A RECONNAISSANCE OF BIRD COMMUNITIES IN OLD-GROWTH COASTAL HEMLOCK FORESTS, BRITISH COLUMBIA

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Abstract

A reconnaissance survey of bird populations in coastal hemlock old-growth forests was conducted in 1983. The main objectives were to assess the similarities between bird populations in undisturbed old-growth western hemlock (Tsuga heterophylla) forests and those found in: 1) western hemlock residuals and 2) mountain hemlock (Tsuga mertensiana) forests at higher elevation. We found that populations in undisturbed western hemlock forests and western hemlock residuals were similar. Populations in higher elevation mountain hemlock forests were different. We conclude that future work should focus on the capacity of managed second-growth western hemlock forests to support old-growth bird communities and on the status of cavity nesters in managed second-growth and high elevation mountain hemlock forests.

Resumé

On a procédé en 1983 à une enquête préliminaire sur les populations d'oiseaux habitant les vieilles forêts côtières de pruches. Le principal objectif visé était de rechercher les similitudes entre les populations d'oiseaux habitant d'une part les vieilles forêts de pruches de l'Ouest (Tsuga heterophylla) restées intactes et d'autre part: 1) les restants de forêts de pruches de l'Ouest 2) les forêts de pruches de Mertens (Tsuga mertensiana) poussant en altitude. L'enquête a montré que les populations d'oiseaux occupant les forêts de pruches de l'Ouest, intactes ou non, étaient similaires, alors que celles qui habitaient les forêts de pruches de Mertens poussant en altitude étaient différentes. Notre conclusion est qu'il faudra a l'avenir porter notre attention sur le pouvoir des forêts de pruches de l'Ouest sous aménagement intensif de supporter les communautés d'oiseaux habitant jusqu'alors les vieilles forêts ainsi que sur le sort réservé aux oiseaux nichant dans les cavities dans ces forêts et dans les forêts de pruches de Mertens poussant en altitude.

Logging in southwestern British Columbia began in old-growth coastal Douglas-fir (Pseudotsuga menziesii) and coastal western hemlock (Tsuga heterophylla) forests, where riverine and marine waterways provided inexpensive and easy transportation to mills and ports (British Columbia Ministry of Forests 1980). Intensive clearcut logging combined with a lack of forest regeneration has forced logging companies further from tidewater and further upslope. In the search for merchantable timber, the industry is now moving into mountain hemlock (Tsuga mertensiana) forests which are the last forest type below the alpine zone.

An analysis by the British Columbia Ministry of Forests (1980) concluded that economically viable virgin stands were being rapidly depleted and that forest regeneration was falling behind cutting levels. As a result government and industry are placing an increased emphasis on intensive silviculture and a shorter timber rotation (B.C. Ministry of Forests 1981). Although much of the Douglas-fir and western hemlock forests seem destined for intensive management, large stands of mountain hemlock forest remain uncut. This is because of their position in parks and to technical and economic problems associated with their removal elsewhere.

To determine if fragmented, residual stands of western hemlock and old-growth stands of mountain hemlock act as refugia for old-growth western hemlock forest bird communities, we carried out a reconnaissance survey of breeding birds during the summer of 1983. Sampling was designed to test two hypothesis: 1) do bird populations in unlogged residual stands of western hemlock have the same species mix and population levels as those in undisturbed western hemlock forests, and 2) do bird populations in undisturbed western hemlock forests have the same species mix and population levels as those in undisturbed mountain

hemlock forests. We also surveyed bird populations in western hemlock clearcuts to document species mix and population levels.

Study Areas

Forest types were defined using the biogeoclimatic zone concept of Krajina (1969). Biogeoclimatic zones are delimited primarily on the basis of the combined influences of climate and physiography on the dominant vegetation. Implicit in our use of zones as a delimiter is the assumption that like vegetation reflects similar environmental conditions and hence similar bird populations.

Bird populations were sampled in western hemlock clearcuts (490-860 m), western hemlock residuals (690-830 m), undisturbed western hemlock forests (520-860 m), and in undisturbed mountain hemlock forests (1030-1155 m). Study plots were located near Whistler, British Columbia (52°06'N, 123°00'W)(Figure 1).

