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Use of *Arbutus menziesii* by Cavity-nesting Birds

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Abstract: As part of a larger study of wildlife habitat associations in Douglas-fir (*Pseudotsuga menziesii*) forests of northwestern California, I recorded characteristics of nest sites used by 16 species of cavity-nesting birds. Pacific madrone (*Arbutus menziesii*) contributed only 8% of the basal area of the stands I studied, but 24% of all cavity nests were in madrone. Although nests were distributed among 17 tree species, only madrone was utilized by birds at a rate greater than predicted from availability. About 75% of available madrone trees were <30 cm diameter at breast height (DBH), but only 11% of the nests were in these smaller trees. Larger than average madrones seem to be an important habitat component for cavity-nesting birds in California's Douglas-fir forests. Madrones are also a prime fuelwood species; thus, a potential conflict exists between commercial use of madrone and its value for wildlife. The importance of Pacific madrone as nesting habitat is less well known. The objective of this study was to evaluate the use of madrone as a nesting substrate for cavity-nesting birds.

Mixed-evergreen forests of northwestern California support one of the most complex vegetation patterns in North America (Whittaker 1961). Much of this complexity results from the diversity of hardwood species comprising the lower overstory canopy. These hardwoods are recognized as a potentially rich resource for wood products and energy (McDonald 1983 and Zerbe 1985). Pacific madrone (*Arbutus menziesii*) is a dominant tree species in this complex. It is heavily used locally because of its value as pulpwood and fuelwood.

Pacific madrone is also an important food source for birds and other species that feed on its berries. For example, Hagar (1960) found that varied thrushes (*Ixoreus naevius*) were more abundant in a winter when there was a large berry crop than in years of poor crops. I observed a similar response of varied thrushes and American robins (*Turdus migratorius*) to changing berry crops in that both species were at least twice as abundant in the winter of 1980–81 when the madrone berry crop was heavy compared with the next 2 winters when berries were much less numerous.

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This study was conducted in the Six Rivers, Shasta-Trinity and Klamath National Forests of northwestern California as part of a larger study of habitat associations of vertebrates in relation to stand age (Raphael 1984). Elevation on the study sites ranges from 427–1220 m. Weather is characterized by cool wet winters (89–137 cm precipitation/year) and warm dry summers (maximum temperature usually <35°C). Douglas-fir (*Pseudotsuga menziesii*) in association with tanoak (*Lithocarpus densiflorus*) and Pacific madrone dominate the forest cover.

METHODS

During the spring and summer of 1981–83 observers located active bird nests. For each active nest, they noted the date, location, bird species, tree species, tree condition (live or dead), tree height, tree diameter at breast height (DBH), nest height, nest aspect, substrate type (if the nest was not in a tree), nest status (building nest, incubating eggs or feeding young) and other relevant observations.

To characterize the structure and composition of vegetation in the study area, 408 0.04 ha circular plots were randomly located. Species, height, DBH and crown dimensions of each tree or shrub >2.0 m tall within each plot were recorded. These data were used to calculate canopy volume for each species on each plot. The computer program HTVOL (Mawson, *et al*. 1976) was modified to perform all canopy volume calculations.

RESULTS

Madrone Characteristics

In all 25,110 individual trees and shrubs, representing 37 species, were sampled on the 408 vegetation plots. Pacific madrone ranked third in average density, basal area, and canopy volume after Douglas-fir and tanoak (Table 3-1). Madrone occurred as a relatively minor component of the lower canopy in association with tanoak; both species were overtopped by Douglas-fir (Figure 3-1). Canopy volume of madrone was distributed below about 30 m canopy height, reaching its maximum volume at a height of about 15 m. Madrone was most abundant on drier, south facing slopes at lower elevations. Its abundance was significantly correlated ($p < 0.001$) only with canyon live oak (*Quercus chrysolepis*), suggesting that the 2 species have similar habitat requirements.

Table 3-1. Abundance of dominant trees in Douglas-fir forests of northwestern California from 1981-83.Values are means from 408 plots of 0.04 ha.

