AVIAN COMMUNITIES IN OLD-GROWTH AND MANAGED FORESTS OF WESTERN VANCOUVER ISLAND BRITISH COLUMBIA

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ABSTRACT

We surveyed birds in forests of various ages to assess the impact of clearcutting and succession on bird communities in a coastal temperate rainforest environment. Between May 1st and July 7th, 1991, we counted birds at 215 sampling stations. Counts lasted for 12 minutes/station. Birds detected >75 metres from the observer were excluded. Each station was surveyed at two-week intervals to provide a total of four counts per station. Two old-growth transects (>200 years-old) and four younger-age transects (5-10 years, 15-20 years, 30-35 years and 50-60 years after logging) were established in three areas on western Vancouver Island (near Franklin River, Kennedy Lake and Sproat Lake). Each transect had 11 or 12 sampling stations located >200 metres apart. Most transects were situated along logging roads. Vegetation conditions were quantified at four plots along each transect.

Excluding seabirds, shorebirds, and raptors, 55 bird species were detected at study transects; 43 species were detected on more than one occasion. Results suggest that forest clearcutting leads to reduced bird diversity and abundance for at least 15-20 years after harvest, and that this effect is most pronounced at inland sites above 500 metres in elevation. In general, bird diversity and abundance increases in 30-35 year-old stands, declines slightly in 50-60 year-old stands, and increases again in old-growth cedar-hemlock-fir forests. Coastal old-growth forests dominated by Western Red Cedar show relatively low bird species diversity and abundance.

Old-growth bird communities are comprised largely of species which are year-round B.C. residents, but communities in 2nd growth forests consist mostly of species which winter outside of Canada. Bird communities in clearcuts and 15-20 year-old forests are mostly comprised of ground or shrub-nesting species. Communities in 30-35 and 50-60 year-old stands contain ground, shrub and tree-nesting species, but cavity-nesters are uncommon. Old-growth communities are comprised mostly of tree and cavity-nesting species.

Individual species respond differently to forest age and vegetation conditions. Ground and shrub-nesting species (e.g., Orange-crowned Warbler, Song Sparrow and Dark-eyed Junco) were most abundant in recently-logged environments. Cavity-nesting species (e.g., Hairy Woodpecker, Brown Creeper and Chestnut-backed Chickadee) and some insectivores (e.g., Winter Wren, Varied Thrush, Pacific Slope Flycatcher) were most abundant in unlogged old-growth forests. Some species (Vaux's Swift, Red-breasted Sapsucker, Pileated Woodpecker, Red-breasted Nuthatch, Western Tanager and Red Crossbill) were found primarily or exclusively in old-growth forests. A few species (MacGillivray's Warbler, Townsend's Warbler, Wilson's Warbler) achieved their highest abundance in mid-successional forests.

Among similar-age forests, there was considerable variation in the relative abundance of birds between study areas. For example, in old-growth forests, Red-breasted Sapsuckers and Hammond's Flycatchers were relatively common at Sproat Lake, but scarce elsewhere. Brown Creepers were relatively abundant at Franklin River and Kennedy Lake, but only rarely encountered at Sproat Lake. Wilson's and Townsend's Warblers were present in low densities at Kennedy and Sproat Lake, but absent from Franklin River transects. Similar geographic differences in relative abundance were recorded for species inhabiting 2nd growth forests.

We conclude that harvesting of temperate rainforests on western Vancouver Island leads to significantly altered bird communities. For some species (e.g., Marbled Murrelet, Red-breasted Sapsucker, Red-breasted Nuthatch), the declining amount of old-growth forest is cause for concern. For others (e.g., MacGillivray's Warbler, Song Sparrow, Dark-eyed Junco, Orange-crowned Warbler), creation of young seral forest stages provides much new habitat.

Sweeping generalizations about the effect of forest age upon bird diversity or abundance must be tempered by consideration of study methods. Our survey methods were unsuitable for some species (e.g., raptors), and estimates of species richness were probably artificially low for this reason (particularly in older forests). In addition, data were collected during a single breeding season, and may therefore be biased by normal year-to-year fluctuations in bird abundance. Finally, our results showed considerable variation within given age-classes in terms of bird community composition and vegetation characteristics. We advise against attempting to extrapolate results from one area to another. For conservation planning purposes, additional research is needed to correlate species occurrence, and demographic success, with physiographic, climatic and vegetation patterns on Vancouver Island.

RÉSUMÉ

Nous avons dénombré les oiseaux dans des forêts d'âges variés afin d'évaluer l'impact des coupes à blanc et de la succession forestière sur les communautés d'oiseaux de la forêt pluvieuse tempérée de la côte ouest de l'île de Vancouver. Deux-cent-quinze points d'écoutes furent recensés entre le 1er mai et le 7 juillet 1991. Tous les oiseaux observés à l'intérieur d'un rayon de 75 mètres durant une période de 12 minutes furent dénombrés. Chaque point d'écoute fut recensé à toutes les deux semaines pour un total de quatre recensements par point. Nous avons établi, à trois endroits, soit près de la Rivière Franklin, du Lac Kennedy et du Lac Sproat, quatre transects dans la forêts de régénération (5-10 ans, 15-20 ans, 30-35 ans et 50 à 60 ans après coupe). Chaque transect comprenait de 11 à 12 points d'écoutes espacés d'au moins 200 mètres. L plupart des transects étaient situés le long de chemins forestiers. La végétation fut échantillonnée à 4 points d'écoutes le long de chacun des transects.

A l'exclusion des oiseaux marins, bécasseaux et oiseaux de proie, 55 espèces d'oiseaux furent observées plus d'une fois. Les résultats suggèrent que la coupe à blanc amène une réduction dans la diversité et l'abondance des oiseaux pour au moins 15-20 ans et que cet effet est plus prononcé aux sites les plus élevés. En général, la diversité et l'abondance des oiseaux augmentent dans les forêts de 30-35 ans, diminuent légèrement dans celles de 50-60 ans et augmentent encore dans les forêts anciennes dominées par la pruche. Les forêts anciennes dominées par le cèdre avaient une diversité et une abondance avienne plus réduites.

Les communautés d'oiseaux des forêts anciennes comprennent surtout des espèces résidentes alors que celles des forêts en régénération comprennent surtout des espèces migratrices. Les forêts de moins de 20 ans se caractérisent par des espèces nichant au sol et dans les buissons. Les forêts de 30 et 60 ans abritent des espèces nichant au sol, dans les buissons et dans les arbres mais peu d'espèces nichant dans les cavités d'arbres.

Les espèces répondent individuellement à l'âge de la forêt et aux types de végétation. Les espèces nichant au sol et dans les buissons (e.g., la Paruline verdâtre, le Bruant chanteur et le Junco ardoisé) étaient plus abondantes dans les jeunes forêts en régénération. Les espèces nichant dans les cavités d'arbres (e.g., Pic chevelu, Grimpereau brun et Mésange à dos marron) et quelques espèces insectivores (e.g., Troglodyte des forêts, Grive à collier, Moucherolle côtier) étaient plus abondantes dans les forêts anciennes. Quelques espèces (Martinet de Vaux, Pic à poitrine rouge, Bec-croisé rouge) ont été aperçues principalement ou seulement dans les forêts anciennes. D'autre espèces (Paruline des buissons, Paruline de Townsend et Paruline à calotte noire) atteignent leur plus grande abondance dans les forêts de mi-succession (15-35 ans).

Il y avait beaucoup de variabilité dans l'abondance des oiseaux dans les forêts d'âges semblables de localités différentes. Par exemple, le Pic à poitrine rouge et le Moucherolle de Hammond étaient relativement communs dans les forêts anciennes du Lac Sproat, mais

rares dans celles du Lac Kennedy et de la Riviére Franklin. Le Grimpereau brun était relativement abondant à la Riviére Franklin et au Lac Kennedy mais rarement observé au Lac Sproat. Les Parulines à calotte noire et de Townsend atteignaient de faibles densités aux Lacs Sproat et Kennedy mais étaient absentes des forêts de la Rivière Franklin. Des différences géographiques semblables existaient aussi dans les forêts en régénération.

Nous concluons que la coupe à blanc dans les forêts pluvieuses de la Côte ouest de l'île de Vancouver altère de façon significative les communautés aviennes. Pour certaines espèces (e.g., Alque marbrée, Pic à poitrine rouge, Sittelle à poitrine rouse) la diminution de la superficie des forêts anciennes est une préoccupation. Pour d'autres espèces (Paruline des buissons, Bruant chanteur, Junco ardoisé, Paruline verdâtre) la création de jeune forêts procure de nouveaux habitats.

Les grandes généralisations sur les relations entre l 'âge de la forêt, la diversité et l'abondance avienne doivent être tempépérées par les méthodes d'études. Nos méthodes n'étaient pas appropriées pour certaines espèces (e.g., oiseaux de proies) ce qui tend à sous-estimer le nombre d'espèces présentes, surtout dans les forêts anciennes. De plus, les oiseaux ne furent dénombrés que durant une saison de nidification et les résultats ne tiennent pas compte des variations annuelles dans les populations d'oiseaux.

Finalement, nos résultats ont révélé une variabilité considérable entre les forêts d' âges semblables en terme des communautés d'oiseaux et des caractéristiques de la végétation. Il pourrait être dangereux d'extrapoler les besoins de conservation et de gestion, des recherces additionelles sont nécessaires afin de préciser les relations entre la présence de certaines espèces, leur succès démographique et les patrons physiographiques, climatiques et végétaux de l'île de Vancouver.

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ACKNOWLEDGMENTS

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The manuscript was materially improved after review by Ken Morgan (Forestry Canada) and Rhonda Milliken (Canadian Wildlife Service).

INTRODUCTION

A growing body of literature addresses the relationship between forest clearcutting, succession, and bird communities in northwestern North America (e.g., Manuwal 1991, Carey *et al.* 1991, Morrison and Meslow 1983, Meslow and Wight 1975). Despite research in progress (see list in Kowall and Eastman 1991), only Wetmore *et al.* (1985), Hatler *et al.* (1978), Buckner *et al.* (1975) and Roe (1974) have presented data with which to assess forestry-effects on coastal avian communities in British Columbia. Roe's (1974) effort provide the only published data from systematic bird surveys conducted in old-growth forests on western Vancouver Island.

In 1991, MacMillan Bloedel Limited (M&B), with assistance from Canadian Wildlife Service (CWS), initiated efforts to survey forest birds within old-growth and managed forests on Vancouver Island. This paper describes results from systematic bird surveys conducted in three areas on western Vancouver Island in 1991.

Study objectives

The goal of the study was to provide baseline information on the diversity and abundance of forest birds on western Vancouver Island. The objectives were to:

1) evaluate diversity and relative abundance of forest birds in old-growth forests and regenerating forests of various ages.

2) compare trends in species distribution, diversity, and relative abundance with forest age, vegetation patterns and geographic location.

METHODS

Study areas and experimental design

Study areas were located between 20 and 700 metres above sea-level within the Coast and Mountains Ecoprovince of British Columbia (Demarchi 1988; Figure 1). Mature coniferous forests of this region are dominated by Western Red Cedar (*Thuja plicata*), Western Hemlock (*Tsuga heterophylla*), Amabilis Fir (*Abies amabilis*) and Douglas-fir (*Pseudotsuga menzesii*). Pacific Yew (*Taxus brevifolia*) and Sitka Spruce (*Picea sitchensis*) occur in varying amounts; Red Alder (*Alnus rubra*) is dominant in moist areas (Klinka *et al.* 1991).

Our experimental design was based on repeated systematic surveys in three areas on western Vancouver Island (Kennedy Lake, Franklin River and Sproat Lake). The intent was to survey a gradient of coastal and inland sites. Within each area, five forest age-classes were examined, as follows:

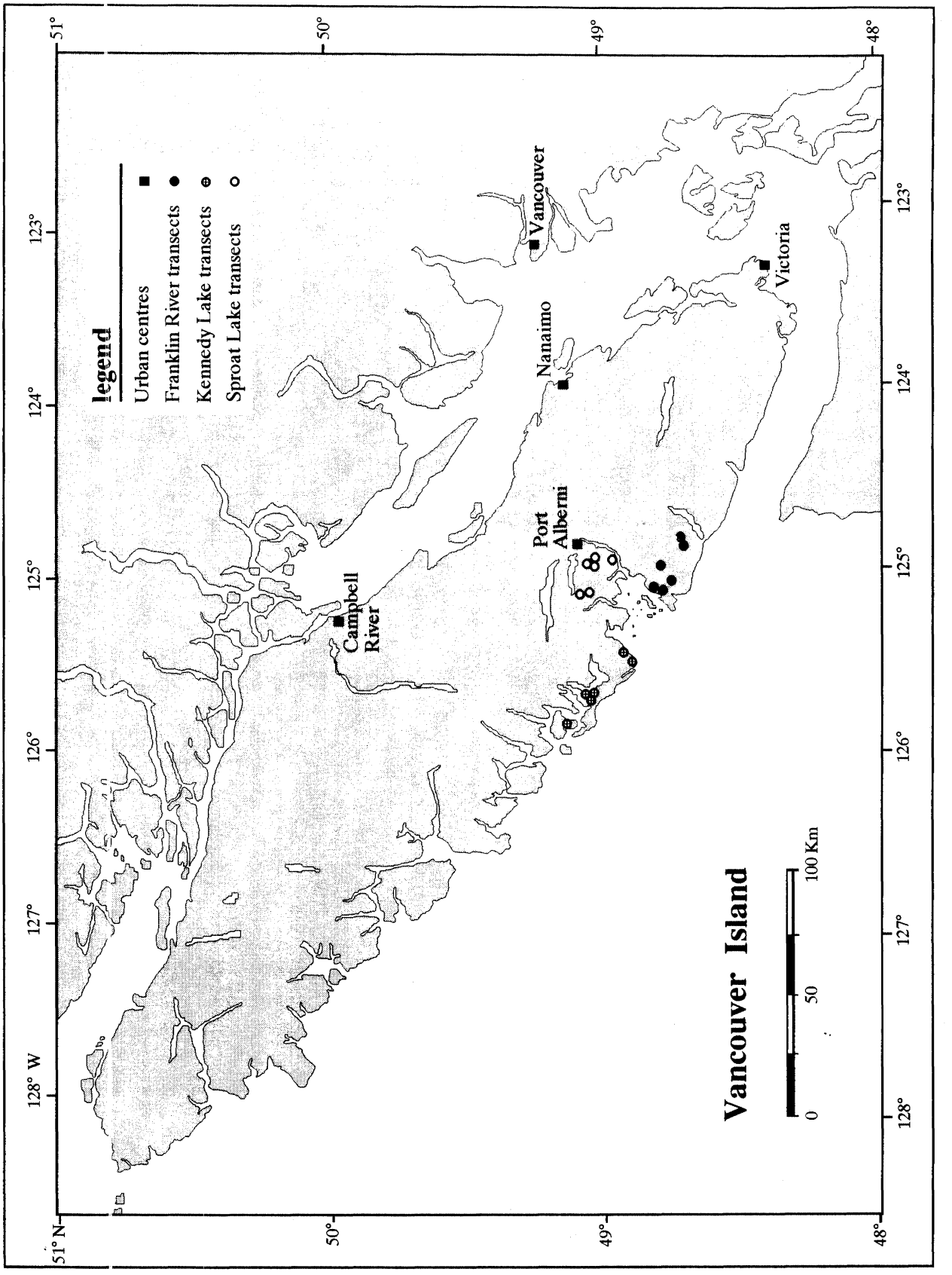

Figure 1: Location of study transects.

- CLEARCUT: 5-10 years old, harvested approximately in 1985, and either replanted or naturally regenerating.

- YOUNG: 15-20 years old, harvested approximately in 1975, and either replanted or naturally regenerating.

- IMMATURE: 30-35 years old, harvested approximately in 1955, and either replanted or naturally regenerating.

- MATURING: 50-60 years old, harvested before 1940, and naturally regenerating.

