress rapidly, represent optimum hole-nesting habitat.

Recommendations for Management

Schmidt et al. (1976) reported that about half of the total area where western larch is a major component is uncut, much of it in western Montana. However, they pointed out that "timber harvest and subsequent regeneration are steadily converting the type to younger age classes." Rotations after conversion will approximate 100 years, they noted, and at that age larch will generally not exceed 16 inches in d.b.h. The resulting stands of small trees with low incidence of heart rot will be generally unsuitable for most hole-nesters.

An individual management plan should be prepared for each endangered or threatened species. For most other birds, it is reasonable to adopt the indicator (key) species approach, as described by Graul et al. (1976) and others. If habitat can be maintained for the most sensitive species, others will also be accommodated. In western larch-Douglas-fir forests, nest sites of pileated woodpeckers appear to be limited to areas with an old-growth component. The feeding territory used by one pair on a year-round basis is large, usually between 500 and 1,000 acres. In stands supporting the pileated woodpecker, one can expect to find sites not only for other hole-nesters (including small mammals)

The yellow-bellied sapsucker is the most common woodpecker in the northern Rocky Mountains. It and the pileated woodpecker establish feeding sites and nest cavities later used by other species.

but for many species of open-nesters—e.g., goshawks (*Accipiter gentilis*). These stands also may serve as essential cover and travel routes for ungulates and carnivores.

Balda (1975), Thomas et al. (1976), and Bull and Meslow (1977) have suggested methods by which a manager can calculate the number of snags needed per acre. However, managing for snags per acre is, by itself, not sufficient. The perpetuation of stands with an old-growth component will require additional skill and ingenuity on the part of the manager.

Nest boxes may increase populations of some secondary hole-nesters where snags and old growth are lacking but food is available. Woodpeckers (except flickers) rarely use nest boxes, however, and are more likely to be limited (in our study area) by food than by nest sites.

On intensively managed timberland, carefully planned harvesting, residue utilization, and prescribed burning are necessary to maintain habitat. Western larch (a seral species) cannot be managed indefinitely by simple preservation, because it is replaced by shade-tolerant species. Recurring wildfires create conditions favorable for larch regeneration. A manager will need to use fire or a carefully conceived cutting plan that will encourage this shade-intolerant species without eliminating the old-growth component. Thinning must be done carefully to avoid covering feeding logs with slash. Stumps 4 to 6 feet high (and more than 15 inches in d.b.h.) will serve as additional feeding sites.

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Data from our study in the northern Rocky Mountains and recent research in other areas (e.g., Gale 1973, Conner and Crawford 1974, Balda 1975, Conner et al. 1975, Miller and Miller 1976, Thomas et al. 1976, Bull and Meslow 1977, Franzreb 1977, and Scott 1978) can be used in devising plans that meet not only timber needs but also habitat requirements of hole-nesting birds. While habitat needs on individual planning units can best be evaluated by interdisciplinary teams, the following recommendations may be useful.

1. Within each 1,000 acres on planning units where objectives include managing for all hole-nesters, 50 to 100 acres with a significant old-growth component of western larch, ponderosa pine, or black cottonwood should be provided to meet long-term nesting and feeding needs for a pair of pileated woodpeckers (the indicator species) and associated species.

2. Old growth should be well scattered rather than grouped into adjacent areas and isolated with miles of intervening clearcut or young growth. Ideally, corridors with a component of old growth should connect the units to provide travel routes and maximize bird diversity (MacClintock et al. 1977).

3. Old-growth units generally should be roughly square (edges irregular), but linear strips at least 300 feet wide are suitable along streams.

4. Old growth often can be maintained in areas currently without roads, in water influence or in travel zones, in the vicinity of campgrounds, or in critical scenic areas.

5. In addition to 50 to 100 acres for nesting and feeding area, feeding substrate (logs, snags, culls, and their future replacements) should be provided for in the harvesting and residue-utilization prescriptions for the remaining 900 acres of a planning unit. Snags left in areas heavily cut will provide nest sites for species needing open habitat.

6. Many large snags are being cut for firewood. Forest managers should limit firewood cutting to snags less than 15 inches in d.b.h. and discourage use of larch, ponderosa pine, and black cottonwood. Closure

of logging roads may be necessary to save high-value snags. Logging slash can be made available for wood gatherers. ■

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Thinning as an Orderly Discipline:

A Graphic Spacing Schedule for Red Pine

Frederick G. Wilson

ABSTRACT—The key correlation of stem count to height has been applied to define and to regulate the density of the residual stand after periodic thinning of a red pine plantation at Star Lake, Wisconsin. A chosen value of added height growth has determined the length of each thinning interval. Graphic evaluation of data from European yield tables for Scotch pine has served to guard against discordant treatment.

The pine plantation project at Star Lake in Vilas County, Wisconsin, was planned by State Forester E. M. Griffith in his 1911-1912 report, with the intent that permanent records would be kept. Planting stock came from the first output of the Trout Lake Nursery, established with the help of the author in the spring of 1911.

By 1943, when the need for thinning in older pine plantations became apparent, there was available at Star Lake a 32-year-old stand of red pine (*Pinus resinosa* Ait.) in which two one-acre plots were established, and the trees numbered serially. One plot has been given periodic thinning since then, and the other has received no treatment to demonstrate the merits of applied silviculture over mere planting and protection.

The first marking aimed at a C-grade thinning, and it was thought that this would be repeated every five years. An awareness of the method's inadequacy, however, showed the need for an unequivocal measure of stand density, so that the thinning records would not only be accurate but also definitive of appropriate stand treatment.

Fundamentally, thinning consists of removing some trees from the places they occupy, with concern centered on an orderly, periodic reduction in numbers to assure the survivors adequate growing space. Also, it is axiomatic that no stand density formula can be written which does not include that basic item—the stem count—or the number of trees per unit of area. And, having thus acknowledged the primacy of spacing, it follows that any expression of stand density which sacrifices the number of trees becomes inappropriate for use as a guide to thinning.

Moreover, the members of a stand grow in size, while their numbers diminish over the rotation, so that the stem count must be qualified by some measure of tree size to have meaning. The traditional dimensions have been diameter at breast height and total height. But diameter increment and, consequently, diameter at breast height are intentionally influenced by thinning treatment, so that this factor must be rejected.

My first (1946) proposal for thinning based on spacing in terms of height noted that height of trees in dominant and codominant positions is negligibly influenced by thinning intensity. In this method, the residual stand after thinning is determined by the following formula:

$$n = \frac{43{,}560}{(hf)^2}$$

where n = the number of trees per acre after thinning

h = the total height in feet of the average dominant trees in the stand

f = the average spacing of trees after thinning, expressed as a percent of average dominant tree height.

THE AUTHOR—Frederick G. Wilson retired in 1952 as superintendent, Forest Management Division, Wisconsin Conservation Department, after serving in the department since 1911. He has followed the development of this red pine plantation since the seeds sprouted in the nursery, and has personally conducted the six thinnings that have been applied, the most recent one in the fall of 1978.