Species	Density (stems/ha)	Basal Area (m^2/ha)	Canopy volume (m^3/ha)
Douglas fir	326	37	48138
Tanoak	460	8	12874
Pacific madrone	58	5	3406

Nest Tree Characteristics

Observers located 126 nests of 33 bird species (Table 3-2). Overall, most nests were in Douglas-fir, followed by Pacific madrone and tanoak (Figure 3-2). Among 70 cavity nests, 35 were in Douglas-fir, 17 in Pacific madrone, 7 in tanoak, 3 in *Quercus* species and 8 in other species. The frequency of cavity nests in Pacific madrone was significantly greater (binomial test, $p < 0.001$) than the relative basal area of madrone. Frequencies of cavity nests in all other tree species did not differ significantly from availability. Open-nesting species, in contrast, used tanoak at a rate

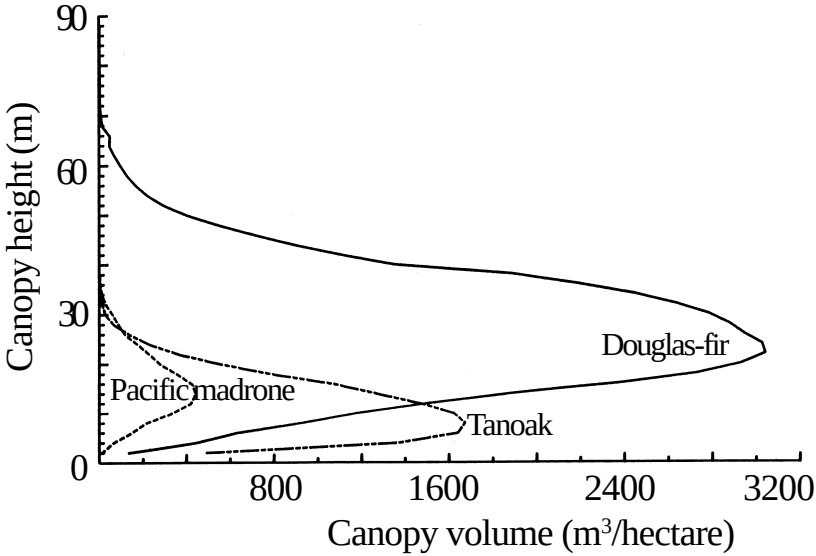

Figure 3-1. Canopy volume in relation to height of 3 species in Douglas-fir forests of northwestern California. Values calculated at each height are averages from all trees sampled on 408 plots of 0.04 ha.

Table 3-2. Tree species used for nesting by cavity-nesting and other bird species in Douglas-fir forests of northwestern California. DF = Douglas fir, PM = Pacific madrone, TO = tanoak, QS = *Quercus* species and OT = other species. Data for 1981-83.

Bird Species	Numbers of nests by species					
	DF	PM	TO	QS	OT	Total
Western screech-owl (Otus kennicottii)	1	0	0	0	0	1
Spotted Owl (Strix occidentalis)	1	0	0	0	0	1
Acorn woodpecker (Melanerpes formicivorus)	1	2	0	0	0	3
Red-breasted sapsucker (Sphyrapicus ruber)	5	6	0	0	2	13
Downy woodpecker (Picoides pubescens)	0	1	1	0	0	2
Hairy woodpecker (Picoides villosus)	0	3	0	0	1	4
White-headed woodpecker (Picoides albolarvatus)	1	0	0	0	0	1
Northern flicker (Colaptes auratus)	2	0	2	0	1	5
Pileated woodpecker (Dryocopus pileatus)	1	0	0	0	1	2
Mountain chickadee (Parus gambeli)	0	1	0	0	1	2
Chestnut-backed chickadee (Parus rufescens)	6	0	0	1	0	7
Red-breasted nuthatch (Sitta canadensis)	8	1	1	2	1	13
White-breasted nuthatch (Sitta carolinensis)	1	0	1	0	1	3
Brown creeper (Certhis americana)	7	0	1	0	0	8
House wren (Troglodytes aedon)	1	2	1	0	0	4
Western bluebird (Sialia mexicana)	0	1	0	0	0	1
All cavity-nesters	35	17	7	3	8	70
Other birds (17 species)	12	4	13	2	25	56
All species	47	21	20	5	33	126

significantly greater than expected (35.1% of nests versus 14.0 % basal area, $p < 0.01$).