- OLD-GROWTH: >200 years old, previously unharvested and otherwise undisturbed. This category included a stand of "hypermaritime" coastal cedar forest near Ucluelet (see Klinka *et al.* 1991 for definition), two stands with a large Douglas-fir component (at Sproat Lake and Franklin River), and three stands of cedar-hemlock-fir-spruce forest.

Six (2 old-growth, and 4 younger-age) transects were established in each area. Transects were approximately 3 kilometres in length, with 12 sampling stations located 150-200 metres apart. The "hypermaritime" old-growth transect at Kennedy Lake had 11 stations; in total, n=215 sampling stations were established. Sampling stations were placed away from creeks and riparian vegetation. Transects were situated along roads except at Meares Island, where it followed a hiking trail. The major criterion for transect selection was availability of 3 linear kilometres of homogenous habitat; secondary considerations included ease-of-access and proximity to nearby transects. Transect descriptions are included (Appendix I).

Vegetation surveys

Vegetation was measured after all bird surveys were completed. Four 20x20 metre sampling plots were established along each study transect (total n=72 sample plots). Due to the large size of trees, and the associated risk of bias caused by sampling a small area, old-growth plots were increased to 30x30 metres in size. Plots were systematically located (near stations #1,#4,#8 and #12) at least 20 m from roads and riparian zones. Variables measured, and methods used, were as follows:

- ELEVATION: Transect elevations above-sea-level were measured from 1:50,000 National Topographic Series (NTS) maps and expressed in metres.

- PROXIMITY TO COAST: Distance from vegetation plots to the nearest salt-water body was measured from 1:50,000 maps and expressed in kilometres.

- BASAL AREA: Diameter-at-breast-height (DBH) tree measurements were made with a metric tape. Data for each species and DBH class were recorded separately, and are expressed as metres^2/hectare.

- TREE DENSITY: The number of trees occurring within the sample plot was recorded, and are expressed as stems/hectare.

- SNAG DENSITY: Standing dead trees >2 metres in height were measured and expressed as stems/hectare.

- CANOPY HEIGHT: The height of >5 canopy trees within each sample plot was estimated with a clinometer, and expressed in metres.

- CANOPY CLOSURE: Crown closure was estimated at 10 points within each sample plot using a "moose-horn", and expressed as a percentage.

- WOODY DEBRIS: the perimeter of the sample plot was walked and each piece of deadwood >5 cm in diameter encountered was recorded. Level of decomposition was recorded on a scale of 1 to 5 (after Fogel *et al.* 1973; see Figure 2). Data are expressed as number of pieces/100 metres.

For each variable, data from 4 sampling plots were averaged to provide $\bar{x} \pm$ s.e. values/transect. Summarized habitat data are included (Appendix II).

Bird surveys

We used the point-count method to survey birds (Verner 1985). Each transect was surveyed four times between May 9th and July 7th. Most surveys were carried out between 0430 hours and 0900 hours. Bird surveys were conducted by the senior author (AB) or R. Toochin (RT); we did not survey during heavy rain or high winds. Observers recorded birds seen or heard within 75 metres of a sampling station during a 12 minute period. Species, number of individuals, behavior, and distance from observer were noted. A sample data sheet is included (Appendix III).

Data compilation

The point-count method is unsuitable for certain groups of birds such as seabirds, shorebirds, diurnal raptors and owls. Elimination of these species yielded a list of 55 forest birds for which survey methods were judged to be suitable, and which were actually detected during the project (Appendix IV).

Birds flying over the plot, or detected outside the 75 metre plot perimeter, were excluded because they were not directly associated with the habitat, whereas birds foraging over the plot (e.g., swifts and swallows), or which landed in the plot, were included. We expressed bird abundance using 3 indices, as follows:

- MAXIMUM detections/sampling station: The maximum number of each species recorded during the 4 surveys may be appropriate for species with low detectability (e.g., woodpeckers). However, this index is sensitive to "waves" of migrants which pass through a site in large numbers (e.g., Orange-crowned Warbler).

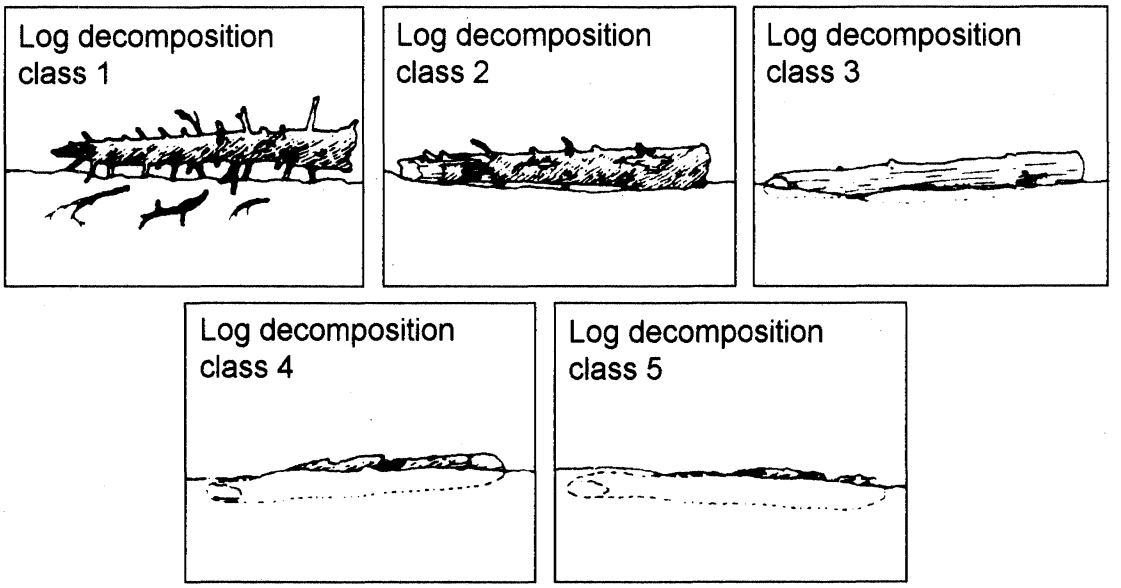

Figure 2: Criteria for scoring woody debris classes. (Adapted from Fogel *et al.* 1973)

- MEAN detections/sampling station: Averaging the number of each species recorded during 4 surveys reduces bias introduced by migrant "waves", but does not eliminate it. In addition, late migrants (e.g., Swainson's Thrush) will tend to be underestimated because they are rarely encountered during the first surveys.

- MEDIAN detections/sampling station: Taking the median number of each species recorded during 4 surveys further reduces bias introduced by "waves" or late migrants, because it eliminates high and low counts (by definition, with 4 surveys the median is the average of the 2nd and 3rd highest counts). However, this index will tend to underestimate numbers of widely-foraging species (e.g., woodpeckers) because it will only count species detected at least twice at any sampling point.

Point-count data include females, juveniles, and non-reproductive males. Inclusion of all data will therefore tend to overestimate breeding bird density. One way to minimize this problem is to count only territorial males. This works well for wood warblers, grouse and tanagers. However, for other species it is impossible to distinguish territorial "song" from non-territorial "call", or females from males (e.g., Chestnut-backed Chickadee, Steller's Jay, Brown Creeper, Red-breasted Sapsucker). For such species we did not attempt to distinguish territorial males, and the number of "singing males" is therefore identical to the number of "all detections". These "difficult" species are listed in Appendix V.

We calculated Maximum, Mean and Median indices using both "all detections" and "singing males". Each transect was therefore summarized in 6 ways. Because each transect contained multiple (11 or 12) stations, detection rates for each species are expressed as $\bar{x} \pm$ s.e. birds/station.

There is no clear rule as to which of the Maximum, Mean or the Median indices best reflects the true relative abundance of a given species at any sampling station. Each index presents a different image of the data, and contains inherent advantages and disadvantages depending upon the species in question. We used the "Median-all detections" index for most songbirds but also discuss the "Maximum-all detections" index for wide-ranging species with low detection rates (e.g., woodpeckers). We present the various possible estimates (Appendices VI through XI) so that the reader can make his or her own choice of the best value with which to interpret our data, and also to permit comparison with other studies. To further facilitate comparison with other studies, we relied on the total number of detections instead of "singing males". This was done to reduce bias caused by classifying "song" versus "call". Raphael (1987) has shown that total detections adequately reflect relative abundance.

Data analysis

To determine whether bird communities were comparable among forest age-classes or study areas, we calculated Shannon-Weiner diversity H' and Simpson's dominance C indices for each transect using equations contained in Whittaker (1975):

$$\text{Shannon-Weiner diversity index } H' = -\sum_{i=1}^{s} p_i^2 \log p_i$$

where s is the number of species in a sample, and p_i is the relative frequency of the ith species in that sample.

$$\text{Simpson's dominance concentration } C = \sum_{i=1}^{s} \left[\frac{n_1}{N}\right]^2$$

where N is the total of importance values (frequency) for all species in a sample, and n_i is the relative frequency of s individual species.

Two-way ANOVA was used to test for differences in species richness ($\bar{x}$ number of bird species/sampling station) and abundance ($\bar{x}$ number of birds/sampling station) among the three study areas and six forest types (Sokol and Rohlf 1991). Neuman-Keuls multiple range tests (Zar 1974) were then used to determine which pairs of transects differed significantly. We also calculated Horn's (1966) similarity index to determine the extent of "overlap" among bird communities in the three study areas, or among different forest age-classes, using the formula contained in Krebs (1989).

$$\text{Horn's overlap } R_o = \frac{\sum (x_i + y_i)\log(x_i + y_i) - \sum x_i \log x_i - \sum y_i \log y_i}{(X+Y)\log(X+Y) - X\log X - Y\log Y}$$

where X and Y are the sample sizes from the two areas being compared, and x_i and y_i are the frequency of the ith species in samples X and Y respectively.

We employed chi-squared (χ^2) tests to compare the frequency of occurrence of a given species across age-classes. For this analysis, we used frequency data (i.e., whether or not a particular species was observed at each of the 215 sampling stations). We did not test species in which low detection rates led to expected frequencies <5 (Zar 1974). Finally, to determine whether particular bird species were associated with habitat features, we calculated Pearson's correlation coefficients (Sokol and Rohlf 1981) using $\bar{x}$ bird and habitat data from all 18 study transects.

For all analyses, significance of results was evaluated at the 95% confidence level.

RESULTS

CHARACTERISTICS OF SAMPLED HABITATS

Elevation and proximity to the coast

Transect elevations varied from a low of 20 metres above sea-level at the Kennedy Lake hypermaritime cedar stand to a high of 680 metres A.S.L at the Sproat Lake clearcut. Transect-to-coast distances varied from 150 metres at the Kennedy Lake clearcut to >32 kilometres at the Sproat Lake Nahmint old-growth (see Figure 3 and Appendix I).

Tree volume, species composition and density

In the forests studied, total basal area and tree species basal area diversity increased with stand age (Figures 4 and 5). At the lower Franklin River old-growth transect, 2 vegetation plots were dominated by 200-year-old fire-generated Douglas-fir; 2 other plots and the upper transect were older, with some large Sitka spruce and Western Red cedars (Figure 6). The Kennedy Lake "hypermaritime cedar" old-growth transect was less dense and diverse in terms of canopy trees, yet had a comparatively large number of standing snags. The Sproat Lake Nahmint old-growth transect had a large number of massive Douglas-firs.

Among younger stands, the 50-60 year-old forest at Sproat Lake was unusual in terms of diversity, basal area and standing snag component (Figure 7). This area, which was railway-logged in the 1930s, retains a number of old-growth characteristics, including some very large live trees, many snags, and a multi-layered canopy. By comparison, the Franklin River and Kennedy Lake transects in this age-class were more uniform, with few old snags or live trees.

Forests in the 30-35 year-old age-class were characterized by a thick Douglas-fir canopy, few snags, and low basal areas (Figure 8). The 15-20 year-old stands and clearcuts contained progressively smaller tree volumes and fewer tree species (Figures 9 and 10). Among clearcuts and 15-20 year-old stands, there was considerable variation in stocking density (Figure 11). In all study areas, standing snags >20 cm in DBH were extremely rare in stands younger than 50-60 years (Figure 12).

Crown height and canopy closure

Canopy height was highest in old-growth stands, but crown closure was highest in the 30-35 year-old age-class (Figures 13 and 14). The relatively high canopy height variance at the Sproat Lake 50-60 year-old transect reflects persistence of some large trees at that site.

Woody debris

Old-growth forests contained the most woody debris, and this was normally comprised of both newly-fallen pieces and decomposing remnants of various age (Figure 15). Recently-

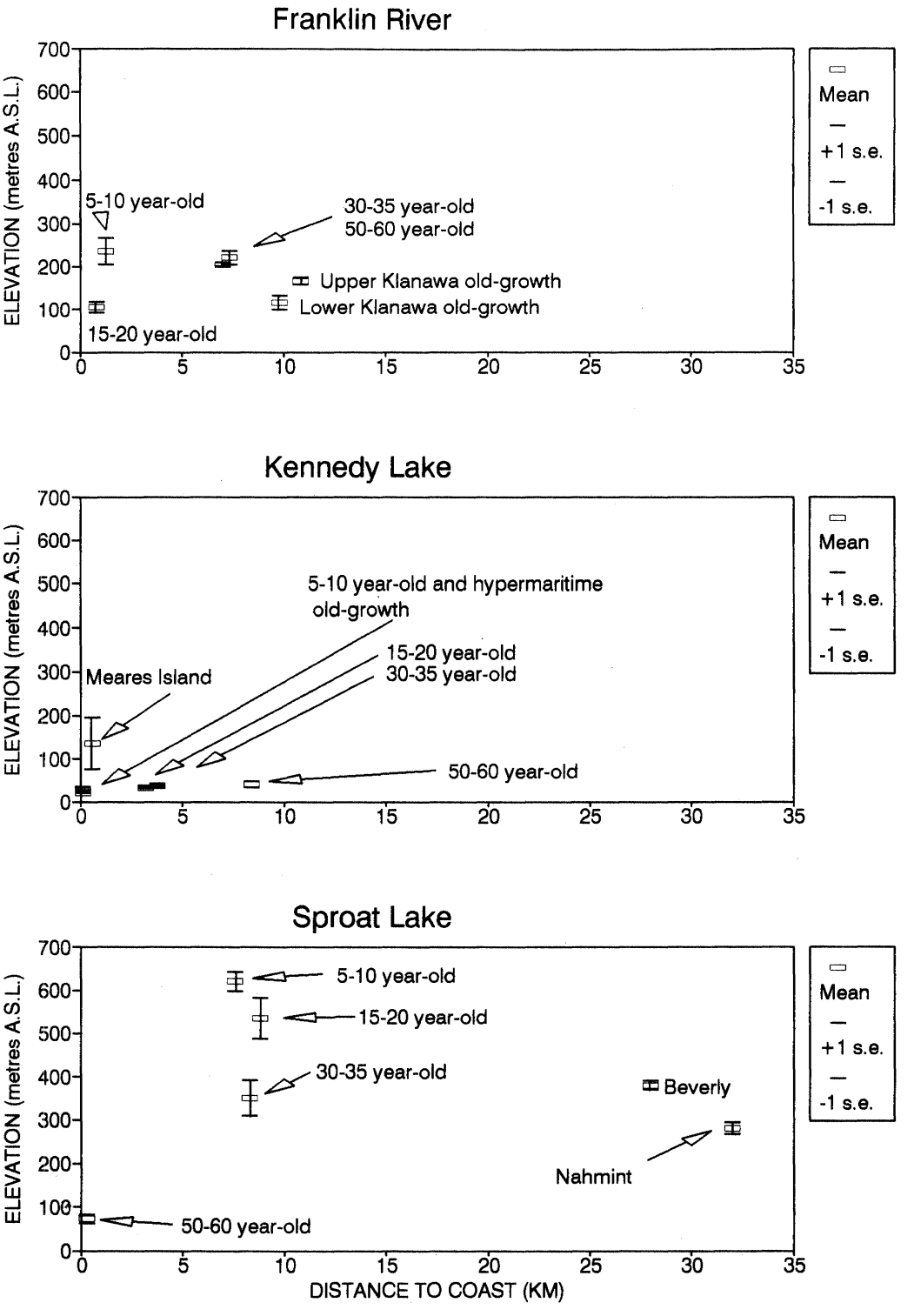

Figure 3: Transect elevation and proximity to the coast.

