Published in proceedings of "Interior Douglas-Fir: The Species and Its Management" held February 27 – March 1, 1990 in Spokane, WA, USA.
Compiled and edited by D.M. Baumgartner and J.E. Lotan, Washington State University Extension, Pullman, WA.
(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0230. 301 pp.

BIRD ASSEMBLAGES IN OLD-GROWTH AND ROTATION-AGED DOUGLAS-FIR/PONDEROSA PINE STANDS IN THE NORTHERN ROCKY MOUNTAINS: A PRELIMINARY ASSESSMENT

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ABSTRACT

In each of 16 old-growth (200+ years) and 16 rotation-aged (80-120 years) Douglas-fir/ponderosa pine stands in western Montana and adjacent Idaho, birds were counted four times during the 1989 breeding season. All individuals were identified by sight and sound during 10-minute counts at two to five points along a transect through each stand. A greater number of bird species was encountered in the old-growth stands; however, on the basis of individual sites, bird species richness was similar in old-growth and rotation-aged stands. Of the 68 species recorded, 14 were found exclusively in old-growth and seven exclusively in rotation-aged stands. Of the species present only in old growth, 43% were hawks and owls. In general, total abundance per site was greater in rotation-aged stands, and individual species abundances differed between habitats. Five of the eight species more abundant in old-growth stands were two woodpecker species, Swainson's Thrush, Townsend's Warbler, and MacGillivray's Warbler. Clark's Nutcracker, Brown-headed Cowbird, and Red Crossbill were three of the seven species more abundant in rotation-aged stands. These differences in bird species richness and abundance are potentially important for managers concerned with maintaining populations of bird species associated with different-aged stands.

Keywords: birds, old growth, rotation age, Douglas-fir, ponderosa pine

INTRODUCTION

Little is known about old-growth associated bird species in the Northern Rocky Mountains. However, the few studies that have been conducted in old growth or stands with old-growth features have found evidence that some species are associated with old-growth components (McClelland *et al.* 1979; Marzluff and Lyon 1983). The highest density and diversity of hole-nesters in northwestern Montana were found in those stands of western larch (*Larix occidentalis*), ponderosa pine (*Pinus ponderosa*), and black cottonwood (*Populus trichocarpa*) that contained major components of old growth (McClelland *et al.* 1979). Significant associations between several bird species and two key features of old-growth forests, large trees and large snags (Franklin *et al.* 1981), were shown in a study comparing logged and unlogged habitats along an elevational gradient in western Montana (Marzluff and Lyon 1983). Habeck (1988) suggested that old-growth forests in the Northern Rockies contain many bird species that are better adapted to old-growth forests than other stands of timber.

Baseline data are needed for bird assemblages in all old-growth habitats in the Northern Rockies, but especially for those plant communities that have been heavily harvested in the past and that will experience the greatest future harvesting pressure. In the Northern Rockies, these plant communities include Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) and Rocky Mountain ponderosa pine (*Pinus ponderosa* var. *scopulorum*).

Comparisons of bird assemblages in logged and unlogged habitats help identify species that are unique to, or associated with, a particular habitat. Under current silvicultural prescriptions for Douglas-fir/ponderosa pine forests in the Northern Region of the Forest Service, U.S. Department of Agriculture, rotation-aged stands (80-120 years old; B. Naumann, pers. comm.) would be the oldest managed stands in the forest. As such they potentially would be considered the ecological equivalent, or replacement, of "old growth" in a completely manipulated forest. Managers need to know if there are differences between bird assemblages found in old-growth compared to rotation-aged stands. If differences are found, managers would need to know what species might be lost with the elimination of old growth.

The objective of this study is to characterize and compare the distribution of diurnal birds during the breeding season of most species in old-growth and rotation-aged Douglas-fir/ponderosa pine stands in the Northern Rockies. These results are preliminary and based on data from one breeding season (1989).

METHODS

Study Sites

Study sites were located in western Montana and adjacent Idaho during the summer of 1988. We attempted to locate as many old-growth and rotation-aged stands as possible to have a large sample of each from which we could randomly select study sites for each treatment. Difficulty in finding stands that adequately met our criteria determined sample sizes of 16 old-aged sites and 16 rotation-aged sites on the Bitterroot and Lolo National Forests and Lubrecht Experimental Forest (Figure 1).

