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SOME CHARACTERISTICS OF CAVITY NESTERS: CAN WE EVER LEAVE ENOUGH SNAGS?
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Attached is a paper presented at the Oregon Chapter of The Wildlife Society in January of 1974.

This article will be of interest to those concerned with the future of hole nesting birds in the Pacific Northwest as it investigates the characteristic of such cavity nesters.

SOME CHARACTERSTICS OF CAVITY NESTERS: CAN WE EVER LEAVE ENOUGH SNAGS? [1]

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I have purposely chosen a provocative title for this paper because I have become very concerned for the future of hole nesting birds in the Pacific Northwest. There are some very fundamental conflicts between the needs of cavity nesters, and the goals and objectives of timber managers, which cannot be resolved by stop-gap measures such as so many snags per acre, or even all snags per acre. These conflicts will be discussed in more detail later.

Table 1. lists some figures which demonstrate the prevalence of hole nesting in birds. Note that 40 percent of those species which I have called “forest” birds nest in cavities. In addition to birds, there are a number of mammals, and also some insects which use cavities (Table 2.). This paper will be restricted to avian species, but much of what I mention applies to mammals as well. Of the 43 avian species of hole nesters in Oregon, 14 are capable of excavating a hole (Table 3.). There are the nuthatches and woodpeckers. Being small, nuthatches excavate small holes with an entrance about 1.25 inches in diameter. Woodpeckers are generally larger, their holes from 1.25 to 4.25 inches in diameter. There are 20 avian species, which almost always nest in holes but do not excavate them (Table 4.). They rely mainly on the excavators to provide holes. Of these species, the chickadees and the bluebirds are small enough to use nuthatch holes. There are nine species which sometimes nest in holes but also nest in other places (Table 5.).

The proportion of the total breeding pairs, which are hole nesting varies with the forest type (Table 6.). In coniferous forests about 20 percent of the total breeding pairs nest in holes, in the deciduous forest about 30 percent, and in mixed forest about 40 percent nest in holes. I calculated these figures from data taken from the Annual Breeding Bird Census published in American Birds.

One reason that such a large proportion of forest birds nest in holes is that it is a very successful breeding strategy. Nice (1957) was the first to demonstrate this (Table 7.). She found that cavity nesters had a fledging success of 66 percent, while open nesters had a fledging success of 46 percent. A number of other studies have confirmed her findings (Huddle 1959, Skutch 1966, Lack 1968).

The primary disadvantage to nesting in holes is that they are in short supply. The density of hole nesters is limited by the number of available holes. This was first demonstrated in Europe in 1917, when resource managers successfully increased populations of hole nesters by providing nest boxes (Wolda 1917, Von Berlepsch 1929). More recently, Pfeifer (1963) working in Germany, has achieved astounding increases in the density of cavity nesters by providing nest boxes (Table 8.). In his smaller study area the number of successfully fledged broods per hectacre was increased from zero to 29.66 and in the larger study area from 1.7 to 25.7. This latter represents a fifteen-fold increase and it is an average over a nine-year period.

Tomna (1967) studied nesting of pied flycatchers at breeding densities of .25 to 20 pairs per hectacre (Table 9.). These densities were achieved by providing nest boxes. Even at the highest density he found no significant decrease in fledging success. This result is evidence that the resource primarily limiting hole nesters is not food or space, but nest sites.

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1 Paper presented at the Oregon Chapter of The Wildlife Society, January 1974.

Some additional unexpected evidence came as a consequence of banding studies of pied flycatchers by von Haartman (19956). After trapping males near their nests, he would take them home to band them. By the time he got back with the birds a few hours later, other males would have taken over the nest sites. At one nest, six different males succeeded each other within a few days. This is evidence that there is a large floating part of the population, which is non-breeding because of a shortage of nest holes.

Further evidence that the limiting factor for hole nesters is holes, comes from a study of forest birds in Finland (Haapanen 1965) (Table 10.). He compared the density of hole nesters and open nesters in managed and unmanaged forests. In the managed forest s he studied, no snags were left, deciduous trees were removed, and the stands were periodically thinned. In every case he found a significant decrease in the number of hole nesting pairs in the managed forest while the density of birds nesting in the open was approximately the same. In the pine forest there was a zero percent decrease of open nesters, but a 44 percent decrease of cavity nesting pairs. Similarly, in the spruce forest there was five percent decrease in open nesters and a 68 percent decrease in cavity nesters. Thus, the lower bird density in managed, as compared to natural forest is due primarily to the decrease in the number of hole nesting pairs.