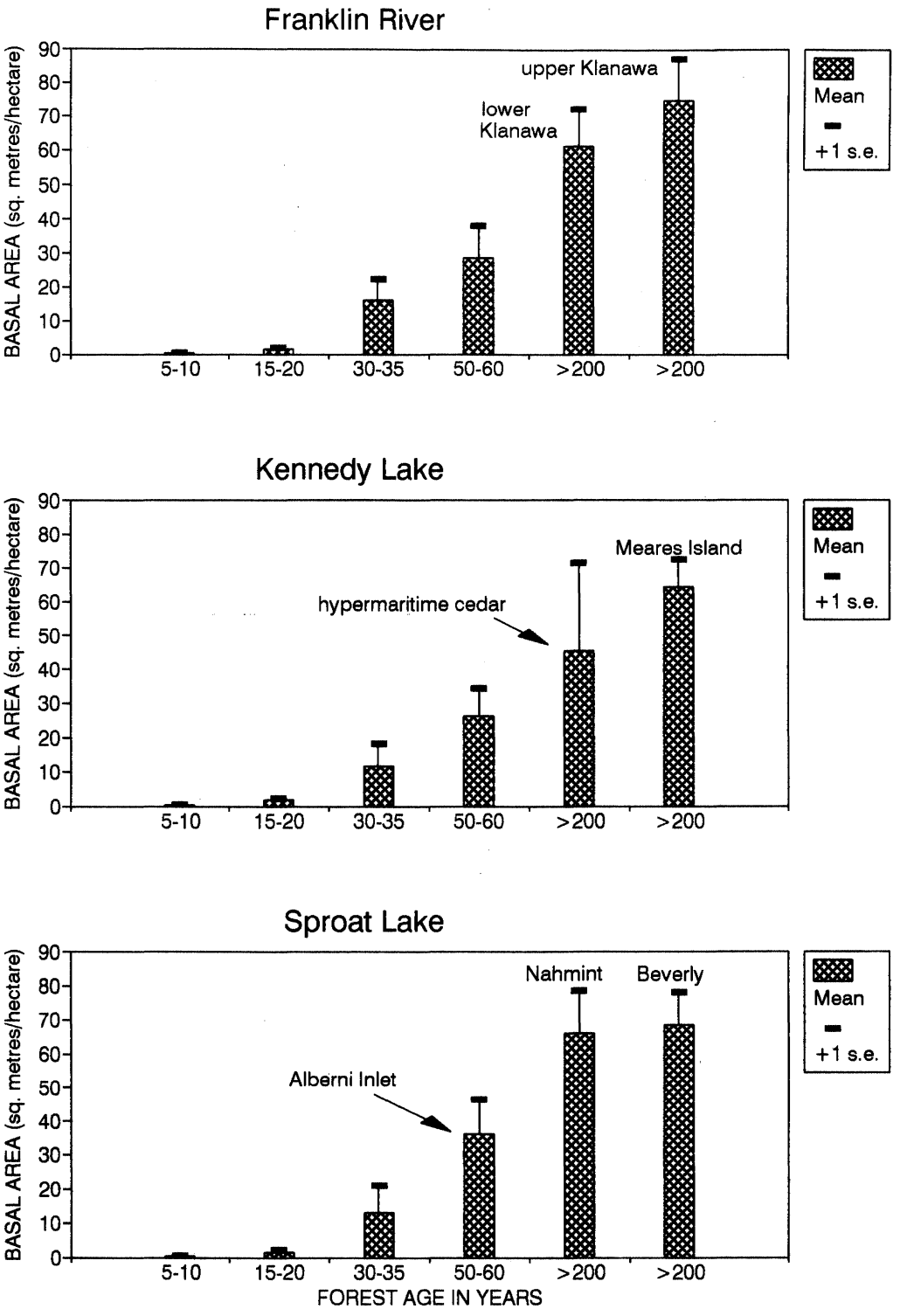

Figure 4: Forest stand basal area by age-class.

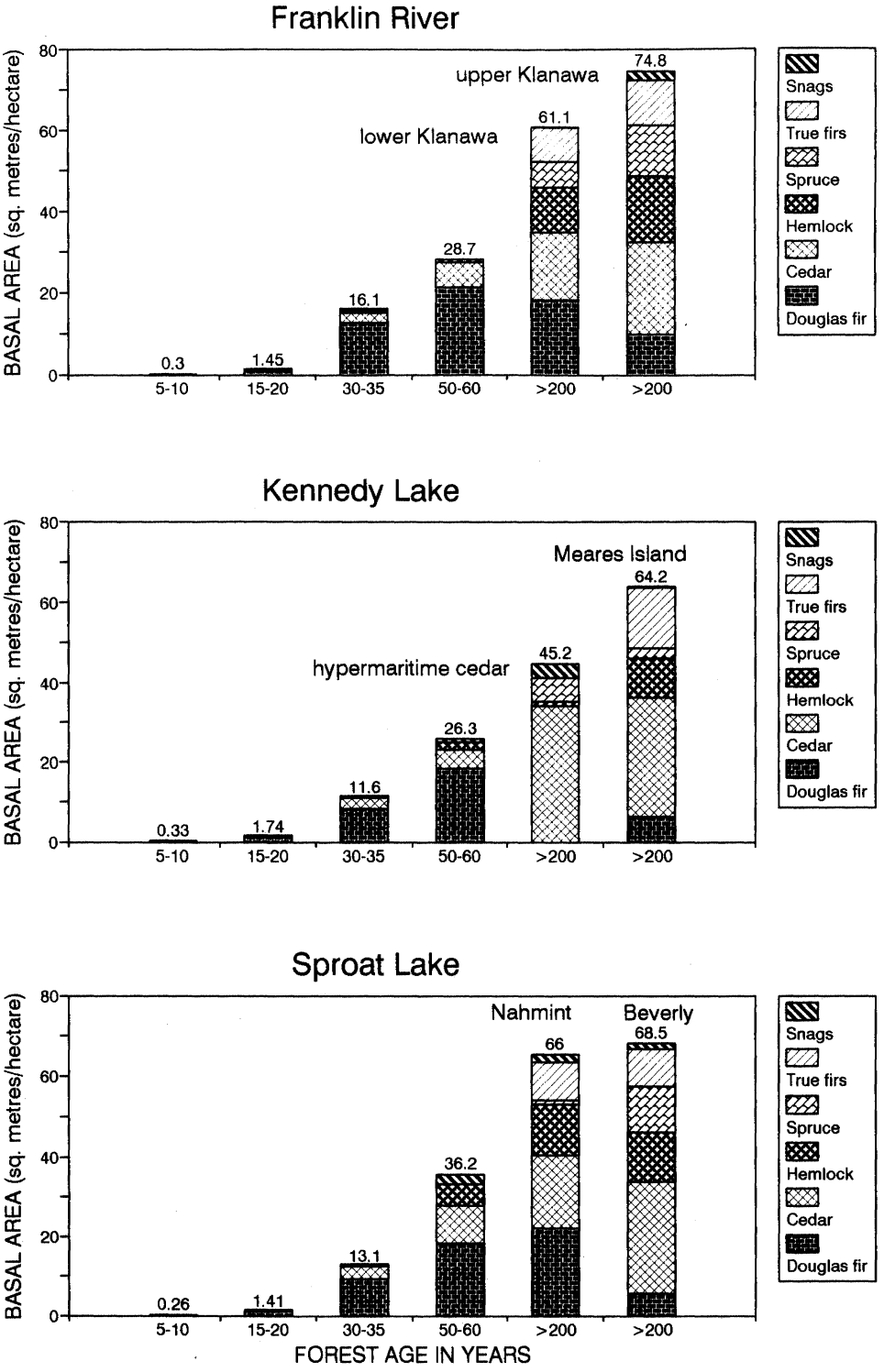

Figure 5: Tree species diversity by age-class.

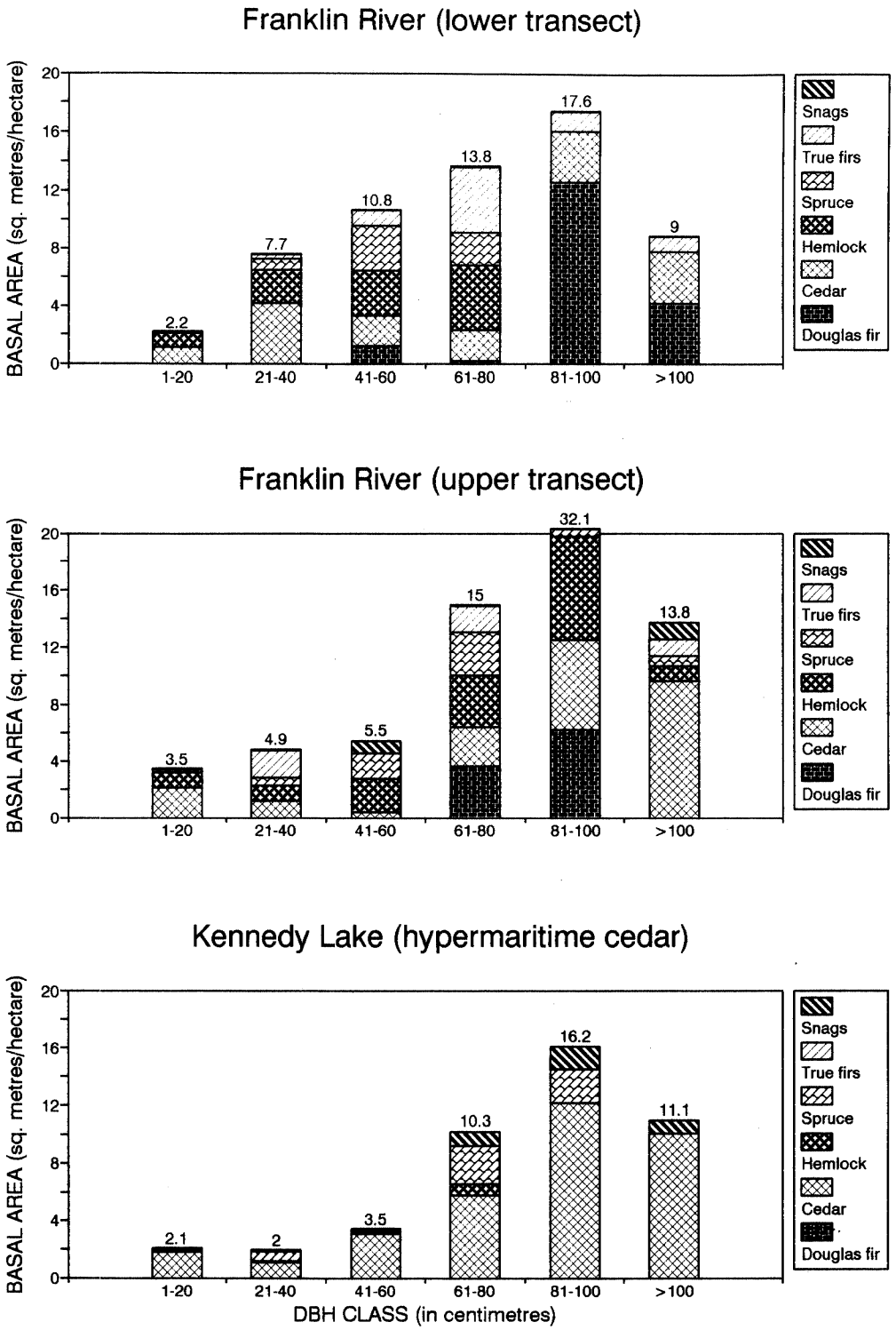

Figure 6: Old-growth basal area by DBH class and species composition.

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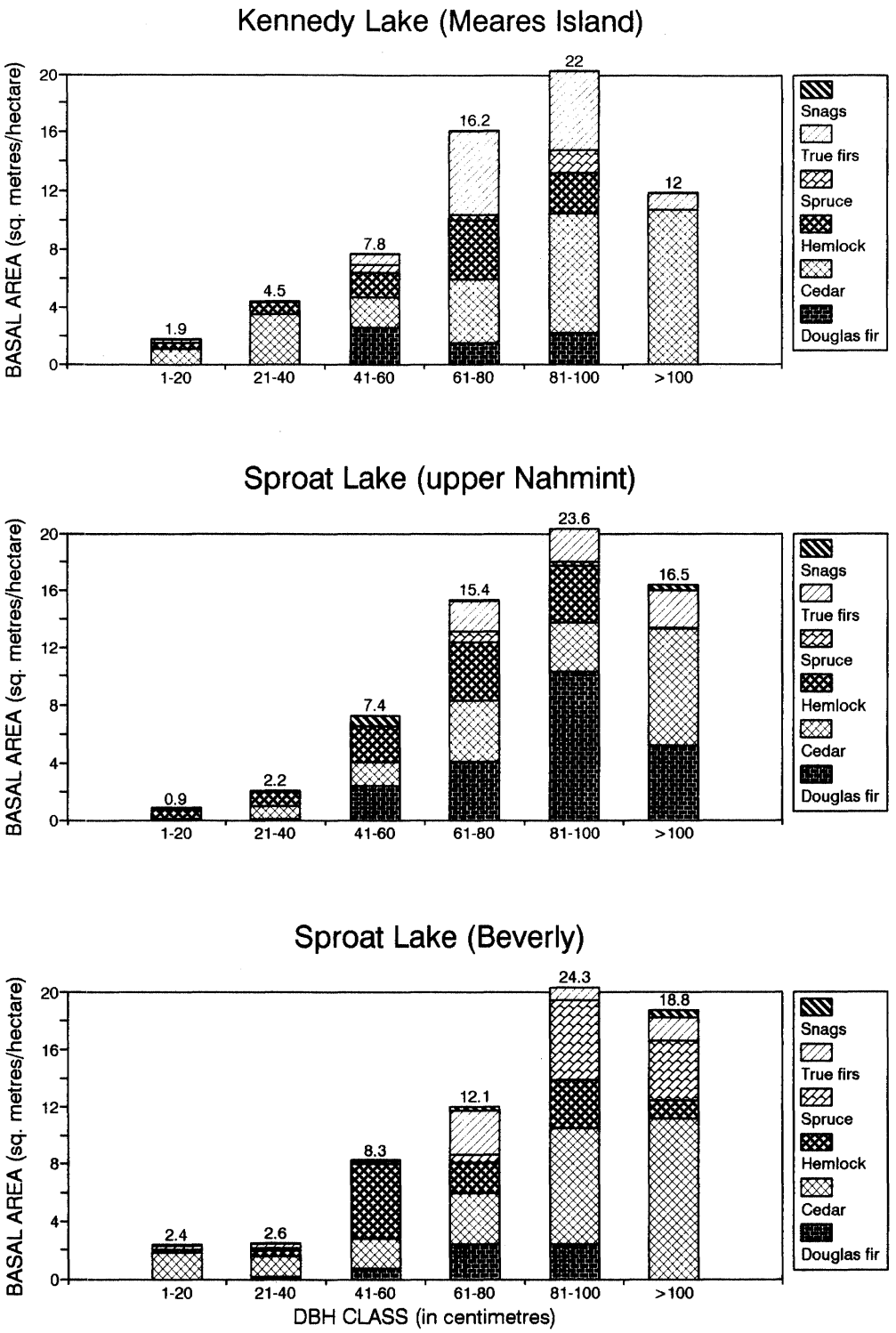

Figure 6 continued: Old-growth basal area by DBH class and species composition.