The criteria for old-growth stands (determined by on-site inspection) were:

(1) each study site was homogeneous in vegetative structure and composition,
(2) each area was at least 8 hectares (19.8 acres) in size and at least 200 meters wide (219 yards),

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(3) the dominant species on each site were Douglas-fir and ponderosa pine,
(4) sites ranged from near 100% Douglas-fir to near 100% ponderosa pine for the large dominant trees,
(5) the dominant trees were near-maximal for the species in this geographic area and had old-age characteristics, and
(6) no obvious large-scale disturbance by people had occurred on any site (except for the exclusion of fire in this region for roughly the last 50 years), and
(7) stands were at least 0.8 kilometer (0.5 mile) apart.

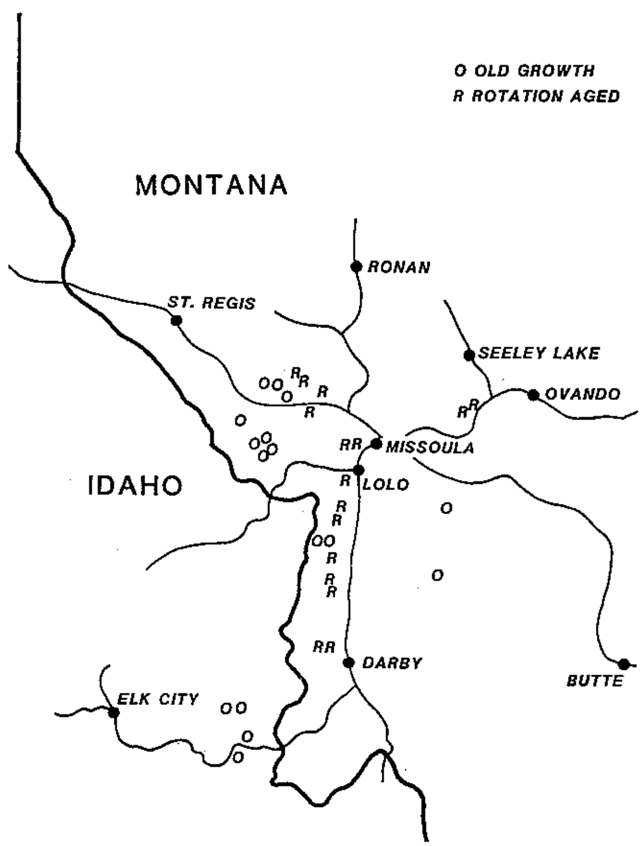

Figure 1.—Location of the 32 study sites in western Montana and adjacent Idaho. The 16 old-growth stands are indicated by O's, and the 16 rotation-aged stands are indicated by R's. The study sites cover an area approximately 240 kilometers long by 130 kilometers wide (150 by 80 miles).

The fifth and sixth criteria (age and disturbance) were of primary importance for selection of old-growth stands (Hunter, 1989). Some sites had evidence of vegetation manipulation. A few sites contained hiking trails. Two sites had some stumps within the stand near one edge, indicating some past firewood cutting or logging activity. All stands had to be free from timber activity for 3 years (until Fall 1991).

The criteria for rotation-aged stands were the same as for the old-aged sites except that the dominant trees were approximately rotation age for Douglas-fir and ponderosa pine in the Northern Region (80-120 years old) and obvious large-scale human disturbance (primarily logging) could have occurred on the site. Small roads and trails were included in some of the stands.

Bird Observations

To compare the distribution of birds on rotation-aged and old-aged stands, one transect usually consisting of five points was marked on each of the 32 study sites. Points were located 200 meters (219 yards) apart along a linear transect and at least 100 meters (109 yards) from any obvious large discontinuity or edge of the stand. Most stands were long and narrow, paralleling drainages. Five points [1-kilometer (0.6-mile) transects] were established in 15 of the rotation-aged stands and in 14 of the old-growth stands. One rotation-aged stand had only four points, and one old-growth stand was only large enough to contain two points. A different old-growth stand was bisected by a road; two points were located below the road and three points above the road.

Bird counts (10 minutes) were conducted by four people during the breeding season (15 May and 6 July) of 1989. Verner (1988) suggested 10-minute counts to avoid double-counting of individuals (Granholm 1983) in most habitats. To minimize observer effects in the analysis (Verner 1985), each observer visited each study site once during 1989. Sampling at each site was spread as evenly as possible throughout the breeding season because detectability of each bird species usually changes during the breeding season (Verner 1985). Visits to a site occurred at 1-2 week intervals. We were concerned initially about the possible differences in detectability between habitats (Verner 1985; Hutto et al. 1986), but the field crew of 1989 noticed no obvious differences.