Among primary cavity-nesting species (those capable of excavating their own nest cavities), red-breasted sapsucker (*Sphyrapicus ruber*), hairy woodpecker (*Picoides villosus*) and acorn woodpecker (*Melanerpes formicivorus*) most often excavated cavities in madrone (Table 3-2). Together, these 3 species excavated 11 of 17 nests in madrone whereas only 2 madrone nests would be expected if nest selection were random with respect to tree species. Two of these species (red-breasted sapsucker and hairy woodpecker) are the most abundant woodpeckers in the Douglas-fir habitat type (Raphael, *et al*. 1988). Their apparently strong preference for Pacific madrone may result in a higher proportion of abandoned cavities (suitable for secondary cavity-nesting bird species) in madrone versus other tree species.

Trees used by cavity-nesting birds were most frequently in the 30-45 cm diameter class (25% of all nests) (Figure 3-3). In contrast, most sampled trees were <15 cm DBH (75%). Among cavity nests in

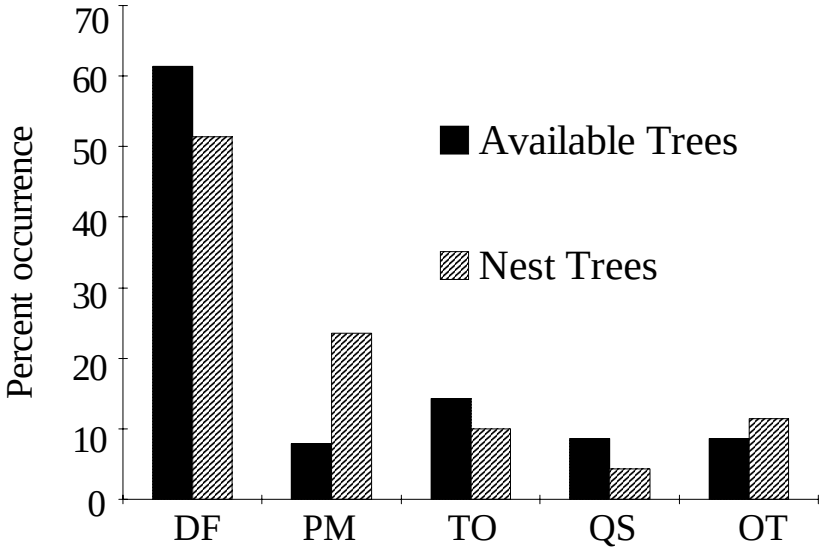

Figure 3-2. Percent occurrrence of trees available for nesting and nests found in 5 types of trees in a Douglas-fir dominated forest in northwestern California. DF = Douglas-fir, PM = Pacific madrone, TO = tanoak, QS = *Quercus* species and OT = other species. Data for 1981-83.

Pacific madrone, 89% were in trees >30 cm DBH, whereas only 22% of available trees were that size. Madrones used by cavity-nesting birds averaged 14.9 m tall [range 6.0–44.0, standard deviation (SD) = ±10.2m]; nest holes averaged 9.0 m above the ground (range 3.0–15.0, SD = _3.4 m). Nine of the 17 madrone nest trees were live. Five of these live trees showed no external evidence of disease or damage.

DISCUSSION

Although sample sizes of nests are small, these data suggest that Pacific madrone is an important component of cavity-nesting bird habitat in Douglas-fir forests of northwestern California. The importance of madrone in this study area seems to parallel the importance of aspen (*Populus tremuloides*) in the northeastern United States (Lawrence 1967), especially for hairy woodpecker and sapsucker populations. Aspen and madrone are similar in form: both are smooth barked and both tend to have long trunks that are relatively free of branches. Their wood is similar in texture and hardness.