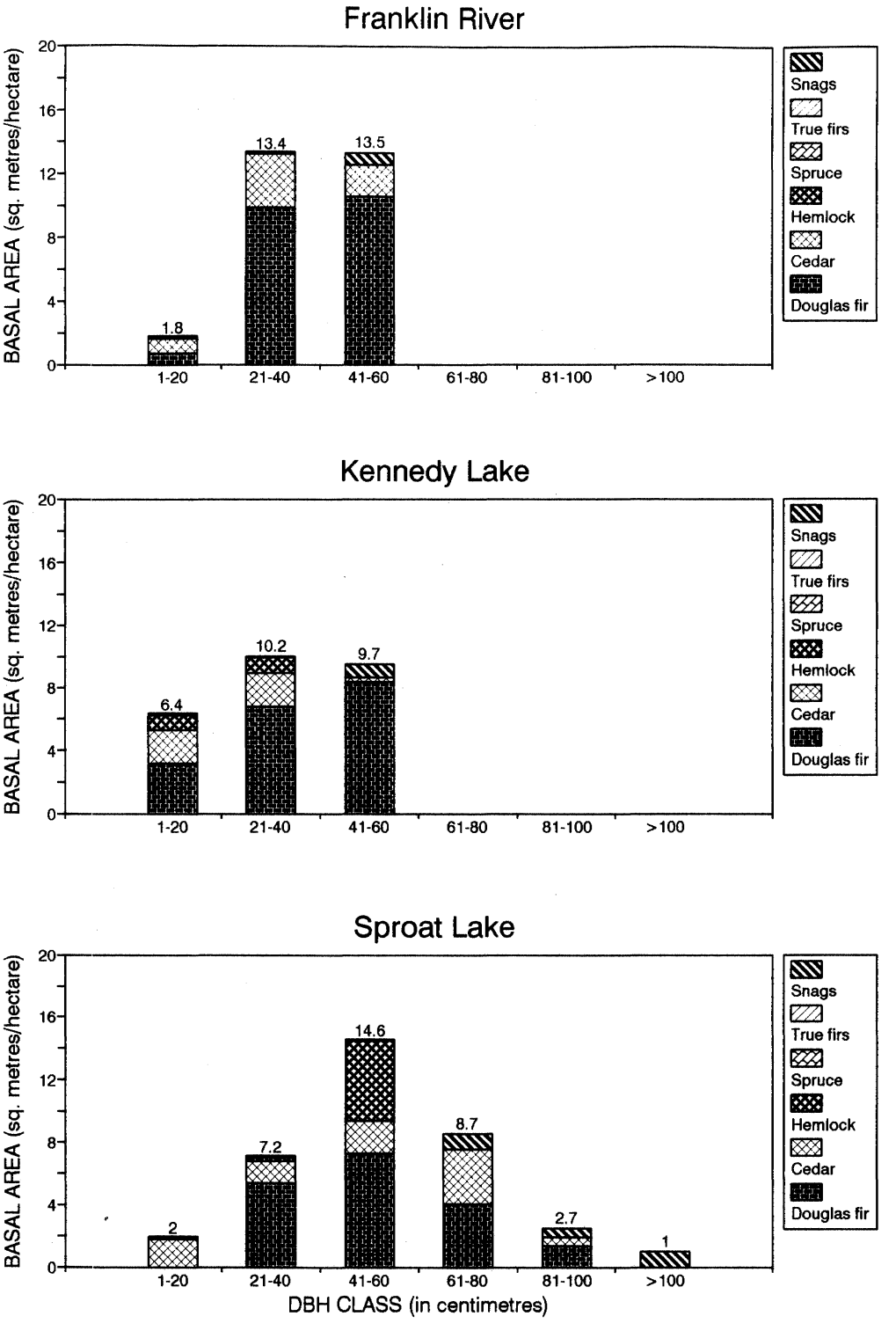

Figure 7: 50-60 year-old basal area by DBH class and species composition.

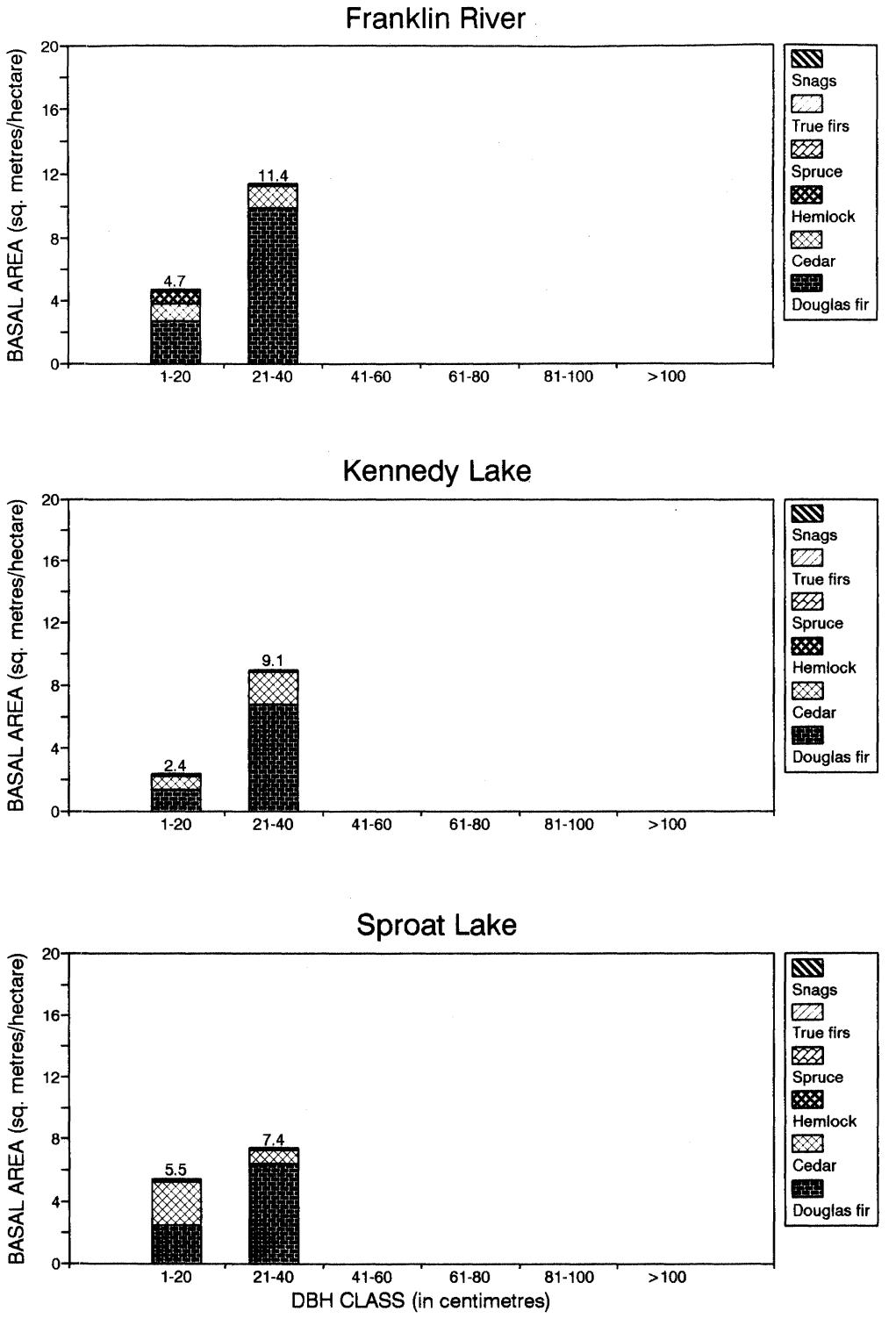

Figure 8: 30-35 year-old basal area by DBH class and species composition.

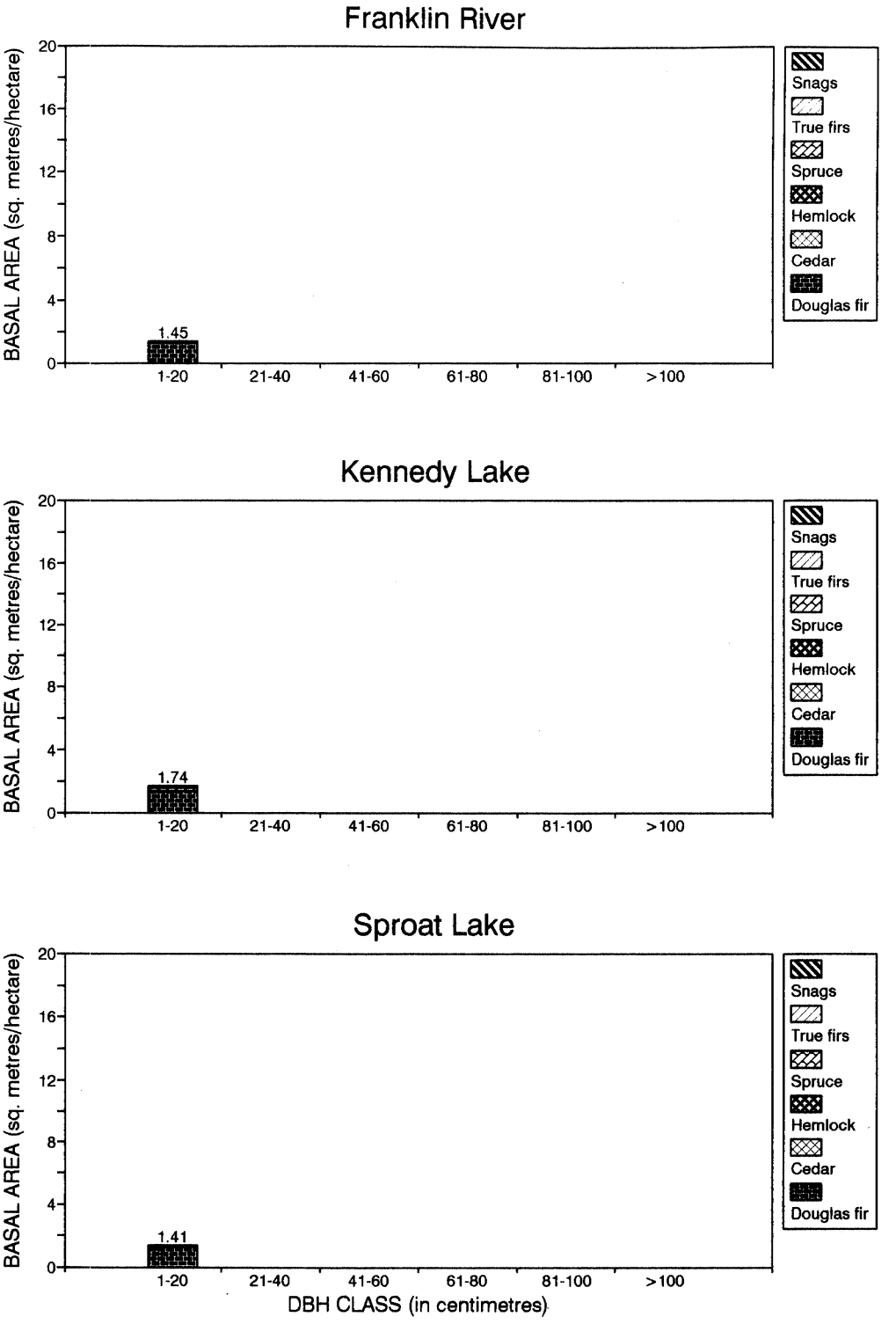

Figure 9: 15-20 year-old basal area by DBH class and species composition.

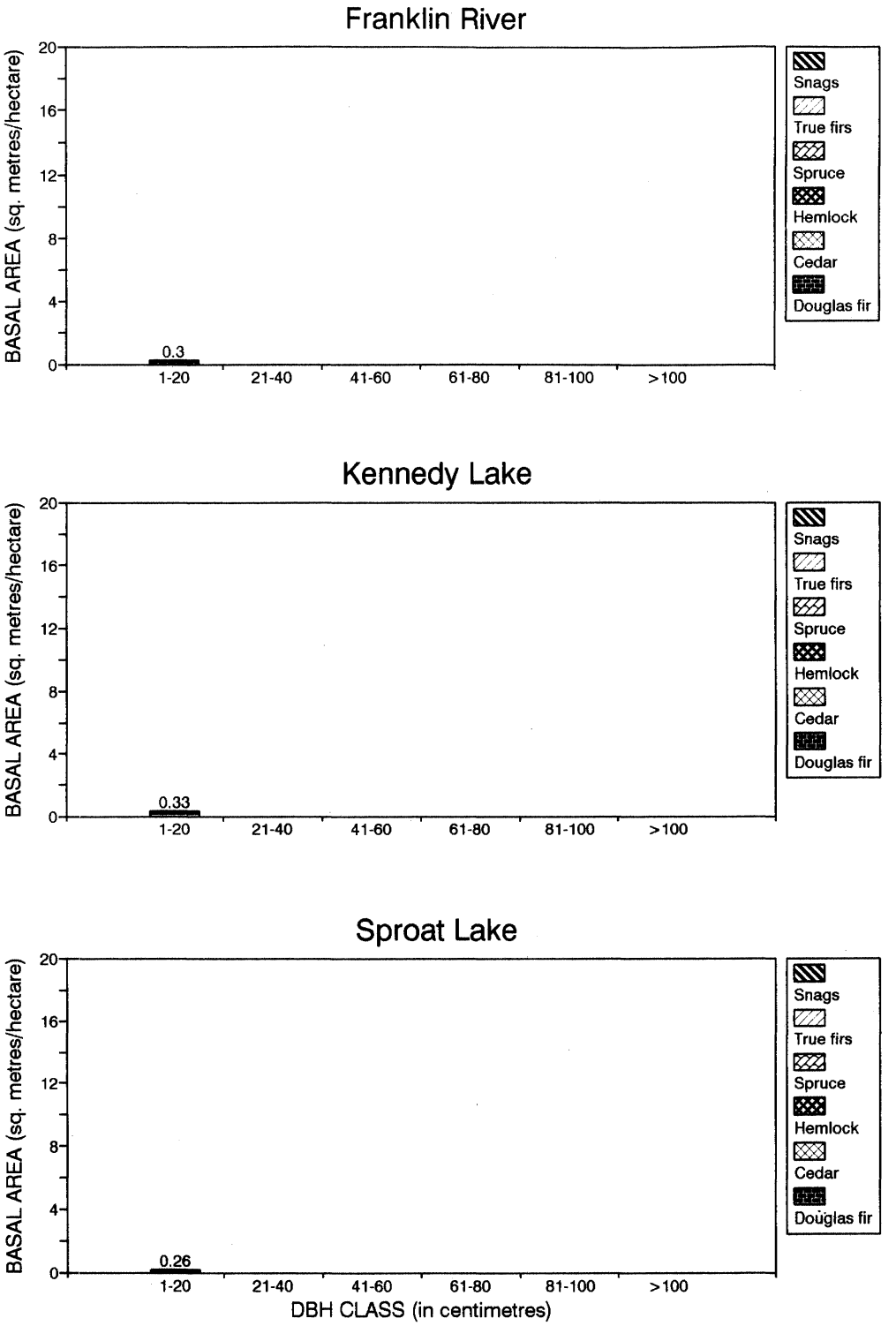

Figure 10: Clearcut basal area by DBH class and species composition.