In our study area about 44% of the western hemlock forest remained in residuals, the rest having been cut. The residual stands were generally bordered on three sides by clearcuts, however, they were continuous with larger blocks of forest at higher elevations. Residuals can be viewed as tongues of forest extending downslope into clearcuts. The tongues were of different sizes and configurations but were no less than 150 m wide and 600 m long. The undisturbed western hemlock and undisturbed mountain hemlock forests were in one continuous block extending from the valley bottom to alpine. At its narrowest point, near the valley bottom, the forest block was 2.7 km wide.

WETMORE, BOOTH FIG 1

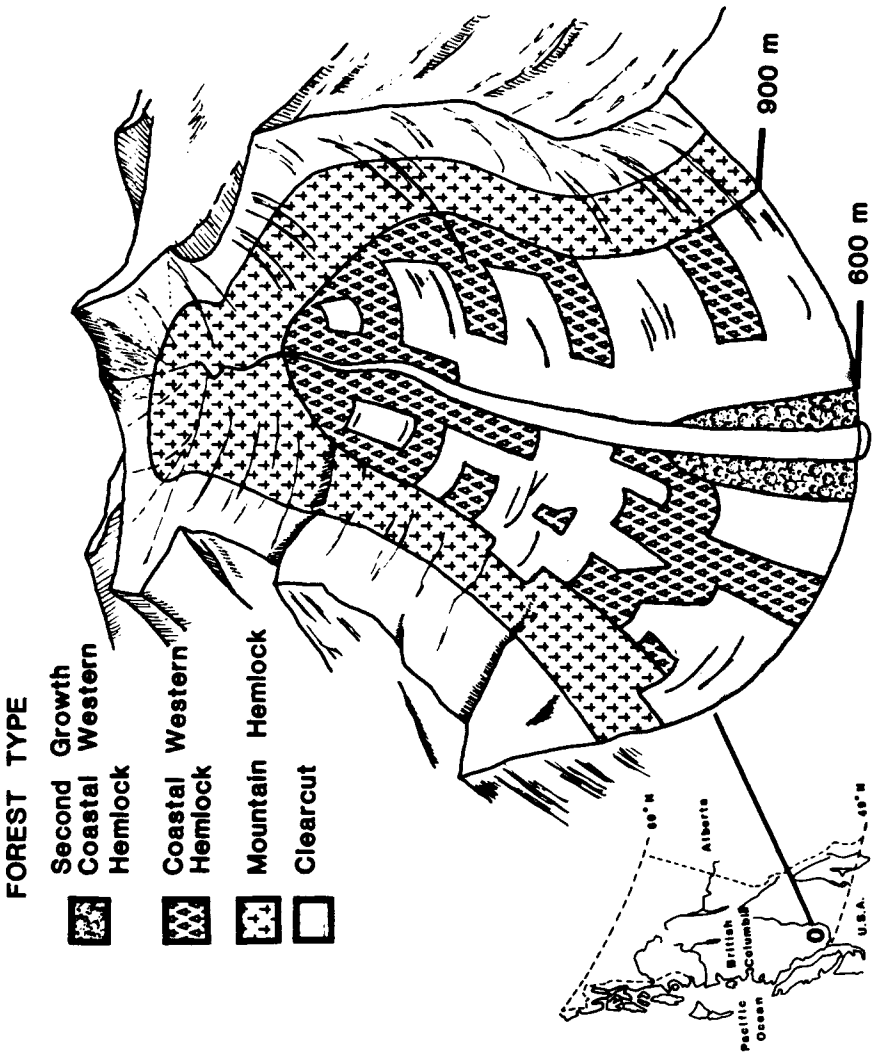

Figure 1. Diagrammatic representation of the study area in southwestern British Columbia. Patterns of clearcuts, second-growth, old-growth forests and alpine are shown.

Western hemlock sites were in steep valley terrain on westerly and northerly facing slopes averaging 19 degrees. Dominant tree species were western hemlock, Douglas-fir, and Pacific silver fir (Abies amabilis). Western red cedar (Thuja plicata) and to a lesser extent yellow cedar (Chamaecyparis nootkatensis) were also present.

Residual and undisturbed western hemlock stands were composed of two upper tree strata with total estimated cover from 35-65%. Tree canopy height was 20-38 m and age was over 251 years (B.C. Ministry of Forests 1975). A third understory tree strata was 2-3 m high and had a total cover of about 6% composed of young Pacific silver fir and western red cedar. The shrub layer was under 2 m and contained Alaskan blueberry (Vaccinium alaskaense) and false azalea (Menziesia ferruginea) with about 30% cover. Herb cover averaged only 4% and was composed of bunchberry (Cornus canadensis), Alaskan blueberry and rattlesnake plantain (Goodyera oblongifolia). Various mosses covered 90% of the ground. Descriptions of how habitat information was gathered are contained in the the Methods section.