Bird counts were conducted between one-half hour after dawn and 1100 and were confined to days with good weather (wind less than 21 miles per hour and light or no precipitation). Some studies have shown time-of-morning effects (Robbins 1981), while others have not (Verner and Ritter 1986). Time-of-day effects are most likely influenced by dawn choruses (rapid changes in the detectability of many species at dawn) and little singing in the afternoon. Therefore, birds were counted in the morning but not during the dawn chorus. To sample points at different times in the morning, two observers traveled the transect in one direction, while the other two observers traveled in the opposite direction.

Each observer noted site information, weather data, and a description of each bird detection during each 10-minute count. Birds flushed as the observer traveled to the point were counted. All observations of birds considered to be using the stand were included in the analysis. Only the first detection of an individual bird was included in the abundance estimates. Repeat detections of the same individual were ignored.

Analysis

Bird species richness, total abundance, abundance of the common and the uncommon species, abundance of some taxonomic groupings of species, and individual species abundances were determined for each site. We used simple measures rather than adjusted counts such as density estimates (Raphael 1987). Because bird species richness is only meaningful as a stand characteristic and we did not want sampling differences to affect the results, bird species richness (hereafter BSR) was analyzed only for the 30 sites with five sampling points. We used information from all 32 sites for the other analyses. Histograms and normal probability plots of residuals were examined for each variable, and analysis of variance (ANOVA) was used only on variables with normally distributed residuals (Steel and Torrie 1960:128-131). ANOVA for BSR included only stand type as a factor. The ANOVA model for all of the different groups of abundance data included stand type (old growth or rotation age) as the treatment variable and site as a nested factor within stand types. Data from each point along a transect were treated as subsamples from that site. Statistical significance was attributed to those tests with $P<0.05$. Species whose residuals were normally distributed were called "common" species. All others were called "uncommon" species. Uncommon species were not analyzed individually with ANOVA.

RESULTS

Of the 68 species that were recorded during the 1989 breeding season, 47 were found in both stand types. Of the 14 species exclusively in old growth, 43% were hawks and owls (Table 1; see Appendix A for scientific names). Of the seven species exclusively in rotation age, many are commonly associated with grasslands. Western Meadowlark was more abundant than the other species exclusive to rotation-age sites. None of these old-growth or rotation-aged associates were very abundant or found on many sites.

Bird Species Richness

Although a greater number of bird species was encountered across all old-growth stands, BSR on individual sites was similar between old growth and rotation age ($F = 0.43$; df = 1, 28; $P = 0.5195$). BSR averaged 27.8 species (range: 21-37) in old-growth stands and 26.7 species (range: 18-33) in rotation-aged stands.

Group Abundances

Although not statistically significant, a greater number of individual birds was encountered on rotation-aged stands ($F = 3.05$; df = 1, 30; $P = 0.0908$). The numbers of individuals per point per visit averaged 13.5 (range: 9.1-24.1) in rotation stands and 11.2 (range: 7.0-16.8) in old stands. Three flocking species (Clark's Nutcracker, Red Crossbill, and Evening Grosbeak) contributed substantially to the greater abundance in rotation-aged stands as well as to great variability within this stand type (Figure 2).

The abundance of the 26 common species pooled was greater in rotation-aged stands than in old growth ($F = 4.73$, df = 1, 30; $P = 0.0376$). Three common species in particular (Clark's Nutcracker, Red Crossbill, and Evening Grosbeaks) were important members of the bird assemblages on the rotation-aged stands (Table 2). The average number of common species per point per visit was 9.8 in old growth and 12.5 in rotation age.

The abundance of uncommon species pooled was similar between old-growth and rotation-aged stands ($F = 2.70$; df = 1, 30; $P = 0.1106$). The number of uncommon species per point per visit was small and averaged 1.4 in old growth and 1.0 in rotation age.

We also chose to examine the abundance of all woodpeckers as a group and the *Empidonax* flycatchers as a group. Both groups are sometimes difficult to distinguish aurally, and the *Empidonax* flycatchers are difficult to distinguish visually. The six woodpecker species pooled were more common in old-growth than in rotation-aged stands ($F = 10.17$; df = 1, 30; $P = 0.0033$). The group of Empidonax flycatchers did not differ between the two stand types ($F = 0.59$; df 1, 30; $P = 0.4491$). However, for the Empidonax detections that we felt comfortable in identifying to species, Hammond's Flycatcher abundances were clearly greater in old growth and Dusky Flycatcher's in rotation age (Table 2). Only a few Willow Flycatchers were encountered during the study (Table 1).