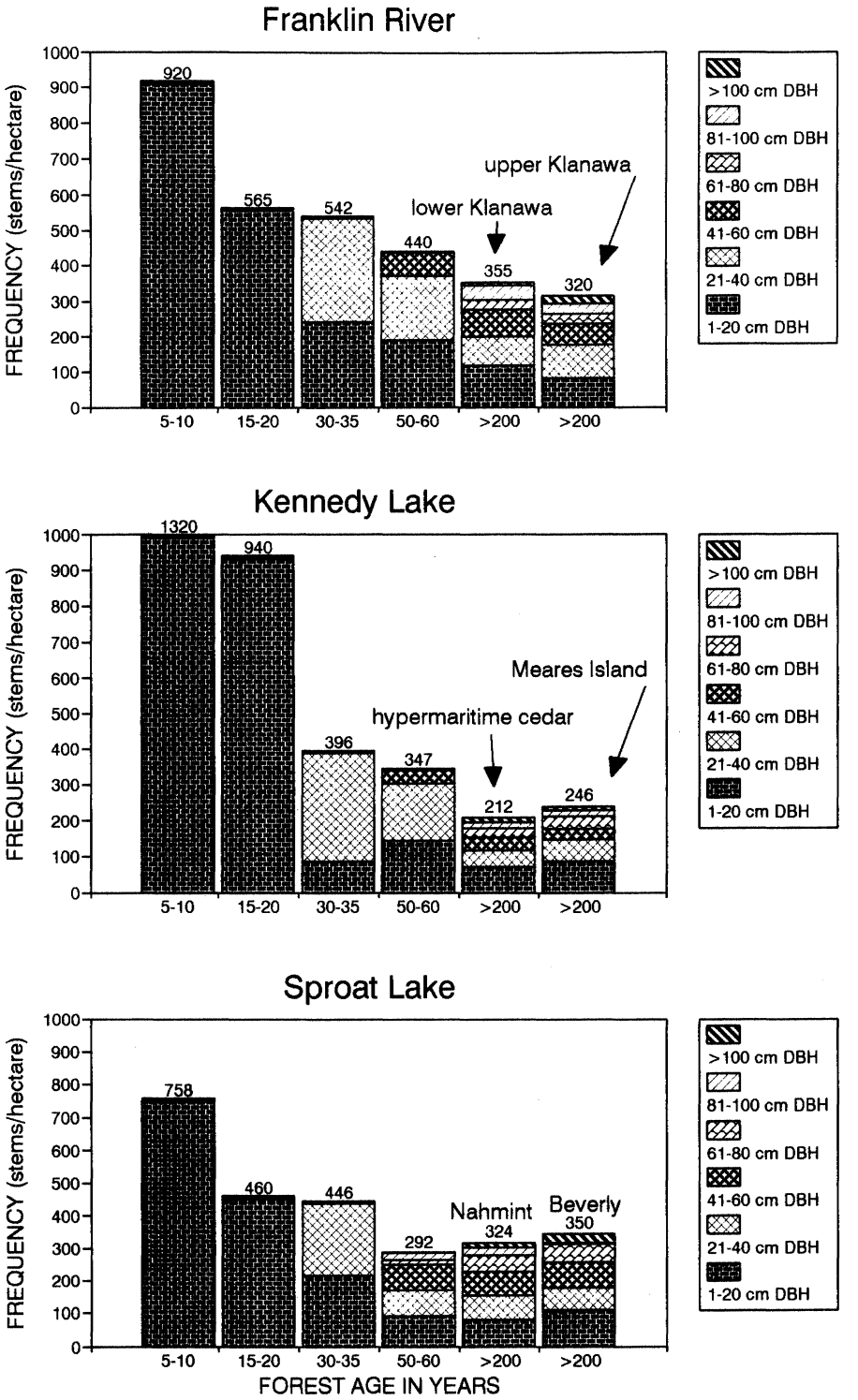

Figure 11: Tree density by DBH and age-class.

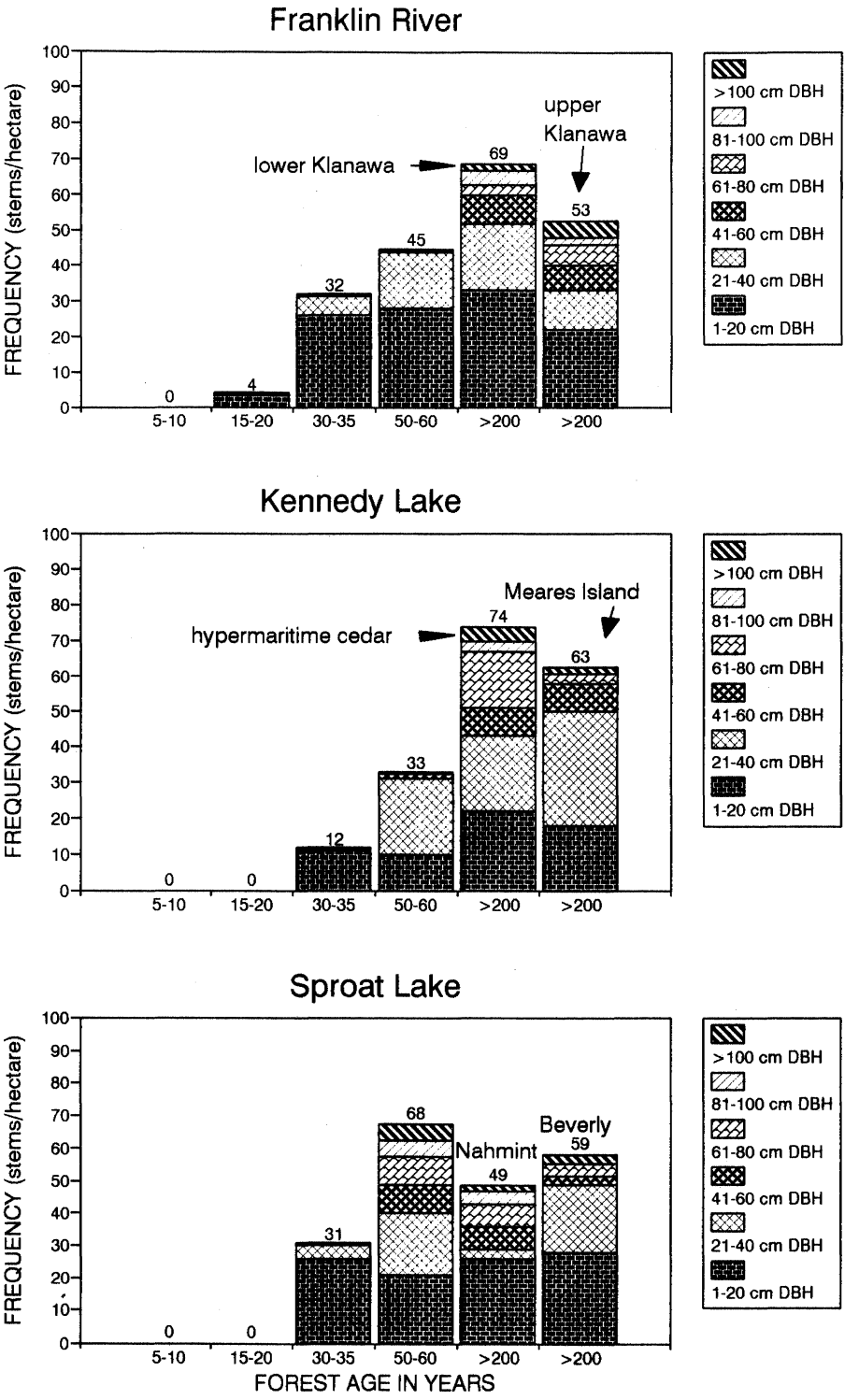

Figure 12: Snag density by DBH and age-class.

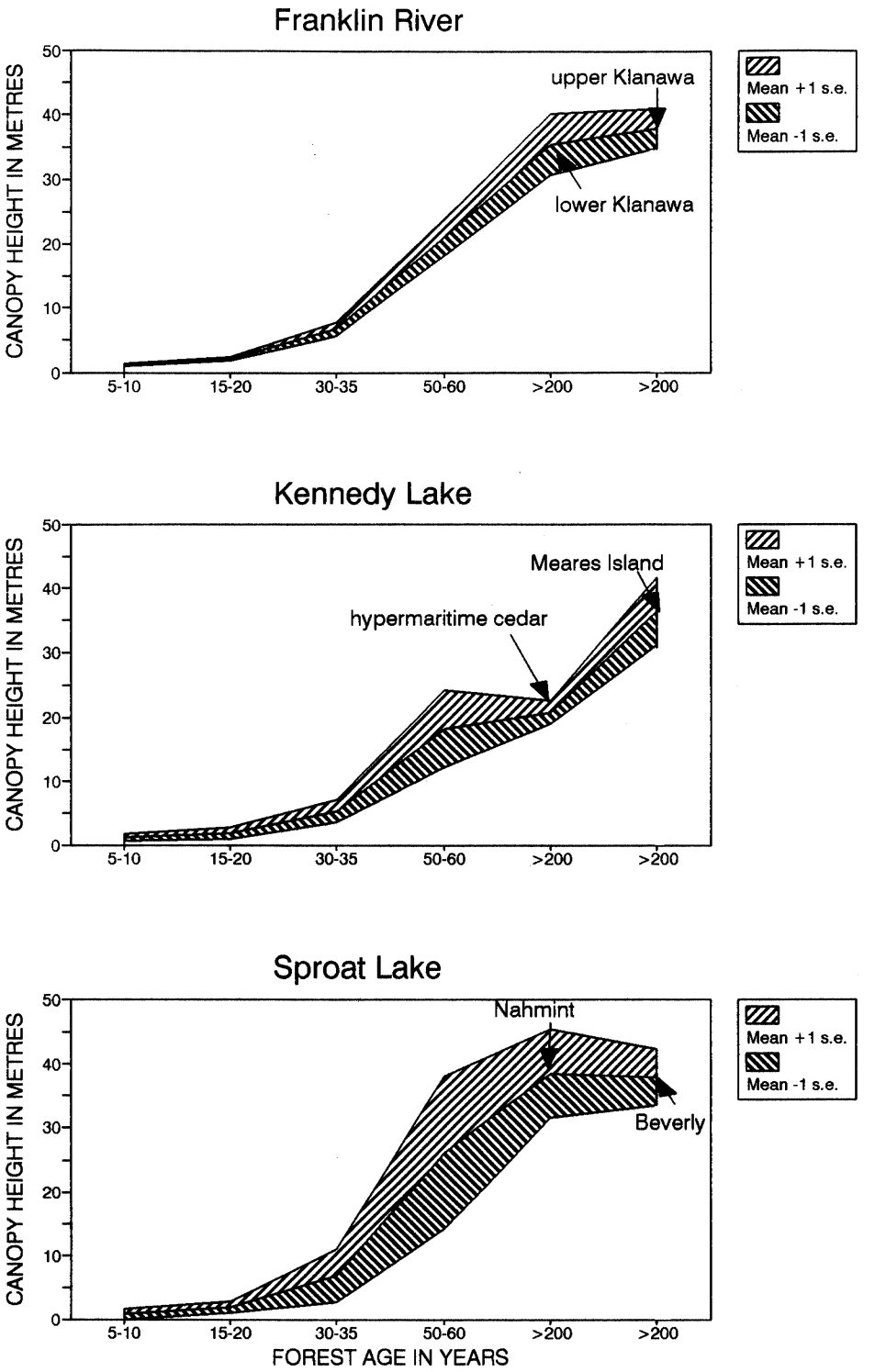

Figure 13: Mean canopy height by age-class.

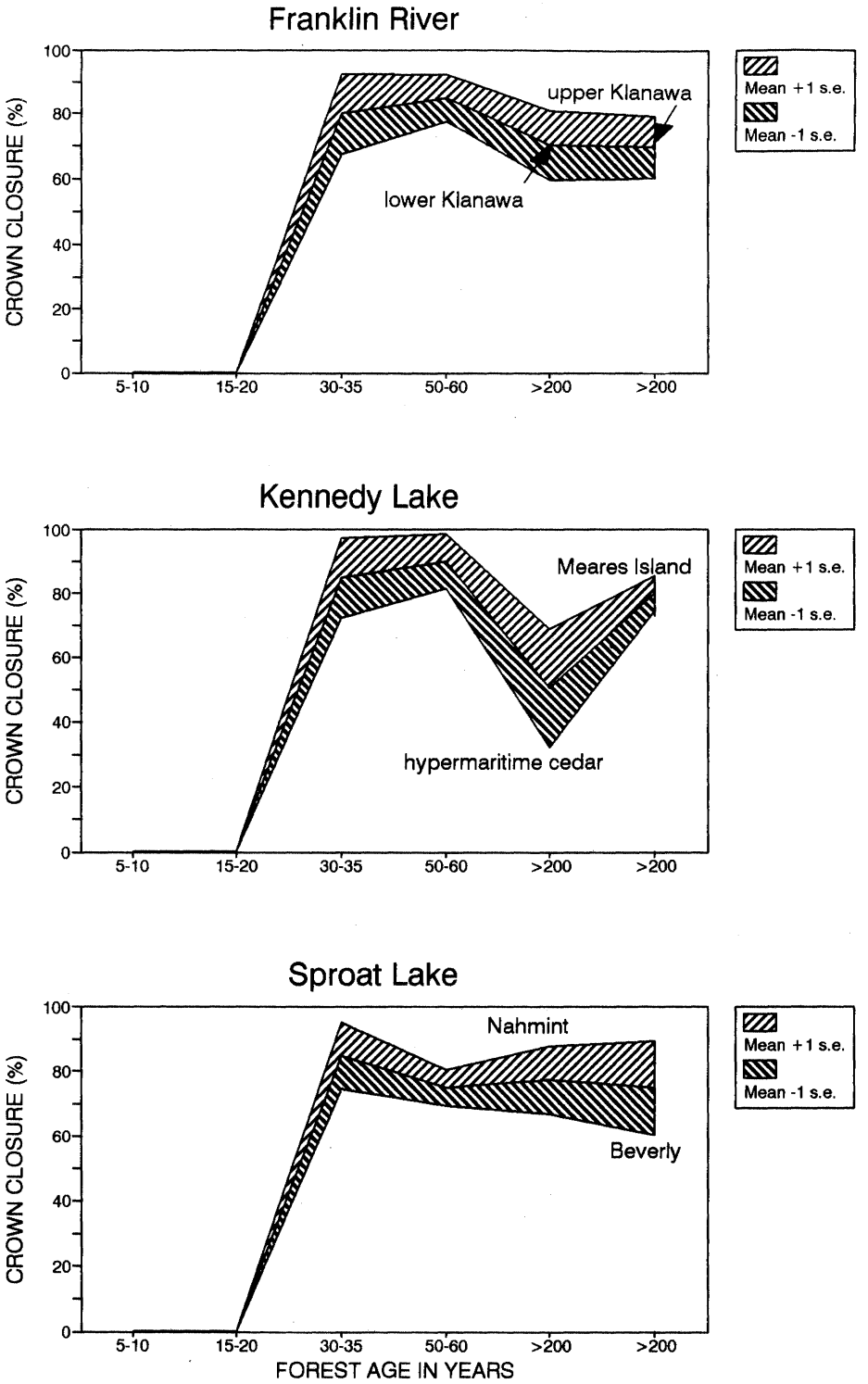

Figure 14: Mean % canopy closure by age-class.