We sampled birds in clearcuts that were close to our residual stands. Logging, using the high-lead cable method, took place between 1969 and 1980 (B.C. Ministry of Forests, Squamich Office, personal communication). About half the area was burned and planted after cutting while the rest received no treatment. Study plots were in the grass-forbes and shrub-seedling stages of succession. Shrub and tree regeneration was in one or two strata from 0.5-4 m in height, covering an estimated 5-60% of the ground. Dominant species included Douglas-fir, western hemlock, western red cedar, Pacific silver fir, willow (Salix spp.), Alaskan blueberry, and false box (Pachistima myrsinites). A herbaceous layer covered 2% to 50% of the ground surface. Bunchberry and

fireweed (Epilobium angustifolium) were common. The moss community was reduced to from 2-75% cover.

The mountain hemlock study area was upslope from the undisturbed western hemlock forest. Trees were in two upper strata with a total cover of between 20% and 55%. Tree canopy height was 20-47 m and stand age was over 251 years (B.C. Ministry of Forests 1975). Dominant trees were mountain hemlock, Pacific silver fir, western hemlock and yellow cedar. A third understory tree layer contained young amabilis fir, mountain hemlock and western hemlock 2-3 m high with about 2% total cover. The shrub layer consisted primarily of Alaskan blueberry with occasional Pacific silver fir and false azalea under 2 m with a total cover of about 40%. A poorly developed herb layer consisted mainly of bunchberry and queen's cup (Clintonia uniflora) with 2% ground cover. Mosses covered 90% of the ground surface.

Methods

A single-visit point-count method was used to survey singing males from 20 May to 10 June 1983 (Wetmore et al. 1985). The fundamental sampling unit was a straight transect, running perpendicular to the study area slope, with four in-line listening points 100 m apart. Fifteen transects in each forest type (60 listening points) were placed at least 100 m apart and 75 m away from any forest edge. Riparian areas were similarly avoided. At each point singing males were recorded for five minutes after a one minute wait. Birds were placed in one of two categories: 20 m or closer to the observer or further than 20 m away. Estimates of abundance were then calculated based on detectability functions derived for each species (Wetmore et al. 1985). All censuses

were conducted by one pair of observers between 0530 and 1100 hrs. Sunrise was approximately 0500 hrs. Censusing did not take place in rain or when wind speed exceeded 10 km/hr.

Two sources of information were used to ensure vegetation within forest types sampled were homogeneous. Tree canopy height and age data were obtained from forest cover maps (B.C. Ministry of Forests 1975). Data on tree, shrub, herb and moss cover, plant species, topography, and other environmental factors were collected at one listening point in each transect.

The time of clearcutting and information on post logging treatments were obtained from the B.C. Ministry of Forests office in Squamish. Data on plant communities and other environmental factors were collected as in the forested plots. Bird data for all clearcut plots were lumped even though plot ages varied from 3 to 13 years and post-cutting treatments varied. We did not have a large enough sample to allow stratification on the basis of age and treatments.

The Shannon-Weaver Index (H') was used to compare the diversity of the bird abundance estimates between forest types (Shannon and Weaver 1949). Horn's Index of Similarity (Ro) was used to measure the overlap of bird communities between types (Horn 1966). Horn's Ro ranges from 0 when two communities have no species in common to 1 when communities have the same proportional species composition. The Kruskall-Wallis nonparametric one-way analysis of variance by ranks (Siegel 1956) was used to test forest types for differences in the densities of the more common bird species. To ensure adequate numbers for analysis we compared only those species whose total number accounted for the top 50% of the total population.

Results

We accepted the first hypothesis: estimates of bird abundance in western hemlock residual stands were similar to those in undisturbed western hemlock forests. Residuals held 25 species with a total population of 834 males/100 ha. Intact forests contained 26 species with 917 males/100ha. The Shannon-Weaver Index was 2.24 for residual and 2.50 for undisturbed stands (Table 1). Horn's Index of Similarity was relatively high (0.87) (Table 2).