Table 1.—Occurrence and mean abundance of the 42 uncommon species (those without normally distributed residuals) on 16 rotation-aged and 16 old-growth Douglas-fir/ponderosa pine stands.

	Rotation-aged		Old-growth	
Species	Number of Sites	Mean Abundance[1]	Number of Sites	Mean Abundance[1]
Cooper's Hawk	0	–	1	0.02
Northern Goshawk	0	–	3	0.08
Red-tailed Hawk	3	0.08	3	0.16
Ring-necked Pheasant	1	0.08	0	–
Blue Grouse	2	0.05	2	0.06
Ruffed Grouse	5	0.17	8	0.30
Mourning Dove	6	0.25	0	–
Flammulated Owl	0	–	1	0.02
Great Horned Owl	0	–	1	0.02
Northern Pygmy-Owl	0	–	1	0.02
Barred Owl	0	–	1	0.05
Common Nighthawk	0	–	1	0.02
White-throated Swift	2	0.05	1	0.02
Calliope Hummingbird	2	0.06	1	0.02
Broad-tailed Hummingbird	1	0.02	0	–
Rufous Hummingbird	0	–	2	0.03
Red-naped Sapsucker	0	–	1	0.02
Williamson's Sapsucker	5	0.17	7	0.34
Black-backed Woodpecker	1	0.02	1	0.02
Olive-sided Flycatcher	1	0.02	3	0.08
Western Wood-Pewee	5	0.13	2	0.03
Willow Flycatcher	0	–	1	0.02
Tree Swallow	1	0.03	0	–
Gray Jay	3	0.08	6	0.38
Steller's Jay	6	0.11	9	0.34
Black-capped Chickadee	5	0.17	5	0.16
White-breasted Nuthatch	5	0.14	9	0.34
Brown Creeper	0	–	1	0.06
Winter Wren	0	–	3	0.13
Golden-crowned Kinglet	1	0.03	5	0.22
Western Bluebird	0	–	1	0.03
Hermit Thrush	3	0.06	7	0.30
Varied Thrush	1	0.02	3	0.20
Cedar Waxwing	2	0.03	0	–
Orange-crowned Warbler	1	0.02	3	0.20
Nashville Warbler	3	0.08	4	0.08
Black-headed Grosbeak	1	0.02	1	0.02
Lazuli Bunting	2	0.08	1	0.14
Rufous-sided Towhee	3	0.17	2	0.25
Vesper Sparrow	2	0.05	0	–
Song Sparrow	0	–	2	0.05
Western Meadowlark	5	0.47	0	–

[1]Average number of detections per site per visit.

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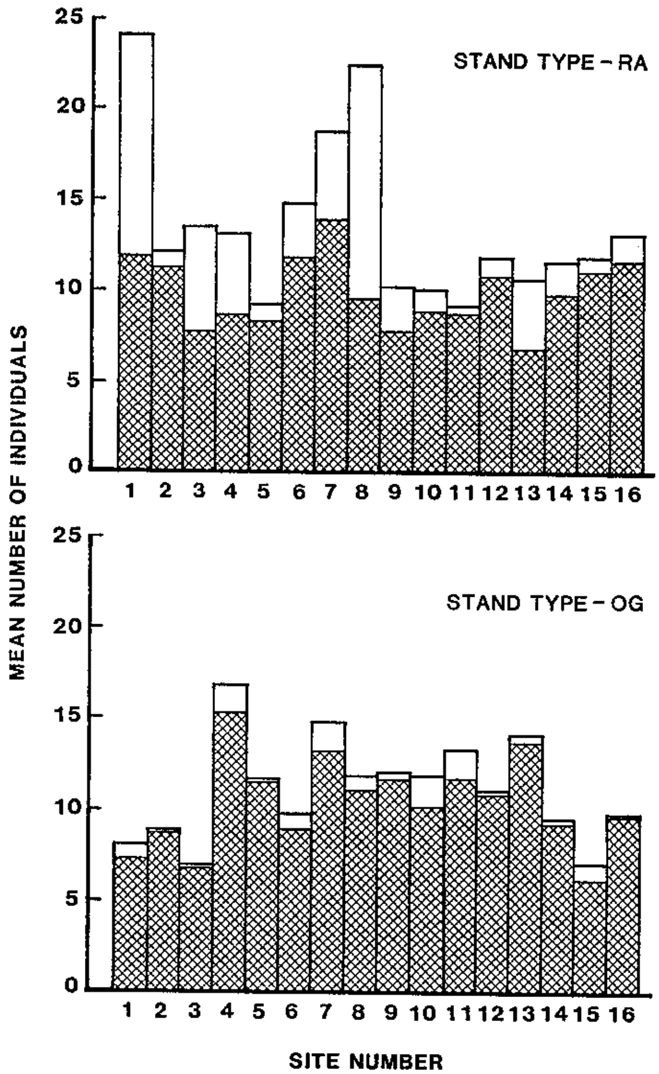