More important, perhaps, is the frequency of heartwood decay fungi associated with both species. Woodpeckers select aspen infected with *Fomes igniarius* (Kilham 1971). By leaving the sapwood sound

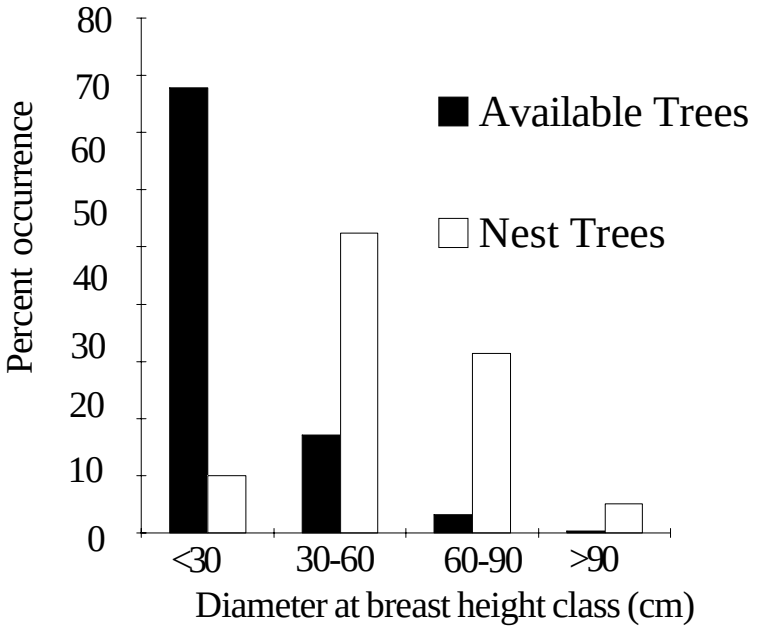

Figure 3-3. Percent occurrence of trees available for nesting and nests found in 4 diameter at breast height size classes of Pacific madrone in northwestern California. Data for 1981-83.

while decaying the heartwood, this fungus creates ideal conditions for excavating a nest cavity surrounded by a strong outer wall. The presence of decay within madrone nest trees was not noted, but I have observed a high incidence of heart rot in cut madrones, especially among larger diameter trees such as those preferred by birds in this study. I believe it is likely that birds in northwestern California select trees that are infected by heart rot fungi. This may explain the apparent preference for madrone and the high incidence of nests located in live trees, unlike other areas in California where dead trees are the preferred substrate (Raphael and White 1984).

Management Recommendations

If Pacific madrone is a preferred nest tree species for primary cavity-nesting birds in this forest type, some considerations should be given for its management. Two considerations are most important: the number of trees and their diameter. To estimate madrone requirements for cavity-nesting populations, I used data from Neitro, *et al.* (1985) and this study to calculate the number of madrone stems needed per yr (S):

$$S = D * C * X$$

where (D) is the maximum density of each primary cavity-nesting species

Table 3-3. Estimated breeding densities of primary cavity-nesting bird species and estimated numbers of Pacific madrone stems >30 cm DBH needed each year to provide nesting substrate. Values of (X) for Northern flickers and pileated woodpeckers are assumed = 0.1.

Woodpecker species	Maximum density (D) (pairs/100 ha)	No. cavities excavated/ pair/yr (C)	Proportion madrone (X)	No. madrone stems needed /100 ha (S)
Acorn woodpecker	8.6	5	1	30
Red-breasted sapsucker	27.9	1	1	14
Downy woodpecker	4.9	2	1	5
Hairy woodpecker	39.5	3	1	95
Northern flicker	12.0	1	0	2
Pileated woodpecker	0.5	3	0	1
Totals	93.4			147

(Neitro, *et al.* 1985), (C) is the number of cavities excavated/pair/year (Neitro, *et al.* 1985) and (X) is the expected proportion of nests excavated in madrone (Table 3-2). Results indicate that a total of about 147 madrone stems/100 ha (1.5 stems/ha) should be available each year (Table 3-3). Birds rarely nested in madrones <30 cm DBH (Figure 3-3). The average density of these larger madrones in the vegetation plots was about 13 stems/ha; therefore, meeting these estimated nesting requirements of primary cavity-nesting birds would entail retention of about 10 percent of the available large stems.

These recommendations are offered as interim guidelines. First, it is not known if birds used madrone opportunistically in this study. The critical question is whether, in the absence of madrone, cavity-nesting birds might shift to another tree species without loss of reproductive fitness. Circumstantial evidence presented in this study suggests otherwise: madrone trees seemed to be actively selected by at least 2 primary cavity-nesting species. Until results of additional research can resolve these questions, retention of madrone in managed stands would seem prudent.

ACKNOWLEDGEMENT

This paper is adapted with permission from Pacific Southwest Research Station, General Technical Report PSW-GTR-100.

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