Where do nest cavities come from? Excavators can drill their own hole. Non-excavating hole nesters and, occasionally, excavators use cavities formed by wood decay, but there is evidence that non-excavating birds rely mainly on the excavators to provide holes for them. This was demonstrated in a Finnish forest by Haapanen (Table 11.). He found that although the density of hole nesters varied greatly with the habitat, the ratio of excavating pairs to non-excavating pairs remained fairly constant at about 2:1. In northwestern forests this ratio is about 2 excavators to every 3 non-excavators (Table 11.). Differences in vegetative or avifaunal composition of Finnish and Northwestern forests may be responsible for the different values of these two ratios, but the important point is that in both cases the ratio was fairly constant. That is, the number of non-excavating pairs present was highly correlated with the number of excavators present. Thus, we may conclude that the non-excavators rely mainly on the excavators to provide them with nest holes.

Woodpeckers tend to choose nest sites at a specific height and tree diameter (Figure 1.). There dimensions are dictated somewhat by the size of the bird. The pileated woodpecker, which is 15 inches tall, excavates at an average of 44 feet above the ground. The diameter of the tree at this point must be at least 15-20 inches to accommodate the hole. White-headed woodpeckers excavate only 9 feet above the ground but require a tree that is 2 feet in diameter at this height.

Excavators drill holes almost exclusively in trees that have undergone a degree of decay which softens the wood. This condition comes about through the action of fungi. On live trees, fungal spores must come in contact with the heartwood in order to grow. This contact is provided by wounds in the tree such as are created by broken branches, fire, and bird and insect borings. Natural cavities form through these same agents.

To summarize:

1. 40 percent of forest bird species are cavity nesters.
2. The density of cavity nesters is limited primarily by the number of available holes.
3. Cavity nesters rely heavily on excavators to provide holes.
4. Wood rotting fungi are fundamental to the excavation or formation of cavites.
5. Lower bird density in managed as compared to natural forests is due primarily to the decrease in the number of hole nesting pairs.

In discussing these points, I have alluded to some of the conflicts between hole nesters and commercial timber management. In recent years, commercially valuable forest lands, public as well as private, have been devoted primarily to meeting the country's demand for wood fiber. The timber industry is a basic industry and as such is important in maintaining the stability of the United States economy. Oregon produces more timber than any other state. On Oregon's west side, intensive timber management is pursued by frequent commercial thins, mortality salvaging, and final cuts in rotations of the most economic length which is about 70 to 100 years. Policy is made to prevent the destruction of wood fiber by fire, disease, or insect attack. Potential fuel for a fire is minimized by maintaining a clean accessible forest. Prompt harvest of infected or infested trees, dead or alive, is practiced in order to save the wood and to prevent the build up of wood destroying insects and fungi. Any misshapen or broken trees are removed at the thinnings in order to release the highly marketable trees from competition. All of these policies make good sense in the light of timber management goals.

But, in keeping the picture of a clean and accessible even-aged stand in mind, let's look at the need of cavity nesters. We have seen that the resource limiting their abundance is nest holes, which are either drilled by the excavators or formed through wood decay. Both of these processes are dependent on the fungi, which are found in trees with distorted shape, broken leader, cankers, burls, and other wounds. There are the trees the timber manager attempts to eliminate from the forest. Also, the excavators, woodpeckers and nuthatches, forage mainly on bark and wood-boring insects. These insects are undesirable to the timber manager because they reduce the commercial value of the stand. The conclusion I have come to is that the needs and requirements of hole nesters are in conflict with the basic goals and objectives of commercial timber management.

In practice the picture is brighter. All stands are not yet intensively managed. There are some areas on public land which are not devoted to raising wood: the wilderness areas, natural areas, buffer strips along streams, and land too low in productivity to be of commercial value. Timber managers have not yet found a way to eliminate insect pests and wood-rotting fungi, but they are trying.

The Forest Service will probably come out with a regionwide snag policy in the spring. On the west side, due to safety regulations, fire hazards and economic considerations, it would require a major change in the harvesting method, which is clearcut, burn, and replant to establish any policy of leaving snags. One compromise may be to leave a wildlife cell, a corner of the proposed cut which is left intact. If this cell is one acre out of a 40 acre cut, this means that nest holes are reduced to $1/40^{th}$ of their previous level. Those species which can best compete for nest sites will monopolize these few remaining holes and the other species will disappear. I might mention that starlings are very effective competitors. Also, this wildlife cell idea would be a policy as distinct from a practice. I am afraid it will be evoked when the proposed cut is full of marketable trees.