Figure 2.—Mean abundance of birds per point per visit for each rotation-aged (RA) and old-growth (OG) site. The unhatched area for each site represents the combined abundance of three flocking species (Clark's Nutcrackers, Red Crossbills, and Evening Grosbeaks). The hatched area represents the abundance of all other species on the site.

Group abundances were significantly different among sites within each stand type for each of the above ANOVAs.

Individual Species Abundances

Of the 26 common species, 11 did not differ in abundance between the two stand types (Table 2). Of the remaining 15 species that were more abundant in one stand type, eight were more prevalent in old growth and seven were more prevalent in rotation age. The eight old-growth associates were Northern Flicker, Pileated Woodpecker, Hammond's Flycatcher, Swainson's Thrush, Townsend's Warbler, MacGillivray's Warbler, Western Tanager, and Pine Siskin. The seven species associated with rotation age were Dusky Flycatcher, Clark's Nutcracker, Red-breasted Nuthatch, Solitary Vireo, Chipping Sparrow, Brown-headed Cowbird, and Red Crossbill.

Aside from the 21 species that were found exclusively in one of the two stand types, we noted only four of the uncommon species that were clearly more abundant in one stand type or the other (Table 1). Gray Jays, Golden-crowned Kinglets, and Hermit Thrushes were more abundant in old-growth stands, while Western Wood-Pewees were more abundant in rotation-aged stands.

The abundance of each species was significantly different among sites within each stand type according to each of the above ANOVAs.

DISCUSSION

We do not know if these patterns of bird presence and abundance are typical of old-growth and rotation-aged stands of Douglas-fir/ponderosa pine in the Northern Rockies. Bird numbers in western coniferous forests often fluctuate greatly between years (Franzreb and Ohmart 1978; Szaro and Balda 1979; Beedy 1982; Granholm 1982; Smith 1982; Morrison *et al.* 1987; Hejl *et al.* 1988). Although the results described here are from only one breeding season, there are several reasons to suspect wide applicability for this habitat in the Northern Rockies. The geographic scope of our study was large. We had 32 sites spread throughout a 240 by 130 kilometer (150 by 80 mile) area in western Montana and adjacent Idaho. Furthermore, many of our findings parallel those of Mannan and Meslow (1984), who studied old-growth and rotation-aged Douglas-fir/ponderosa pine stands in northeastern Oregon for 3 years (1978-1980). The general applicability of our findings is strengthened for those species with similar trends in Oregon and the Northern Rockies.

We found similar patterns of abundance for 25 species between stand types in the current study compared to the results of Mannan and Meslow (1984) in Oregon. The most notable similarities were for Williamson's Sapsucker, Northern Flicker, Pileated Woodpecker, Townsend's Warbler, and Brown-headed Cowbirds. However, we recorded 24 species on our sites that Mannan and Meslow did not, and they recorded four species that we did not. We do not know if these differences reflect yearly differences in bird numbers, sample size discrepancies, true differences, or the omission in the reporting of some species by Mannan and Meslow. At least one difference was probably real. White-headed Woodpeckers (*Picoides albolarvatus*) are not known to nest in Montana and are uncommon breeders in Idaho, but common breeders in Oregon (DeSante and Pyle 1986). The similarities in abundance of species between our study and Mannan and Meslow's offer some evidence of an effect of stand age on bird assemblages.