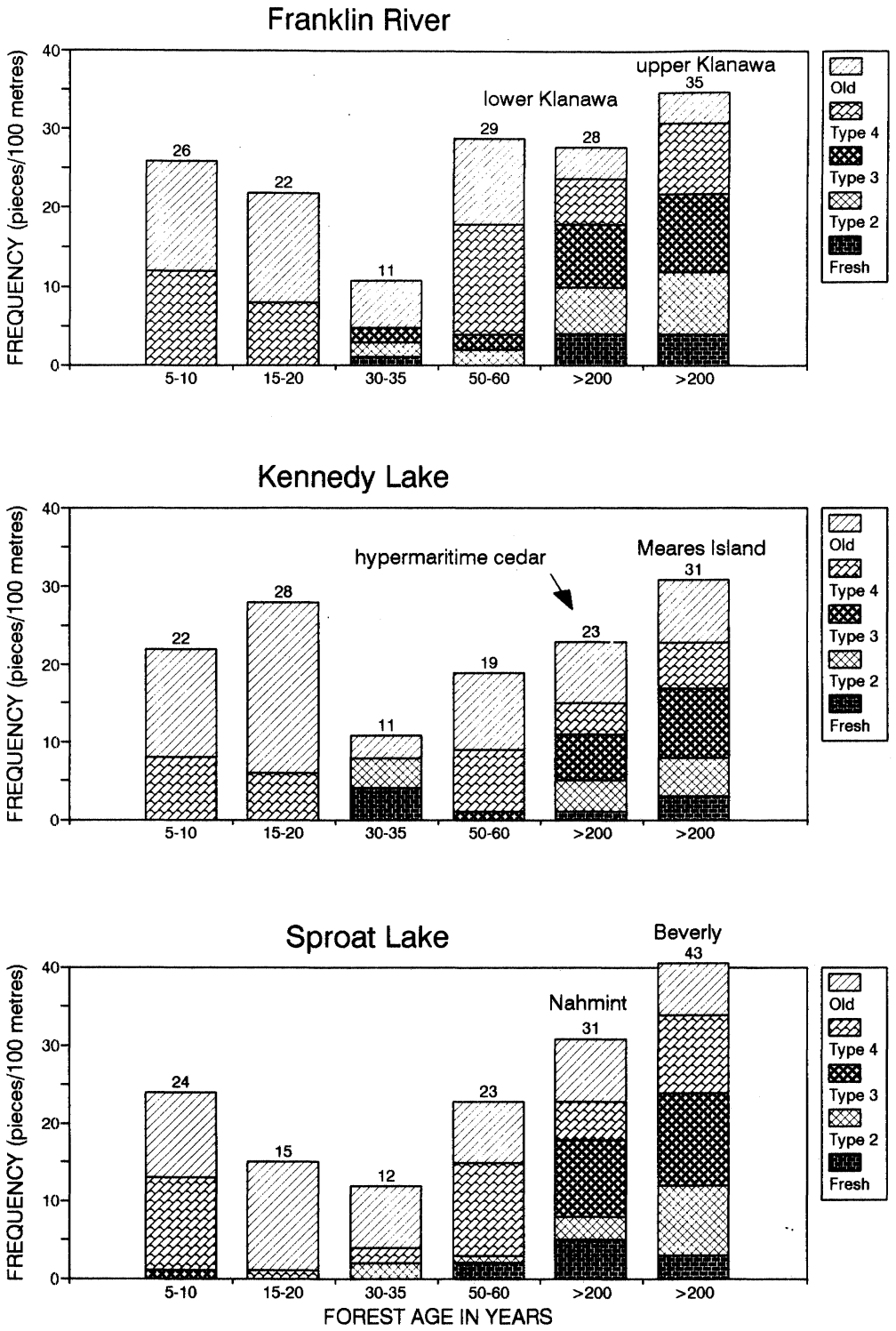

Figure 15: Woody debris by decay class.

logged clearcuts and 15-20 year-old stands also contained much debris, but because none has been recently added, it tended to be of more advanced age. Immature 30-35 year-old stands contained the least debris, and most of this was very decomposed.

BIRDS IN SAMPLED HABITATS

Effect of bird-indices on species detected

Excluding seabirds, shorebirds and raptors, 55 bird species were detected during the study (Table 1). Twelve species were detected on only 1 survey (Western Wood Pewee, Tree Swallow, Northern Rough-winged Swallow, House Wren, Townsend's Solitaire, Hermit Thrush, European Starling, Solitary Vireo, Yellow-rumped Warbler, Common Yellowthroat, Pine Siskin, and Golden-crowned Sparrow). The remaining 43 species were detected on at least 2 surveys.

The choice of bird-index used has a direct and disproportionate impact on results obtained for different species. For common, vocal and highly territorial species such as Winter Wren, Varied Thrush, American Robin or Townsend's Warbler, there is generally only a small (10-20%) difference between results obtained using the Maximum and Median indices (Tables 2 and 3). However, for uncommon, wide-ranging species such as the Hairy Woodpecker or Red-breasted Sapsucker, differences between indices result in compiled "detection" at far fewer (200-300% fewer) sampling stations (Tables 2 and 3). It is for this reason that we sometimes present both Maximum and Median results in the species accounts.

Effect of survey date on bird detections

The abundance of some species increased or decreased depending on survey date. In some cases this was caused by "waves" of migrants moving through the site. For example, Golden-crowned Sparrows were detected during the 1st survey but not afterwards. Orange-crowned Warblers and Townsend's Warblers also showed a dramatic decline in abundance between early and late surveys. Other species, including Pacific Slope Flycatcher, Swainson's Thrush, and Cedar Waxwing, were late migrants, showing substantial increases as summer progressed. Migration was not the only factor involved. In some cases, changes in estimated abundance over time probably reflects a decrease in the amount of territorial song as the breeding season progressed (e.g., Chestnut-backed Chickadee, Dark-eyed Junco).

Seasonal changes in detections have an important effect upon calculation of Maximum, Mean and Median bird-indices for some species (Figure 16).

Clearcuts

Bird communities in clearcuts were dominated by ground and shrub-nesting species. Typical species included Rufous Hummingbird, American Robin, Orange-crowned Warbler, MacGillivray's Warbler, Rufous-sided Towhee, Song Sparrow, White-crowned

TABLE 1: Bird detections by species and survey date. Detections for all areas and age-classes are combined.

		SURVEY					
	SPECIES	#1 May 1-17	#2 May 18-29	#3 Jun 2-14	#4 Jun 16-Jul 7	TOTAL	% of TOTAL
1.	Blue Grouse	43	18	16	12	89	1
2.	Ruffed Grouse	4	5	1	0	10	-
3.	Vaux's Swift	6	0	3	7	16	-
4.	Rufous Hummingbird	86	65	63	23	237	4
5.	Northern Flicker	16	7	1	0	24	-
6.	Red-breasted Sapsucker	3	6	13	14	36	1
7.	Hairy Woodpecker	27	22	17	15	81	1
8.	Pileated Woodpecker	3	2	1	2	8	-
9.	Olive-sided Flycatcher	2	5	11	4	22	-
10.	Western Wood Pewee	0	0	1	0	1	-
11.	Hammond's Flycatcher	40	32	18	12	102	2
12.	Willow Flycatcher	1	1	2	9	13	-
13.	Pacific Slope Flycatcher	13	17	116	110	316	5
14.	Tree Swallow	1	0	0	0	1	-
15.	Violet-green Swallow	5	4	1	1	11	-
16.	Barn Swallow	0	1	1	0	2	-
17.	Northern Rough-winged Swallow	3	0	0	0	3	-
18.	Steller's Jay	35	48	30	23	136	2
19.	Northwestern Crow	6	7	3	6	22	-
20.	Common Raven	2	2	3	3	10	-
21.	Chestnut-backed Chickadee	49	84	76	65	274	4
22.	Brown Creeper	29	20	19	20	88	1
23.	Red-breasted Nuthatch	8	5	8	15	36	1
24.	House Wren	0	0	0	1	1	-
25.	Winter Wren	147	135	165	147	594	9
26.	Golden-crowned Kinglet	109	104	76	71	360	6
27.	Townsend's Solitaire	0	1	0	0	1	-
28.	Swainson's Thrush	3	178	218	144	543	9
29.	Hermit Thrush	13	2	1	1	17	-
30.	Varied Thrush	90	67	74	75	306	5
31.	American Robin	225	198	146	107	676	11
32.	Cedar Waxwing	0	11	19	18	48	1
33.	European Starling	1	0	0	0	1	-
34.	Hutton's Vireo	30	41	41	20	132	2
35.	Solitary Vireo	1	0	0	0	1	-
36.	Warbling Vireo	4	8	4	4	20	-
37.	Orange-crowned Warbler	191	105	95	77	468	7
38.	Yellow-rumped Warbler	3	3	1	0	7	-
39.	Townsend's Warbler	130	76	52	31	289	5
40.	Black-throated gray Warbler	3	13	11	13	40	1
41.	Yellow Warbler	3	4	2	1	10	-
42.	MacGillivray's Warbler	41	67	25	41	174	3
43.	Wilson's Warbler	38	44	39	27	148	2
44.	Common Yellowthroat	0	1	0	2	3	-
45.	Rufous-sided Towhee	19	16	21	19	75	1
46.	Song Sparrow	79	80	60	63	282	4
47.	White-crowned Sparrow	22	36	22	21	101	2
48.	Golden-crowned Sparrow	20	0	0	0	20	-
49.	Fox Sparrow	2	6	6	2	16	-
50.	Dark-eyed Junco	72	77	62	41	252	4
51.	Western Tanager	1	0	3	4	8	-
52.	Pine Siskin	0	3	10	3	16	-
53.	American Goldfinch	0	16	8	2	26	-
54.	Red Crossbill	3	57	79	39	178	3
55.	Purple Finch	9	5	5	10	29	-
	N of sampling stations	215	215	215	215	215	
	N of species detected	47	46	47	44	55	
	N of birds detected	1641	1705	1649	1325	6380	100%

TABLE 2: **Probability of detection using the Median-all detections index.** Data are % of sampling stations at which individual species were detected. An asterisk * denotes species confined to a single age-class based on this index.

		FOREST AGE-CLASS (years)				
	SPECIES	5-10	15-20	30-35	50-60	>200
1.	Blue Grouse	**17**	**19**	-	**3**	**1**
2.	Ruffed Grouse *	-	-	-	**3**	-
3.	Vaux's Swift *	-	-	-	-	**1**
4.	Rufous Hummingbird	**58**	**66**	**11**	**11**	**13**
5.	Northern Flicker	-	-	**3**	-	**3**
6.	Red-breasted Sapsucker *	-	-	-	-	**10**
7.	Hairy Woodpecker	**6**	-	-	-	**17**
8.	Pileated Woodpecker *	-	-	-	-	**3**
9.	Olive-sided Flycatcher *	-	-	-	-	**3**
1	Western Wood Pewee	-	-	-	-	-
11.	Hammond's Flycatcher	-	-	-	**11**	**24**
12.	Willow Flycatcher *	-	-	**3**	-	-
13.	Pacific Slope Flycatcher	**6**	**3**	**25**	**36**	**79**
14.	Tree Swallow	-	-	-	-	-
15.	Violet-green Swallow *	-	-	-	**3**	-
16.	Barn Swallow *	-	-	-	-	**1**
17.	Northern Rough-winged Swallow	-	-	-	-	-
18.	Steller's Jay	**6**	**19**	**8**	**36**	**15**
19.	Northwestern Crow	**3**	**3**	-	-	**3**
20.	Common Raven	**3**	-	-	-	**1**
21.	Chestnut-backed Chickadee	-	-	**8**	**17**	**56**
22.	Brown Creeper	-	-	**14**	-	**28**
23.	Red-breasted Nuthatch *	-	-	-	-	**8**
24.	House Wren	-	-	-	-	-
25.	Winter Wren	**22**	**11**	**64**	**69**	**96**
26.	Golden-crowned Kinglet	-	-	**44**	**47**	**46**
27.	Townsend's Solitaire	-	-	-	-	-
28.	Swainson's Thrush	**36**	**44**	**83**	**81**	**34**
29.	Hermit Thrush	-	-	-	-	-
30.	Varied Thrush	-	-	**27**	**31**	**59**
31.	American Robin	**64**	**39**	**86**	**100**	**53**
32.	Cedar Waxwing	**3**	**3**	**6**	-	-
33.	European Starling	-	-	-	-	-
34.	Hutton's Vireo	-	-	**27**	**14**	**20**
35.	Solitary Vireo	-	-	-	-	-
36.	Warbling Vireo	-	-	**8**	**8**	-
37.	Orange-crowned Warbler	**64**	**100**	**53**	**22**	**11**
38.	Yellow-rumped Warbler	-	-	-	-	-
39.	Townsend's Warbler	-	**3**	**53**	**53**	**8**
40.	Black-throated gray Warbler *	-	-	-	**19**	-
41.	Yellow Warbler *	-	-	**3**	-	-
42.	MacGillivray's Warbler	**36**	**50**	**36**	**11**	-
43.	Wilson's Warbler	**3**	**24**	**50**	**17**	**3**
44.	Common Yellowthroat	-	-	-	-	-
45.	Rufous-sided Towhee	**33**	**11**	-	-	-
46.	Song Sparrow	**89**	**64**	**17**	**6**	-
47.	White-crowned Sparrow	**25**	**33**	**3**	-	-
48.	Golden-crowned Sparrow	-	-	-	-	-
49.	Fox Sparrow *	**8**	-	-	-	-
50.	Dark-eyed Junco	**44**	**36**	**3**	-	**15**
51.	Western Tanager *	-	-	-	-	**4**
52.	Pine Siskin	-	-	-	-	-
53.	American Goldfinch	**3**	**3**	-	-	-
54.	Red Crossbill *	-	-	-	-	**15**
55.	Purple Finch *	**3**	-	**6**	-	-
N of sampling stations		**36**	**36**	**36**	**36**	**71**
N of species detected		**21**	**18**	**24**	**21**	**29**

TABLE 3: **Probability of detection using the Maximum-all detections index.** Data are % of sampling stations at which individual species were detected. An asterisk * denotes species confined to a single age-class based on this index.

		FOREST AGE-CLASS (years)				
	SPECIES	5-10	15-20	30-35	50-60	>200
1.	Blue Grouse	**44**	**44**	**28**	**14**	**13**
2.	Ruffed Grouse	-	-	**22**	**3**	-
3.	Vaux's Swift	-	-	-	**3**	**6**
4.	Rufous Hummingbird	**75**	**81**	**44**	**31**	**38**
5.	Northern Flicker	-	**11**	**11**	**14**	**4**
6.	Red-breasted Sapsucker	-	-	-	**3**	**28**
7.	Hairy Woodpecker	**36**	**6**	**6**	**6**	**58**
8.	Pileated Woodpecker *	-	-	-	-	**7**
9.	Olive-sided Flycatcher	**22**	**6**	**6**	**6**	**8**
10.	Western Wood Pewee *	-	-	-	-	**1**
11.	Hammond's Flycatcher	**6**	**3**	**17**	**22**	**39**
12.	Willow Flycatcher	**6**	**11**	**6**	**3**	-
13.	Pacific Slope Flycatcher	**11**	**8**	**47**	**50**	**94**
14.	Tree Swallow *	**3**	-	-	-	-
15.	Violet-green Swallow	-	**3**	**3**	**8**	-
16.	Barn Swallow	-	-	-	-	**1**
17.	Northern Rough-winged Swallow *	**3**	-	-	-	-
18.	Steller's Jay	**31**	**44**	**39**	**47**	**39**
19.	Northwestern Crow	**14**	**11**	-	**3**	**7**
20.	Common Raven	**3**	-	-	-	**7**
21.	Chestnut-backed Chickadee	-	**3**	**25**	**58**	**89**
22.	Brown Creeper	-	-	**19**	**17**	**55**
23.	Red-breasted Nuthatch *	-	-	-	**8**	**21**
24.	House Wren *	-	-	-	**3**	-
25.	Winter Wren	**25**	**17**	**81**	**92**	**97**
26.	Golden-crowned Kinglet	-	**11**	**81**	**75**	**82**
27.	Townsend's Solitaire *	-	**3**	-	-	-
28.	Swainson's Thrush	**50**	**81**	**94**	**92**	**63**
29.	Hermit Thrush	-	**3**	**14**	**3**	**10**
30.	Varied Thrush	-	**3**	**44**	**47**	**87**
31.	American Robin	**86**	**78**	**97**	**100**	**94**
32.	Cedar Waxwing	**17**	**31**	**14**	-	**3**
33.	European Starling *	-	-	-	-	**1**
34.	Hutton's Vireo	**3**	**3**	**56**	**44**	**44**
35.	Solitary Vireo *	-	**3**	-	-	-
36.	Warbling Vireo	-	-	**17**	**17**	-
37.	Orange-crowned Warbler	**86**	**100**	**89**	**53**	**32**
38.	Yellow-rumped Warbler	**3**	**8**	-	-	**4**
39.	Townsend's Warbler	**3**	**8**	**75**	**69**	**39**
40.	Black-throated gray Warbler *	-	-	-	**33**	-
41.	Yellow Warbler	**8**	**6**	**8**	-	-
42.	MacGillivray's Warbler	**64**	**83**	**53**	**31**	**6**
43.	Wilson's Warbler	**19**	**42**	**69**	**47**	**20**
44.	Common Yellowthroat	-	-	**3**	**6**	-
45.	Rufous-sided Towhee	**67**	**50**	**6**	-	**3**
46.	Song Sparrow	**94**	**94**	**31**	**19**	**4**
47.	White-crowned Sparrow	**39**	**44**	**8**	**3**	-
48.	Golden-crowned Sparrow	**17**	**25**	-	-	**4**
49.	Fox Sparrow	**14**	-	**28**	**6**	-
50.	Dark-eyed Junco	**75**	**92**	**31**	**6**	**30**
51.	Western Tanager	-	-	-	**3**	**4**
52.	Pine Siskin	**3**	**11**	**3**	**3**	**3**
53.	American Goldfinch	**8**	**14**	**8**	-	-
54.	Red Crossbill	**3**	-	**8**	**6**	**51**
55.	Purple Finch	**11**	**6**	**25**	**11**	**3**
N of sampling stations		**36**	**36**	**36**	**36**	**71**
N of species detected		**33**	**36**	**37**	**40**	**40**