Six species found in the western hemlock forest were not found in the residuals: Western Flycatcher, Swainson's Thrush, Black-headed Grosbeak, Red-tailed Hawk, Brown Creeper, and Evening Grosbeak (Table 1). The first three species do not rely exclusively on mature forest types for nesting. The Red-tailed Hawk, Brown Creeper, and to a lesser extent the Evening Grosbeak show a preference for nesting in older second-growth and mature coniferous forests (Jewett et al. 1953, Meslow and Wight 1975). Further surveys will be necessary to determine to what extent these latter species will use residuals for nesting.

We rejected the second hypothesis: bird populations in undisturbed western hemlock forests are not the same as those in undisturbed mountain hemlock forests. Although total density and diversity were similar and Horn's Index of Similarity was a high 0.87 there were many differences between western hemlock and mountain hemlock forests (Tables 1 and 2). Total species richness in mountain hemlock forest was 18 vs. 26 in western hemlock forests. Ten species found at relatively low density in western hemlock forest were not seen in mature mountain hemlock forest: Red-tailed Hawk, Red-breasted Sapsucker, Western Flycatcher, Steller's Jay, Common Raven, Swainson's Thrush, American Robin, Yellow-rumped

Warbler, Black-headed Grosbeak, and Purple Finch. The Red-tailed Hawk and Purple Finch are of concern due to their preference for nesting in older second-growth and mature forests. The other species nest in younger seral stages (Meslow and Wight 1975).

Table 1. Abundance estimates of singing males/100 ha in mountain hemlock (M.H.) forests and western hemlock (W.H.) forests, residual stands and clearcuts near Whistler, British Columbia. 1983.

Species	M.H. Forests	W.H. Forests	W.H. Residuals	W.H. Clearcuts
Red-tailed Hawk (*Buteo jamaicensis*)		2		
Blue Grouse (*Dendragapus obscurus*)	9	1	5	6
Vaux's Swift (*Chaetura vauxi*)	18			9
Rufous Hummingbird (*Selasphorus rufus*)	81	113	35	136
Red-breasted Sapsucker (*Sphyrapicus ruber*)		22	12	
Hairy Woodpecker (*Picoides villosus*)				+
Northern Flicker (*Colaptes auratus*)	5	16	6	5
Pileated Woodpecker (*Dryocopus pileatus*)			+	
Olive-sided Flycatcher (*Contopus borealis*)	1	3	1	11
Alder Flycatcher (*Empidonax alnorum*)				+
Hammond's Flycatcher (*E. hammondii*)				+
Western Flycatcher (*E. difficilis*)		19		

Species	M.H. Forests	W.H. Forests	W.H. Residuals	W.H. Clearcuts
Gray Jay (Perisoreus canadensis)	10	15	16	2
Steller's Jay (Cyanocitta stelleri)		+	+	
Common Raven (Corvus corax)		3	5	2
Chestnut-backed Chickadee (Parus rufescens)	69	25	53	
Red-breasted Nuthatch (Sitta canadensis)	2	2	2	
Brown Creeper (Certhia americana)	6	6		
Winter Wren (Troglodytes troglodytes)	99	78	126	28
Golden-crowned Kinglet (Regulus satrapa)	242	156	232	
Townsend's Solitaire (Myadestes townsendi)				+
Swainson's Thrush (Catharus ustulatus)		3		3
Hermit Thrush (C. guttatus)	13	6	8	
American Robin (Turdus migratorius)		11	6	24
Varied Thrush (Ixoreus naevius)	79	45	56	2
Cedar Waxwing (Bombycilla cedrorum)				+
Orange-crowned Warbler (Vermivora celata)			5	
Yellow Warbler (Dendroica petechia)				+

Species	M.H. Forests	W.H. Forests	W.H. Residuals	W.H. Clearcuts
Yellow-rumped Warbler (D. coronata)		3	10	12
Black-throated Gray Warbler (D. nigrescens)	16	56	36	
Townsend's Warbler (D. townsendi)	106	194	173	
MacGillivray's Warbler (Oporornis tolmiei)	2		2	32
Wilson's Warbler (Wilsonia pusilla)			+	+
Black-headed Grosbeak (Pheucticus melanocephalus)		5		
Rufous-sided Towhee (Pipilo erythrophthalmus)				+
Savannah Sparrow (Passerculus sandwichensis)				3
Song Sparrow (Melospiza melodia)			5	22
White-crowned Sparrow (Zonotrichia leucophrys)				+
Dark-eyed Junco (Junco hyemalis)	29	31	25	86
Purple Finch (Carpodacus purpureus)		4	14	4
Pine Siskin (Carduelis pinus)	a	a	a	a
American Goldfinch (C. tristis)				6
Evening Grosbeak (Coccothraustes vespertinus)	20	81		
Total Density	807	900	833	393