Comparing this study with Mannan and Meslow's (1984), notably different trends in abundance were found for 11 species. Ruby-crowned Kinglets, Yellow-rumped Warblers, Dark-eyed Juncos, and Cassin's Finches did not differ between stand types in our study but were more abundant in managed stands in Oregon. In contrast, Franzreb and Ohmart (1978) found greater numbers of ruby-crowns in an old-growth stand than in a managed stand in central Arizona. Pine Siskins were clearly associated with old growth in our study but were more prevalent in managed stands in Oregon. Red-breasted Nuthatches showed the opposite pattern. Franzreb and Ohmart, similarly to Mannan and Meslow, found these nuthatches in much greater numbers in

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Table 2.—Occurrence and mean abundance of the 26 common species (those with normally distributed residuals) on 16 rotation-aged (RA) and 16 old-growth (OG) Douglas-fir/ponderosa pine stands. P values for the F-test for stand type are given for each species. The stand type in which the species was more abundant is indicated for those species with significant F-tests.

Species	Rotation-aged		Old-growth		Significant F-test
	Number of Sites	Mean Abundance[1]	Number of Sites	Mean Abundance[1]	P (Stand Type)
Hairy Woodpecker	11	0.30	11	0.64	0.0540
Northern Flicker	9	0.31	11	0.77	0.0227 (OG)
Pileated Woodpecker	7	0.22	14	0.56	0.0349 (OG)
Hammond's Flycatcher	7	0.23	13	0.75	0.0145 (OG)
Dusky Flycatcher	13	1.63	8	0.39	0.0068 (RA)
Clark's Nutcracker	16	6.09	13	1.17	0.0138 (RA)
Common Raven	12	0.58	10	0.66	0.7055
Mountain Chickadee	16	1.89	15	2.20	0.3716
Red-breasted Nuthatch	16	8.06	16	6.27	0.0495 (RA)
Ruby-crowned Kinglet	14	2.42	11	1.88	0.5190
Townsend's Solitaire	13	0.70	12	0.98	0.3198
Swainson's Thrush	8	0.44	12	0.94	0.0448 (OG)
American Robin	15	2.09	16	1.84	0.6494
Solitary Vireo	15	1.66	10	0.81	0.0363 (RA)
Warbling Vireo	10	0.59	7	0.23	0.0909
Yellow-rumped Warbler	16	4.30	16	5.88	0.0637
Townsend's Warbler	11	0.50	14	2.83	0.0087 (OG)
MacGillivray's Warbler	6	0.13	13	0.47	0.0077 (OG)
Western Tanager	16	3.58	16	5.64	0.0047 (OG)
Chipping Sparrow	16	5.52	16	3.63	0.0450 (RA)
Dark-eyed Junco	16	3.02	14	2.19	0.1910
Brown-headed Cowbird	16	2.52	4	0.38	0.0008 (RA)
Cassin's Finch	15	2.13	12	1.69	0.6367
Red Crossbill	16	3.58	11	1.33	0.0462 (RA)
Pine Siskin	15	1.02	15	2.20	0.0431 (OG)
Evening Grosbeak	13	8.39	11	1.00	0.0843

[1]Average number of detections per site per visit.

old growth. Of the three flocking species that dominated many of our rotation-aged stands, a small number of Evening Grosbeaks were found in both stand types by Mannan and Meslow, and no Clark's Nutcrackers were present in either age class. Although we had a large number of Evening Grosbeaks on some of our rotation-aged stands, the difference between stand types was not statistically significant. Warbling Vireos were common on both stand types in our study but were not detected by Mannan and Meslow. The trend for Golden-crowned Kinglets was similar between the Northern Rockies and Oregon, but many more kinglets were noted in old growth in Oregon. We only detected a few Brown Creepers in our study. Mannan and Meslow detected Brown Creepers on both stand types, but especially in old growth. Discrepancies in occurrence and abundance of these species between studies make it difficult to conclude anything about their association with managed and old-growth stands in the Northern Rockies. Because differences could be due to birds responding differently in different areas, we will feel more confident in the discussion of our patterns after two more field seasons.

Mannan and Meslow (1984) also documented different abundances of Dusky and Hammond's Flycatchers than we did. Hammond's Flycatchers were found in greater numbers in managed stands and Dusky Flycatchers only in managed stands in Oregon. However, the two studies entailed different sampling methodologies. Mannan and Meslow determined the relative abundance of the two species by randomly collecting 20 birds in 1981 and multiplying the total density of visually and aurally detected *Empidonaxes* in both habitats by the proportions of each species in the collected sample. The abundance numbers in our table reflect our relatively certain Dusky and Hammond's detections according to visual and aural cues, primarily vocalizations. Unknown *Empidonax* sightings were treated only in our group analysis. We do not know whose assessment technique is more accurate or if there are true differences in *Empidonax* distribution between Oregon and Montana/Idaho.