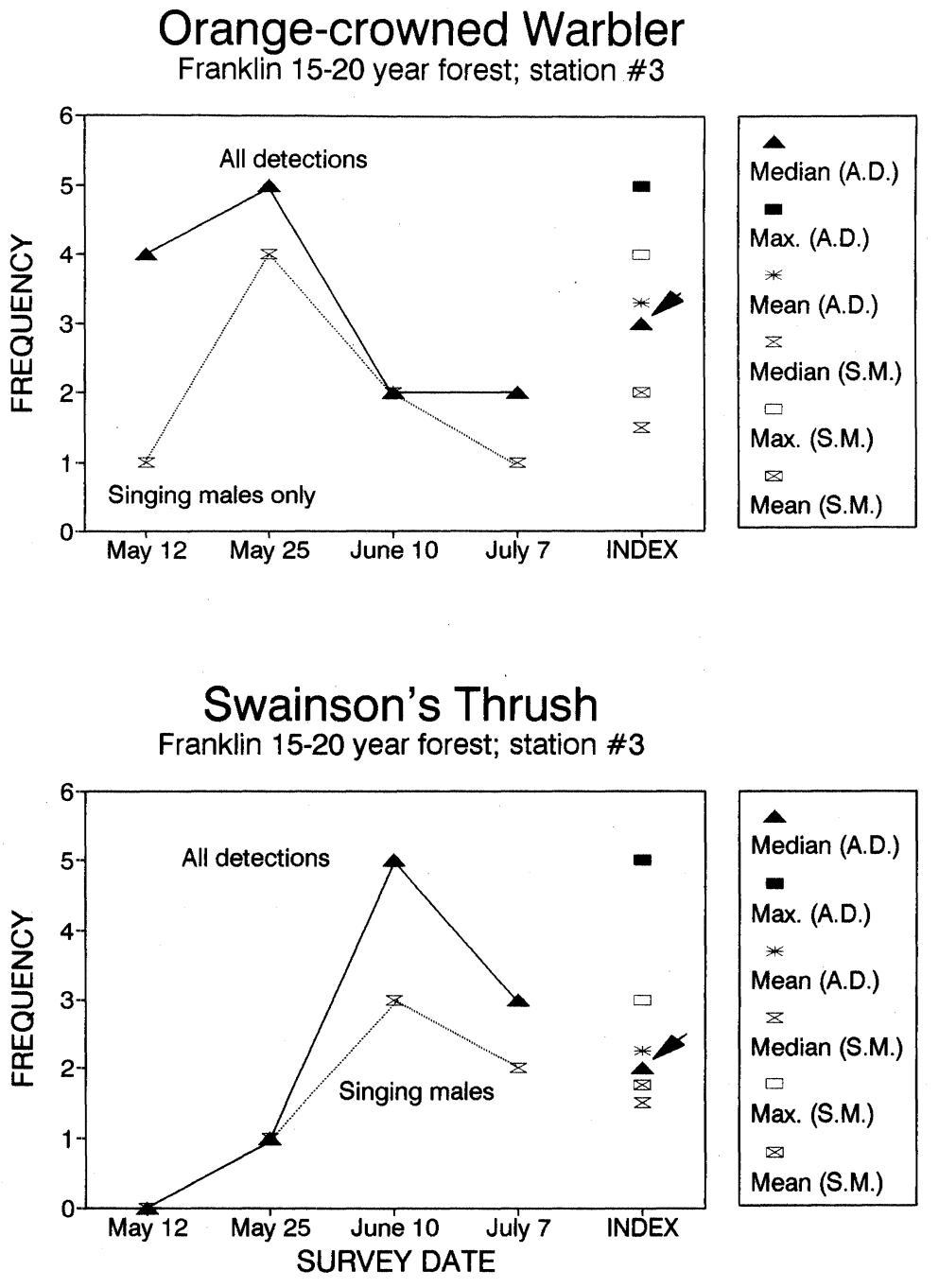

Figure 16: Example of bird-index calculation.

Indices are based on all-detections (A.D.) or singing males (S.M.). Results from multiple sample stations were averaged to calculate a per-transect index. The Median-all detections index is arrowed.

Sparrow and Dark-eyed Junco, although there were often substantial differences in abundance of these species among the 3 study areas (Table 4). Widely-foraging species such as the Hairy Woodpecker, Steller's Jay, Northwestern Crow, and Common Raven, although commonly seen, were usually eliminated by use of the Median-all detections index, since they were rarely observed at the same sampling station on more than one survey. Two species (Fox Sparrow and Purple Finch) were confined to this age-class.

The Franklin River clearcut contained relatively high numbers of Blue Grouse and MacGillivray's Warblers. The Sproat Lake clearcut was virtually devoid of species other that White-crowned Sparrow, Song Sparrow and Orange-crowned Warbler. The Kennedy Lake clearcut was richest in terms of species diversity, including five species (Pacific Slope Flycatcher, Winter Wren, Fox Sparrow and Purple Finch) not found in other clearcuts. The Kennedy Lake transect also contained relatively high numbers of Swainson's Thrushes and Rufous-sided Towhees.

15-20 year-old stands

Forests of this age were similar to clearcuts in bird species composition. Typical birds included Blue Grouse, Rufous Hummingbird, American Robin, Orange-crowned Warbler, Rufous-sided Towhee, White-crowned Sparrow, Song Sparrow and Dark-eyed Junco. In general, MacGillivray's Warbler, Wilson's Warbler and Swainson's Thrush were more abundant in this age-class than in clearcuts. No species were confined to this age-class.

The Franklin River and Kennedy Lake stands were quite similar in species composition (Table 5). However, large numbers of Swainson's Thrush and Orange-crowned Warbler detections at Kennedy Lake resulted in a considerably higher estimate of bird abundance. As with the clearcut age-class, the Sproat Lake 15-20 year-old stand contained both fewer species overall and fewer birds/station.

30-35 year-old stands

Small insectivorous birds which forage by gleaning (Brown Creeper, Chestnut-backed Chickadee, Golden-crowned Kinglet, Hutton's Vireo, Warbling Vireo) made their first appearance in this age-class, while ground-foragers (Song Sparrow, White-crowned Sparrow, Dark-eyed Junco) declined in importance. Several shrub and tree-nesting species (American Robin, Swainson's Thrush, Townsend's Warbler, Wilson's Warbler, and MacGillivray's Warbler) achieved their greatest abundance in this forest type. Two species (Willow Flycatcher and Yellow Warbler) were detected only in this age-class.

There was considerable variation among study areas (Table 6). The Franklin River transect was characterized by abundant Pacific Slope Flycatchers and Hutton's Vireos, neither of which were detected elsewhere. Varied Thrushes were relatively common at Franklin River and Kennedy Lake, but were not detected at the Sproat Lake transect. Townsend's Warblers were abundant at Kennedy Lake, present in numbers at Sproat Lake, and not detected at Franklin River. Willow Flycatchers were found only at Kennedy Lake, and Yellow Warblers appeared only at Sproat Lake. Sproat Lake contained the highest

TABLE 4: **Bird abundance in clearcuts using the Median-all detections index.** Data are $\bar{x} \pm$ s.e. individuals/sampling station. An asterisk * denotes species confined to a single area.

		Franklin River			Kennedy Lake			Sproat Lake		
	SPECIES	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.
1.	Blue Grouse *	**0.29**	±	0.09	**0**	±	0	**0**	±	0
2.	Ruffed Grouse	**0**	±	0	**0**	±	0	**0**	±	0
3.	Vaux's Swift	**0**	±	0	**0**	±	0	**0**	±	0
4.	Rufous Hummingbird	**0.67**	±	0.14	**0.67**	±	0.12	**0.21**	±	0.11
5.	Northern Flicker	**0**	±	0	**0**	±	0	**0**	±	0
6.	Red-breasted Sapsucker	**0**	±	0	**0**	±	0	**0**	±	0
7.	Hairy Woodpecker	**0.04**	±	0.04	**0**	±	0	**0.04**	±	0.04
8.	Pileated Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
9.	Olive-sided Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
10.	Western Wood Pewee	**0**	±	0	**0**	±	0	**0**	±	0
11.	Hammond's Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
12.	Willow Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
13.	Pacific Slope Flycatcher *	**0**	±	0	**0.13**	±	0.09	**0**	±	0
14.	Tree Swallow	**0**	±	0	**0**	±	0	**0**	±	0
15.	Violet-green Swallow	**0**	±	0	**0**	±	0	**0**	±	0
16.	Barn Swallow	**0**	±	0	**0**	±	0	**0**	±	0
17.	Northern Rough-winged Swallow	**0**	±	0	**0**	±	0	**0**	±	0
18.	Steller's Jay *	**0**	±	0	**0.08**	±	0.05	**0**	±	0
19.	Northwestern Crow *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
20.	Common Raven *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
21.	Chestnut-backed Chickadee	**0**	±	0	**0**	±	0	**0**	±	0
22.	Brown Creeper	**0**	±	0	**0**	±	0	**0**	±	0
23.	Red-breasted Nuthatch	**0**	±	0	**0**	±	0	**0**	±	0
24.	House Wren	**0**	±	0	**0**	±	0	**0**	±	0
25.	Winter Wren *	**0**	±	0	**0.75**	±	0.20	**0**	±	0
26.	Golden-crowned Kinglet	**0**	±	0	**0**	±	0	**0**	±	0
27.	Townsend's Solitaire	**0**	±	0	**0**	±	0	**0**	±	0
28.	Swainson's Thrush	**0.08**	±	0.08	**0.83**	±	0.09	**0**	±	0
29.	Hermit Thrush	**0**	±	0	**0**	±	0	**0**	±	0
30.	Varied Thrush	**0**	±	0	**0**	±	0	**0**	±	0
31.	American Robin	**0.58**	±	0.13	**0.88**	±	0.16	**0.17**	±	0.07
32.	Cedar Waxwing *	**0.17**	±	0.16	**0**	±	0	**0**	±	0
33.	European Starling	**0**	±	0	**0**	±	0	**0**	±	0
34.	Hutton's Vireo	**0**	±	0	**0**	±	0	**0**	±	0
35.	Solitary Vireo	**0**	±	0	**0**	±	0	**0**	±	0
36.	Warbling Vireo	**0**	±	0	**0**	±	0	**0**	±	0
37.	Orange-crowned Warbler	**1.00**	±	0.17	**1.17**	±	0.18	**0.13**	±	0.09
38.	Yellow-rumped Warbler	**0**	±	0	**0**	±	0	**0**	±	0
39.	Townsend's Warbler	**0**	±	0	**0**	±	0	**0**	±	0
40.	Black-throated gray Warbler	**0**	±	0	**0**	±	0	**0**	±	0
41.	Yellow Warbler *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
42.	MacGillivray's Warbler	**0.38**	±	0.10	**0.08**	±	0.05	**0.21**	±	0.09
43.	Wilson's Warbler *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
44.	Common Yellowthroat	**0**	±	0	**0**	±	0	**0**	±	0
45.	Rufous-sided Towhee	**0.08**	±	0.08	**0.29**	±	0.07	**0.25**	±	0.11
46.	Song Sparrow	**1.00**	±	0.10	**1.04**	±	0.18	**0.75**	±	0.14
47.	White-crowned Sparrow	**0.04**	±	0.04	**0**	±	0	**0.83**	±	0.20
48.	Golden-crowned Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
49.	Fox Sparrow *	**0**	±	0	**0.17**	±	0.09	**0**	±	0
50.	Dark-eyed Junco	**0.54**	±	0.17	**0.04**	±	0.04	**0.83**	±	0.21
51.	Western Tanager	**0**	±	0	**0**	±	0	**0**	±	0
52.	Pine Siskin	**0**	±	0	**0**	±	0	**0**	±	0
53.	American Goldfinch *	**0**	±	0	**0.08**	±	0.08	**0**	±	0
54.	Red Crossbill	**0**	±	0	**0**	±	0	**0**	±	0
55.	Purple Finch *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
	N of sampling stations	**12**			**12**			**12**		
	N of species detected	**12**			**18**			**9**		
	$\bar{x}$ detections/sampling station	**4.86**	±	0.54	**6.41**	±	0.44	**3.41**	±	0.44

TABLE 5: **Bird abundance in 15-20 year-old stands using the Median-all detections index.** Data are $\bar{x} \pm$ s.e. individuals/sampling station. An asterisk * denotes species confined to a single area.

		Franklin River			Kennedy Lake			Sproat Lake		
	SPECIES	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.
1.	Blue Grouse	**0.08**	±	0.05	**0.13**	±	0.09	**0.17**	±	0.07
2.	Ruffed Grouse	**0**	±	0	**0**	±	0	**0**	±	0
3.	Vaux's Swift	**0**	±	0	**0**	±	0	**0**	±	0
4.	Rufous Hummingbird	**0.79**	±	0.14	**0.96**	±	0.07	**0.08**	±	0.08
5.	Northern Flicker	**0**	±	0	**0**	±	0	**0**	±	0
6.	Red-breasted Sapsucker	**0**	±	0	**0**	±	0	**0**	±	0
7.	Hairy Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
8.	Pileated Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
9.	Olive-sided Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
10.	Western Wood Pewee	**0**	±	0	**0**	±	0	**0**	±	0
11.	Hammond's Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
12.	Willow Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
13.	Pacific Slope Flycatcher *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
14.	Tree Swallow	**0**	±	0	**0**	±	0	**0**	±	0
15.	Violet-green Swallow	**0**	±	0	**0**	±	0	**0**	±	0
16.	Barn Swallow	**0**	±	0	**0**	±	0	**0**	±	0
17.	Northern Rough-winged Swallow	**0**	±	0	**0**	±	0	**0**	±	0
18.	Steller's Jay	**0.25**	±	0.11	**0.13**	±	0.06	**0**	±	0
19.	Northwestern Crow *	**0**	±	0	**0.08**	±	0.08	**0**	±	0
20.	Common Raven	**0**	±	0	**0**	±	0	**0**	±	0
21.	Chestnut-backed Chickadee	**0**	±	0	**0**	±	0	**0**	±	0
22.	Brown Creeper	**0**	±	0	**0**	±	0	**0**	±	0
23.	Red-breasted Nuthatch	**0**	±	0	**0**	±	0	**0**	±	0
24.	House Wren	**0**	±	0	**0**	±	0	**0**	±	0
25.	Winter Wren	**0.08**	±	0.05	**0.08**	±	0.05	**0**	±	0
26.	Golden-crowned Kinglet	**0**	±	0	**0**	±	0	**0**	±	0
27.	Townsend's Solitaire	**0**	±	0	**0**	±	0	**0**	±	0
28.	Swainson's Thrush	**0.21**	±	0.09	**1.54**	±	0.21	**0**	±	0
29.	Hermit Thrush	**0**	±	0	**0**	±	0	**0**	±	0
30.	Varied Thrush	**0**	±	0	**0**	±	0	**0**	±	0
31.	American Robin	**0.42**	±	0.22	**0.29**	±	0.09	**0.25**	±	0.11
32.	Cedar Waxwing *	**0.04**	±	0.04	**0**	±	0	**0**	±	0
33.	European Starling	**0**	±	0	**0**	±	0	**0**	±	0
34.	Hutton's Vireo	**0**	±	0	**0**	±	0	**0**	±	0
35.	Solitary Vireo	**0**	±	0	**0**	±	0	**0**	±	0
36.	Warbling Vireo	**0**	±	0	**0**	±	0	**0**	±	0
37.	Orange-crowned Warbler	**1.46**	±	0.20	**1.79**	±	0.20	**1.00**	±	0.10
38.	Yellow-rumped Warbler	**0**	±	0	**0**	±	0	**0**	±	0
39.	Townsend's Warbler	**0**	±	0	**0.08**	±	0.08	**0**	±	0
40.	Black-throated gray Warbler	**0**	±	0	**0**	±	0	**0**	±	0
41.	Yellow Warbler	**0**	±	0	**0**	±	0	**0**	±	0
42.	MacGillivray's Warbler	**0.13**	±	0.06	**0.50**	±	0.13	**0.46**	±	0.11
43.	Wilson's Warbler	**0.21**	±	0.09	**0.17**	±	0.11	**0**	±	0
44.	Common Yellowthroat	**0**	±	0	**0**	±	0	**0**	±	0
45.	Rufous-sided Towhee	**0.04**	±	0.04	**0**	±	0	**0.21**	±	0.11
46.	Song Sparrow	**0.42**	±	0.16	**0.75**	±	0.15	**0.71**	±	0.16
47.	White-crowned Sparrow	**0.13**	±	0.06	**0**	±	0	**0.71**	±	0.14
48.	Golden-crowned Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
49.	Fox Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
50.	Dark-eyed Junco	**0.04**	±	0.04	**0.13**	±	0.06	**0.50**	±	0.10
51.	Western Tanager	**0**	±	0	**0**	±	0	**0**	±	0
52.	Pine Siskin	**0**	±	0	**0**	±	0	**0**	±	0
53.	American Goldfinch *	**0**	±	0	**0.04**	±	0.04	**0**	±	0
54.	Red Crossbill	**0**	±	0	**0**	±	0	**0**	±	0
55.	Purple Finch	**0**	±	0	**0**	±	0	**0**	±	0
	N of sampling stations	**12**			**12**			**12**		
	N of species detected	**14**			**15**			**9**		
	$\bar{x}$ detections/sampling station	**4.29**	±	0.47	**6.71**	±	0.51	**4.08**	±	0.41

TABLE 6: **Bird abundance in 30-35 year-old stands using the Median-all detections index.** Data are $\bar{x} \pm$ s.e. individuals/sampling station. An asterisk * denotes species confined to a single area.