Species	M.H. Forests	W.H. Forests	W.H. Residuals	W.H. Clearcuts
Shannon-Weaver Diversity (H')	2.21	2.50	2.24	2.04
Total Species	18	26	25	27

\+ Species present but in insufficient numbers to calculate abundance estimates or to include in Shannon-Weaver (H').

a Large mobile flocks of Pine Siskins were present but we were unable to determine what proportion, if any, were part of the breeding bird community.

Table 2. Horn's (Horn 1966) Index of Similarity of bird populations in mountain hemlock (M.H.) forests and coastal western hemlock (W.H.) forests, residuals and clearcuts near Whistler, British Columbia. 1983.

	M.H. Forests	W.H. Forests	W.H. Residuals	W.H. Clearcuts
M.H. Forests	1.00			
W.H. Forests	.87	1.00		
W.H. Residuals	.91	.87	1.00	
W.H. Clearcuts	.44	.47	.41	1.00

Most of the western hemlock species that commonly nest in older forest types were observed in the mountain hemlock forest. These species include: Gray Jay, Chestnut-backed Chickadee, Brown Creeper, Golden-crowned Kinglet, Hermit Thrush, Varied Thrush and Townsend's Warbler (Jewett et al. 1953, Meslow and Wight 1975). Of the common species tested for density differences between forest types, only the Townsend's Warbler showed a significant difference. That bird had a lower density

in mountain hemlock forests than in western hemlock forests and western hemlock residuals ($P<0.02$ Kruskall-Wallis ANOVA).

Clearcuts supported a different bird population than the forested plots. Total density was only 391 males/100 ha made up of 27 species, 9 of which were in insufficient numbers for us to calculate density (Table 1). The high species richness probably resulted because study plots ranged through two successional stages, grass-forbes and shrub-seedling. Horn's Index of Similarity between forest plots and clearcuts was low (Table 2).

Nine species occurred only in the clearcut plots: Hairy Woodpecker, Hammond's Flycatcher, Alder Flycatcher, Townsend's Solitaire, Yellow Warbler, White-crowned Sparrow, Savannah Sparrow, Cedar Waxwing and American Goldfinch. Few of the forest nesting species were recorded singing in the clearcuts. One interesting exception was the Varied Thrush which was occasionally heard in clearcuts.

Discussion

Able and Noon (1976) found that forest bird communities changed along elevational gradients in the northeast United States. Species richness and diversity decreased with elevation. Lower elevation forests contained a greater proportion of low density species while higher elevation forests had a greater dominance or concentration of abundant species. This is similar to what we found. With increasing mountain elevation, mean temperatures drop, the available land area decreases, the fog and cloud cover increases and there is a higher incidence of severe physical disturbance. These factors cause a decline in productivity and a decline in plant species richness (Beehler 1982). We surmise that

these declines in available resources result in the smaller, less rich avifauna observed in the mountain hemlock forest.

A final area of concern is for cavity nesters. Three cavity nesters from the western hemlock forest, residuals, and clearcuts were not observed in the mountain hemlock forests: Red-breasted Sapsucker, Hairy Woodpecker, and Pileated Woodpecker. The Sapsucker and the Hairy Woodpecker will nest in deciduous trees and snags over 25.4 cm diameter breast high. The Pileated Woodpecker prefers snags over 50.8 cm diameter breast high (Bent 1939, Thomas 1979). In our study area, no provision was being made for the regrowth of large deciduous trees or the retention of snags in clearcuts.

Our preliminary reconnaissance indicates that although bird communities in old-growth western hemlock and mountain hemlock forests are similar, they are not identical. Since most of the western hemlock residual stands will be logged in the future, they will not be available to act as refugia for the intact western hemlock bird community. Future work should focus on the capacity of managed second-growth western hemlock stands to support old-growth bird communities and on the status of cavity nesters in second-growth western hemlock and mountain hemlock forests.

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