Mannan and Meslow (1984) also noted the presence of four species of hawks and owls in their managed stands that we did not. Neither of our sampling methodologies are particularly well-suited for hawks, and ours was not for owls. Detection of hawks and owls on our study is considered a bonus and may be affected by sampling error. Both studies indicate the need for further research on hawks and owls in these habitats.

Aney (1984) also sampled 19 old-growth, primarily ponderosa pine/Douglas-fir, stands in Lolo National Forest during one season, 1983. The most notable differences were four common species we detected that he did not: Common Raven, Warbling Vireo, Brown-headed Cowbird, and Red Crossbill. We also recorded at least 15 uncommon species (excluding owls) that Aney did not, including Steller's Jay and Nashville Warbler. He noted two species that we did not: Sharp-shinned Hawk and Pygmy Nuthatch. These differences could be due to year, sampling, or observer differences.

Medin and Booth (1989) found trends contrary to ours for several species of birds in a comparison of logged and unlogged Douglas-fir/ponderosa pine habitat in central Idaho. Olive-sided Flycatcher, Swainson's Thrush, Yellow-rumped Warbler, and Chipping Sparrows responded positively to selection logging, while Red-breasted Nuthatch and Brown Creepers responded negatively. Based on our data, we would have correctly predicted only the Chipping Sparrow and Brown Creeper responses. Differences could be due to logging effects, habitats, observers, years, species' ranges, or sample sizes.

The most consistent trend in our study was that of site differences within both stand types. Each ANOVA, whether for abundances of species groupings or individual species abundances, indicated statistically significant site differences. It is perhaps not surprising that differences exist between sites, but it does caution against drawing inferences from studies with few sites in a particular habitat or type. In future analyses, we will try to tease apart the differences among our sites for individual species by examining correlations between relative abundance of each species and vegetation, fragmentation, and biogeographic factors. Particularly interesting are the large numbers of three flocking species (Clark's Nutcrackers, Red Crossbills, and Evening Grosbeaks) that contributed greatly to the variability in bird numbers on our rotation-aged stands. We do not know what caused their high numbers, but we plan to investigate potential differences (e.g., seed cone densities) among sites in future years.

We are concerned about the high number of Brown-headed Cowbirds in rotation-aged stands in our study and in Mannan and Meslow's (1984). We do not know if the greater number of cowbirds in these stands is due to some characteristic of the stands themselves that perhaps allows cowbirds to parasitize nests more easily in them, to the proximity of foraging areas, or to the presence of certain host species. Cowbirds are known to feed in areas disjunct from their egg-laying areas in the Sierra Nevada (Rothstein *et al.* 1984). In the Sierra Nevada, feedings sites include towns, horse corrals, campgrounds, and grazing cattle, while the nests that they parasite are in forests and riparian areas. Brown-headed Cowbirds may have similarly disjunct feeding and egg-laying areas in the Northern Rockies and may be parasitizing nests in forests that are relatively close to foraging locations. We will investigate this concern in future analyses.

MANAGEMENT RECOMMENDATIONS

To maintain viable populations of all old-growth associated species, we recommend the preservation of as many old-growth Douglas-fir/ponderosa pine stands as possible under given management constraints. Where adequate old growth is not available, mature stands should be allowed to become old growth. We doubt that there is a large number of old-growth stands of this habitat left in the Northern Rockies. It took us 4 months to find 16, fairly large [> 8 hectares (19.8 acres)] undisturbed stands of old-growth Douglas-fir/ponderosa pine in the Bitterroot and Lolo National Forests.

We suggest that managers increase their effort in snag habitat management and increase public awareness of the importance of snags to many wildlife species. Our preliminary vegetation data suggest that a major structural difference between rotation-aged and older-aged stands is the lack of snags, especially large ones, in rotation-aged stands. Mannan and Meslow (1984) had a similar snag distribution in eastern Oregon. Primary and secondary cavity-nesters need snags of all species, sizes, and stages of decay for nesting and foraging habitat. In northwestern Montana, many cavity-nesters preferentially select large snags, especially western larch and ponderosa pine (McClelland *et al.* 1979). In Douglas-fir/ponderosa pine stands in eastern Oregon, the proportion of snags used as nest-sites and for foraging increased with the size of the snag, and a greater proportion of large snags was found in old-growth stands (Mannan and Meslow 1984). We agree with McClelland *et al.* (1979) that to maintain habitat for these primary and secondary cavity-nesters, more snags should be designated and left in logged areas, and woodcutters should be discouraged from taking snags, especially those greater than 51 centimeters (20 inches) diameter at breast height. To maintain the continual presence of snags over time, green trees, preferably large ones, could be left for snag recruitment later in the rotation of the stand. If large snags are to exist throughout the managed landscape, some trees should be allowed to grow to greater than rotation age until they attain the size that most bird species prefer and some species require.