Because harvest by partial cut is extensively practiced on the east side, the outlook for hole nesters there is brighter. There, also, all snags are felled on clearcuts, but allowing dead trees to remain standing is compatible with the partial cut method. Most of the forests on the east side have snag policies, some districts practice them. In one case, provisions have been made for the future by designating live trees, which will become snags.

I have tried to demonstrate that it is not only snags that cavity nesters require. Under natural conditions the forest, especially a mature forest, contains many trees with soft, rotten heartwood, dead-topped trees and distorted trees in which cavities have formed, and trees harboring bark and wood-boring insects which provide food for the excavators. These aspects of the forest are eliminated under intensive management.

The following is a policy, admittedly somewhat idealistic, which would create some of the conditions which favor hole nesting birds.

1. No standing dead trees will be cut unless absolutely necessary.
2. At the precommercial thin, commercial thins, and final cut, or at the partial cuts, the following trees will be left:
   A) dying trees
   B) trees showing signs of heartwood rot
   C) insect infested trees
   D) trees with distorted shape or wind breakage
   E) dead-topped trees
3. Fallen dead trees will be left as foraging sites.

Clearly, this policy conflicts with the methods now employed in managing our forest lands for high wood fiber production. In my title I asked the question, “Can we ever leave enough snags?” The answer is no. The conflicts between timber management and cavity nesters are too basic to be resolved by a snag policy. They can only be resolved by a rethinking of the nation’s priorities and a greater value placed on those aspects of life which cannot be measured in dollars and cents or in board feet.

Literature Cited

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Table 1. Proportion of avian species which nest in holes.

	Total Species	Cavity Nesters
Passerines in the World	5140	1166 (22%)
Birds in Oregon	242	43 (18%)
Forest Birds in Oregon	96	38 (40%)

Table 2. Non-avian cavity nesters.

California Myotis	Chickaree
Little Brown Myotis	Red Squirrel
Big Brown Bat	Grey Squirrel
Raccoon	Western Harvest Mouse
Marten	Deer Mouse
Fisher	Red Tree Mouse
Bushy-Tailed Woodrat	
	Some Bees

Table 3. Excavators.

Red-Breasted Nuthatch	Hairy Woodpecker
White-Breasted Nuthatch	Downy Woodpecker
Pygmy Nuthatch	Williamson's Sapsucker
	Yellow-Bellied Sapsucker
Black-Backed 3-Toed Woodpecker	Pileated Woodpecker
Northern 3-Toed Woodpecker	Acorn Woodpecker
White-Headed Woodpecker	Lewis Woodpecker
	Common Flicker

Table 4. Almost always nest in cavities.

Wood Duck	Sparrow Hawk
Common Goldeneye	
Barrow's Goldeneye	Tree Swallow
Bufflehead	Purple Marten
Harlequin Duck	Western Bluebird
Hooded Merganser	Mountain Bluebird
	Ash-Throated Flycatcher
Spotted Owl	Black-Capped Chickadee
Sawhet Owl	Mountain Chickadee
Screech Owl	Chestnut-Backed Chickadee
Pygmy Owl	
Flammulated Owl	

Table 5. Sometimes nest in cavities.

Common Merganser	House Wren
Barn Owl	Winter Wren
House Sparrow	Bewick's Wren
Violet-Green Swallow	House Finch
	Starling

Table 6. Percent of breeding pairs which are cavity nesters in the forests of the Northwest.
(Data from American Birds)

Coniferous	.21 ± .02	
Deciduous	.28 ± .02	(5%C.I., n = 61)
Mixed	.38 ± .04	

Table 7. Fledging success of temperate passerines.

Nest Type	Fledgling Success	Number of Eggs
Cavity	.66	94,400
Open	.46	21,951
		(Nice, 1957)

Table 8. Population increase by providing nest boxes.

Size of Area	Fledged Broods per Hectare	
	Before	After
1.25 ha	0	29.66
	(1948)	(1949-61)
25.0 ha	1.70	25.70
	(1949-51)	(1952-61)
		(Pfeifer, 1961)

Table 9. Breeding success of pied flycatchers.

Density (pairs per hectare)	Percent Eggs laid that fledged
0.25	90
1.00	95
3.00	84
9.00	73
20.00	85
	(Tompa, 1967)

Table 10. Decrease in bird density (pairs per kilometer^2) found in managed as compared to natural forests in Finland. (Haapanen, 1965)

	Open Nesters	Cavity Nesters
Pine Forest		
Natural	91	39
Managed	91	22
	(0% decrease)	(44% decrease)
Spruce Forest		
Natural	149	59
Managed	142	20
	(5% decrease)	(68% decrease)

Table 11.Ratio of excavators to non-excavators.