Because cowbird parasitism has threatened the existence of several songbird species (Laymon 1987), we suggest that wildlife biologists monitor cowbird numbers to document long-term changes related to stand age and habitat, especially in rotation-aged Douglas-fir/ponderosa pine stands.

ACKNOWLEDGMENTS

L. T. Rutledge helped in finding and marking all of the study sites. G. D. Booth, R. L. Hutto, S. A. Laymon, L. J. Lyon, and B. R. McClelland helped in study design. Many Forest Service personnel helped with finding study sites, especially S. F. Arno, D. N. Cole, J. M. Hillis, and L. L. Johnson. D. L. Anderson, P. D. Hunt, and A. M. Wildman collected bird count data. M. Feather Earring and L. M. Watson entered data into the computer. G. W. Bell and D. L. Turner discussed statistical analyses. R. L. Hutto and B. R. McClelland reviewed the manuscript. We appreciate the help of all.

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APPENDIX A

Common Name	Scientific Name
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-necked Pheasant	*Phasianus colchicus*
Blue Grouse	*Dendragapus obscurus*
Ruffed Grouse	*Bonasa umbellus*
Mourning Dove	*Zenaida macroura*
Flammulated Owl	*Otus flammeolus*
Great Horned Owl	*Bubo virginianus*
Northern Pygmy-Owl	*Glaucidium gnoma*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*
White-throated Swift	*Aeronautes saxatalis*
Calliope Hummingbird	*Stellula calliope*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Rufous Hummingbird	*Selasphorus rufus*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Hairy Woodpecker	*Picoides villosus*
Black-backed Woodpecker	*Picoides arcticus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Olive-sided Flycatcher	*Contopus borealis*

Published in proceedings of "Interior Douglas-Fir: The Species and Its Management" held February 27 – March 1, 1990 in Spokane, WA, USA.
Compiled and edited by D.M. Baumgartner and J.E. Lotan, Washington State University Extension, Pullman, WA.

(Bulletin Office, WSU, PO Box 645912, Pullman, WA 99164-5912.) MISC0230. 301 pp.

Western Wood-Pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Hammond's Flycatcher	*Empidonax hammondii*
Dusky Flycatcher	*Empidonax oberholseri*
Tree Swallow	*Tachycineta bicolor*
Gray Jay	*Perisoreus canadensis*
Steller's Jay	*Cyanocitta stelleri*
Clark's Nutcracker	*Nucifraga columbiana*
Common Raven	*Corvus corax*
Black-capped Chickadee	*Parus atricapillus*
Mountain Chickadee	*Parus gambeli*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
Brown Creeper	*Certhia americana*
Winter Wren	*Troglodytes troglodytes*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Western Bluebird	*Sialia Mexicana*
Townsend's Solitaire	*Myadestes townsendi*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Cedar Waxwing	*Bombycilla cedrorum*
Solitary Vireo	*Vireo solitarius*
Warbling Vireo	*Vireo gilvus*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow-rumped Warbler	*Dendroica coronata*
Townsend's Warbler	*Dendroica townsendi*
MacGillivray's Warbler	*Oporornis tolmiei*
Western Tanager	*Piranga ludoviciana*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Lazuli Bunting	*Passerina amoena*
Rufous-sided Towhee	*Pipilo erythrophthalmus*
Chipping Sparrow	*Spizella passerina*
Vesper Sparrow	*Pooecetes gramineus*
Song Sparrow	*Melospiza melodia*
Dark-eyed Junco	*Junco hyemalis*
Western Meadowlark	*Sturnella neglecta*
Brown-headed Cowbird	*Molothrus ater*
Cassin's Finch	*Carpodacus cassinii*
Red Crossbill	*Loxia curvirostra*
Pine Siskin	*Carduelis pinus*
Evening Grosbeak	*Coccothraustes vespertinus*