Finland	Pacific Northwest
2 Excavators	2 Excavators
3 Non-Excavators	3 Non-Excavators
(Haapanen, 1965)	.61 + .20
	(95% C.I., n = 61)
	Data from American Birds

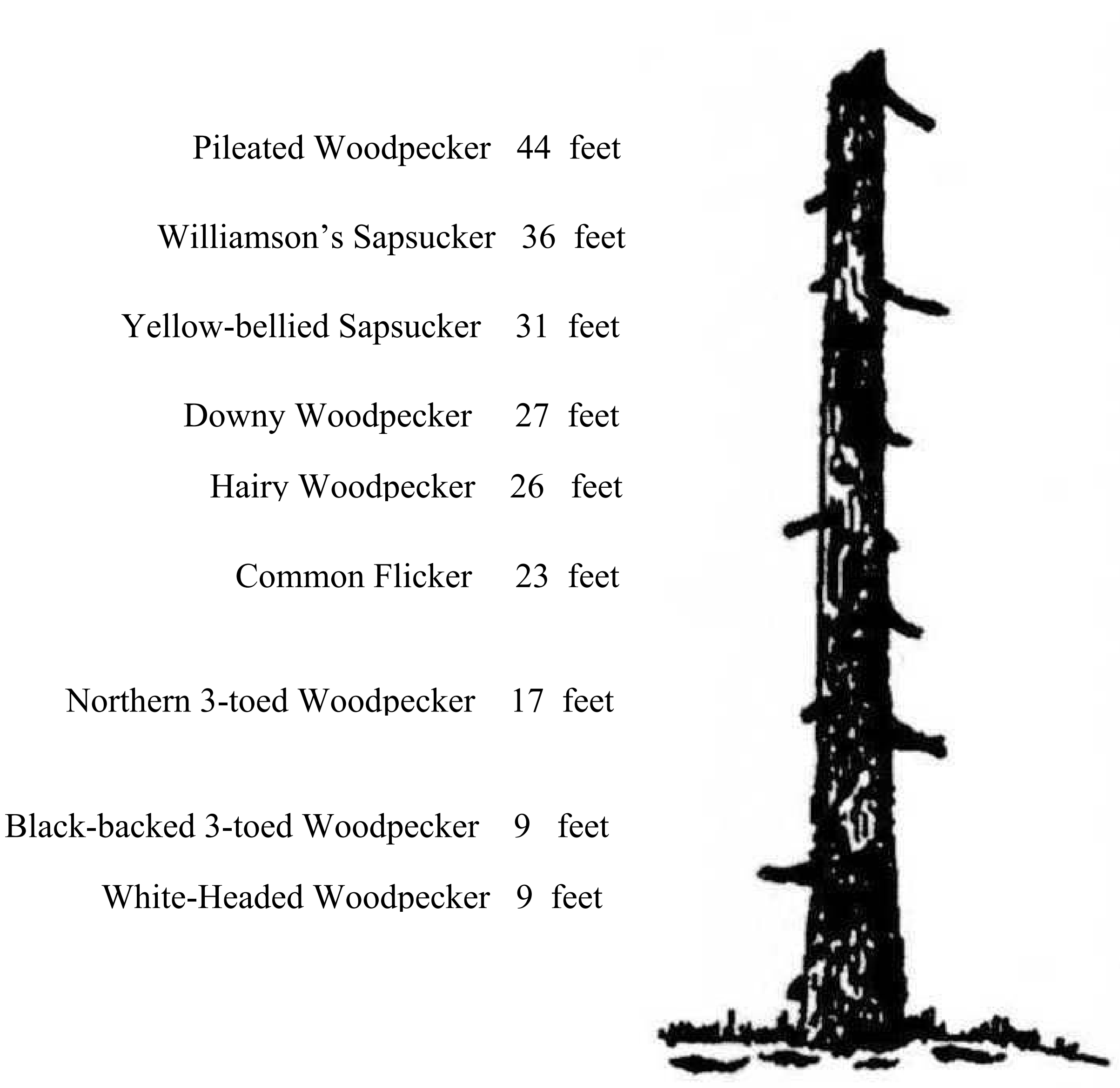

Figure 1. Average height of nest hole. These figures are averages of 217 mentions in the literature of heights of nest holes.