		Franklin River			Kennedy Lake			Sproat Lake		
	SPECIES	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.
1.	Blue Grouse *	**0**	±	0	**0**	±	0	**0.17**	±	0.09
2.	Ruffed Grouse	**0**	±	0	**0**	±	0	**0**	±	0
3.	Vaux's Swift	**0**	±	0	**0**	±	0	**0**	±	0
4.	Rufous Hummingbird	**0**	±	0	**0.13**	±	0.06	**0.08**	±	0.08
5.	Northern Flicker *	**0**	±	0	**0**	±	0	**0.04**	±	0.04
6.	Red-breasted Sapsucker	**0**	±	0	**0**	±	0	**0**	±	0
7.	Hairy Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
8.	Pileated Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
9.	Olive-sided Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
10.	Western Wood Pewee	**0**	±	0	**0**	±	0	**0**	±	0
11.	Hammond's Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
12.	Willow Flycatcher *	**0**	±	0	**0.08**	±	0.08	**0**	±	0
13.	Pacific Slope Flycatcher *	**0.63**	±	0.13	**0**	±	0	**0**	±	0
14.	Tree Swallow	**0**	±	0	**0**	±	0	**0**	±	0
15.	Violet-green Swallow	**0**	±	0	**0**	±	0	**0**	±	0
16.	Barn Swallow	**0**	±	0	**0**	±	0	**0**	±	0
17.	Northern Rough-winged Swallow	**0**	±	0	**0**	±	0	**0**	±	0
18.	Steller's Jay	**0.04**	±	0.04	**0.04**	±	0.04	**0.04**	±	0.04
19.	Northwestern Crow	**0**	±	0	**0**	±	0	**0**	±	0
20.	Common Raven	**0**	±	0	**0**	±	0	**0**	±	0
21.	Chestnut-backed Chickadee *	**0.25**	±	0.13	**0**	±	0	**0**	±	0
22.	Brown Creeper	**0**	±	0	**0.04**	±	0.04	**0.17**	±	0.07
23.	Red-breasted Nuthatch	**0**	±	0	**0**	±	0	**0**	±	0
24.	House Wren	**0**	±	0	**0**	±	0	**0**	±	0
25.	Winter Wren	**0.83**	±	0.2	**0.42**	±	0.15	**0.42**	±	0.12
26.	Golden-crowned Kinglet	**0.46**	±	0.24	**0.5**	±	0.22	**0.75**	±	0.17
27.	Townsend's Solitaire	**0**	±	0	**0**	±	0	**0**	±	0
28.	Swainson's Thrush	**0.58**	±	0.16	**1.04**	±	0.17	**1.33**	±	0.22
29.	Hermit Thrush	**0**	±	0	**0**	±	0	**0**	±	0
30.	Varied Thrush	**0.33**	±	0.14	**0**	±	0	**0.46**	±	0.17
31.	American Robin	**1.13**	±	0.16	**0.83**	±	0.19	**0.96**	±	0.25
32.	Cedar Waxwing *	**0**	±	0	**0.13**	±	0.09	**0**	±	0
33.	European Starling	**0**	±	0	**0**	±	0	**0**	±	0
34.	Hutton's Vireo *	**0.75**	±	0.11	**0**	±	0	**0**	±	0
35.	Solitary Vireo	**0**	±	0	**0**	±	0	**0**	±	0
36.	Warbling Vireo	**0.04**	±	0.04	**0**	±	0	**0.13**	±	0.09
37.	Orange-crowned Warbler	**0.17**	±	0.09	**0.75**	±	0.13	**0.42**	±	0.14
38.	Yellow-rumped Warbler	**0**	±	0	**0**	±	0	**0**	±	0
39.	Townsend's Warbler	**0**	±	0	**1.46**	±	0.34	**0.58**	±	0.14
40.	Black-throated gray Warbler	**0**	±	0	**0**	±	0	**0**	±	0
41.	Yellow Warbler *	**0**	±	0	**0**	±	0	**0.04**	±	0.04
42.	MacGillivray's Warbler	**0**	±	0	**0.21**	±	0.11	**0.71**	±	0.12
43.	Wilson's Warbler	**0.71**	±	0.17	**0.38**	±	0.1	**0.08**	±	0.05
44.	Common Yellowthroat	**0**	±	0	**0**	±	0	**0**	±	0
45.	Rufous-sided Towhee	**0**	±	0	**0**	±	0	**0**	±	0
46.	Song Sparrow	**0**	±	0	**0.33**	±	0.15	**0.13**	±	0.09
47.	White-crowned Sparrow *	**0**	±	0	**0**	±	0	**0.04**	±	0.04
48.	Golden-crowned Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
49.	Fox Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
50.	Dark-eyed Junco *	**0**	±	0	**0**	±	0	**0.08**	±	0.08
51.	Western Tanager	**0**	±	0	**0**	±	0	**0**	±	0
52.	Pine Siskin	**0**	±	0	**0**	±	0	**0**	±	0
53.	American Goldfinch	**0**	±	0	**0**	±	0	**0**	±	0
54.	Red Crossbill	**0**	±	0	**0**	±	0	**0**	±	0
55.	Purple Finch *	**0**	±	0	**0.13**	±	0.09	**0**	±	0
	N of sampling stations	**12**			**12**			**12**		
	N of species detected	**12**			**15**			**19**		
	$\bar{x}$ detections/sampling station	**5.91**	±	0.48	**6.46**	±	0.81	**6.62**	±	0.62

number of species and birds overall.

50-60 year-old stands

Compared to 30-35 year-old stands, 50-60 year-old forests generally contained a higher abundance of Golden-crowned Kinglets, Swainson's Thrushes, Winter Wrens and Townsend's Warblers. Such stands were also characterized by declining numbers of ground-and shrub-nesting birds such as the Orange-crowned Warbler, MacGillivray's Warbler, Wilson's Warbler and Song-Sparrow. Three species (Ruffed Grouse, Violet-green Swallow, and Black-throated Gray Warbler) were confined to this age-class.

Differences among study areas were pronounced (Table 7). Black-throated Gray Warblers were abundant at Sproat Lake, but detected at only one other station (at Kennedy Lake). Golden-crowned Kinglets were virtually absent from Sproat Lake but relatively common elsewhere. Blue Grouse and Warbling Vireos were found only at Sproat Lake. Pacific Slope Flycatchers were abundant only at Sproat Lake. Varied Thrushes were abundant at Franklin River but not elsewhere. Overall, the number of species detected was similar for all 3 areas; the highest bird abundance was recorded at Kennedy Lake.

Old-growth stands

Old-growth stands were characterized by increasing numbers of large and small cavity nesters (Hairy Woodpecker, Chestnut-backed Chickadee, Brown Creeper), some insectivores (Pacific Slope Flycatcher, Varied Thrush, Winter Wren), and a single seed-eating species (Red Crossbill). Ground and shrub-nesting species typical of younger forests (Blue Grouse, Rufous Hummingbird, Swainson's Thrush, American Robin, Orange-crowned Warbler, Wilson's Warbler, Dark-eyed Junco) were usually present in low densities. Eight species (Vaux's Swift, Red-breasted Sapsucker, Pileated Woodpecker, Olive-sided Flycatcher, Barn Swallow, Red-breasted Nuthatch, Western Tanager and Red Crossbill) were found only in old-growth stands.

Between-area differences were pronounced (Table 8). The "hypermaritime" cedar stand at Kennedy Lake was unusual. This stand hosted an abundance of Dark-eyed Juncos and Orange-crowned Warblers not found elsewhere, together with a dearth of Pacific Slope Flycatchers and Varied Thrushes, which were both common at all other old-growth transects. The other Kennedy Lake old-growth transect (Meares Island) was also unusual; very low numbers of Townsend's warblers were detected, and several reasonably common species (Steller's Jay, Hutton's Vireo, Red Crossbill) were absent.

Red-breasted Sapsuckers and Hammond's Flycatchers were particularly common at Sproat Lake transects, but were scarce or absent from other old-growth stands. Brown Creepers were relatively abundant at Franklin River and Kennedy Lake, but were rarely encountered at Sproat Lake. Wilson's and Townsend's Warblers were present in low densities at Kennedy and Sproat Lakes, but were absent from Franklin River transects. The highest number of species detected was at the Sproat Lake Beverly transect.

TABLE 7: **Bird abundance in 50-60 year-old stands using the Median-all detections index.** Data are $\bar{x} \pm$ s.e. individuals/sampling station. An asterisk * denotes species confined to a single area.

		Franklin River			Kennedy Lake			Sproat Lake		
	SPECIES	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.	$\bar{x}$	±	s.e.
1.	Blue Grouse *	**0**	±	0	**0**	±	0	**0.04**	±	0.04
2.	Ruffed Grouse *	**0.04**	±	0.04	**0**	±	0	**0**	±	0
3.	Vaux's Swift	**0**	±	0	**0**	±	0	**0**	±	0
4.	Rufous Hummingbird	**0.04**	±	0.04	**0**	±	0	**0.13**	±	0.06
5.	Northern Flicker	**0**	±	0	**0**	±	0	**0**	±	0
6.	Red-breasted Sapsucker	**0**	±	0	**0**	±	0	**0**	±	0
7.	Hairy Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
8.	Pileated Woodpecker	**0**	±	0	**0**	±	0	**0**	±	0
9.	Olive-sided Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
10.	Western Wood Pewee	**0**	±	0	**0**	±	0	**0**	±	0
11.	Hammond's Flycatcher *	**0**	±	0	**0**	±	0	**0.17**	±	0.07
12.	Willow Flycatcher	**0**	±	0	**0**	±	0	**0**	±	0
13.	Pacific Slope Flycatcher	**0.04**	±	0.04	**0.13**	±	0.09	**0.54**	±	0.09
14.	Tree Swallow	**0**	±	0	**0**	±	0	**0**	±	0
15.	Violet-green Swallow *	**0**	±	0	**0.08**	±	0.08	**0**	±	0
16.	Barn Swallow	**0**	±	0	**0**	±	0	**0**	±	0
17.	Northern Rough-winged Swallow	**0**	±	0	**0**	±	0	**0**	±	0
18.	Steller's Jay	**0.08**	±	0.08	**0.17**	±	0.09	**0**	±	0
19.	Northwestern Crow	**0**	±	0	**0**	±	0	**0**	±	0
20.	Common Raven	**0**	±	0	**0**	±	0	**0**	±	0
21.	Chestnut-backed Chickadee	**0.25**	±	0.17	**0.17**	±	0.12	**0.13**	±	0.09
22.	Brown Creeper	**0**	±	0	**0**	±	0	**0**	±	0
23.	Red-breasted Nuthatch	**0**	±	0	**0**	±	0	**0**	±	0
24.	House Wren	**0**	±	0	**0**	±	0	**0**	±	0
25.	Winter Wren	**0.96**	±	0.27	**0.79**	±	0.14	**0.38**	±	0.10
26.	Golden-crowned Kinglet	**0.71**	±	0.25	**0.42**	±	0.1	**0.08**	±	0.05
27.	Townsend's Solitaire	**0**	±	0	**0**	±	0	**0**	±	0
28.	Swainson's Thrush	**0.83**	±	0.20	**1.21**	±	0.14	**0.42**	±	0.10
29.	Hermit Thrush	**0**	±	0	**0**	±	0	**0**	±	0
30.	Varied Thrush	**0**	±	0	**0.54**	±	0.12	**0.13**	±	0.09
31.	American Robin	**1.25**	±	0.22	**1.38**	±	0.18	**1.38**	±	0.20
32.	Cedar Waxwing	**0**	±	0	**0**	±	0	**0**	±	0
33.	European Starling	**0**	±	0	**0**	±	0	**0**	±	0
34.	Hutton's Vireo	**0.25**	±	0.13	**0**	±	0	**0.04**	±	0.04
35.	Solitary Vireo	**0**	±	0	**0**	±	0	**0**	±	0
36.	Warbling Vireo	**0**	±	0	**0**	±	0	**0.13**	±	0.06
37.	Orange-crowned Warbler	**0.13**	±	0.06	**0.29**	±	0.11	**0**	±	0
38.	Yellow-rumped Warbler	**0**	±	0	**0**	±	0	**0**	±	0
39.	Townsend's Warbler	**0.04**	±	0.04	**0.88**	±	0.26	**1.38**	±	0.28
40.	Black-throated gray Warbler	**0**	±	0	**0.13**	±	0.09	**0.63**	±	0.25
41.	Yellow Warbler	**0**	±	0	**0**	±	0	**0**	±	0
42.	MacGillivray's Warbler	**0.08**	±	0.05	**0**	±	0	**0.13**	±	0.09
43.	Wilson's Warbler	**0.38**	±	0.13	**0.08**	±	0.08	**0**	±	0
44.	Common Yellowthroat	**0**	±	0	**0**	±	0	**0**	±	0
45.	Rufous-sided Towhee	**0**	±	0	**0**	±	0	**0**	±	0
46.	Song Sparrow	**0.04**	±	0.04	**0.04**	±	0.04	**0**	±	0
47.	White-crowned Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
48.	Golden-crowned Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
49.	Fox Sparrow	**0**	±	0	**0**	±	0	**0**	±	0
50.	Dark-eyed Junco	**0**	±	0	**0**	±	0	**0**	±	0
51.	Western Tanager	**0**	±	0	**0**	±	0	**0**	±	0
52.	Pine Siskin	**0**	±	0	**0**	±	0	**0**	±	0
53.	American Goldfinch	**0**	±	0	**0**	±	0	**0**	±	0
54.	Red Crossbill	**0**	±	0	**0**	±	0	**0**	±	0
55.	Purple Finch	**0**	±	0	**0**	±	0	**0**	±	0
	N of sampling stations	**12**			**12**			**12**		
	N of species detected	**15**			**14**			**15**		
	$\bar{x}$ detections/sampling station	**5.12**	±	0.66	**6.29**	±	0.45	**5.67**	±	0.36

TABLE 8: **Bird abundance in old-growth stands using the Median-all detections index.** Data are $\bar{x} \pm$ s.e. individuals/sampling station. An asterisk * denotes species confined to a single transect.

	SPECIES	Franklin River (lower transect) $\bar{x}$ ± s.e.	Franklin River (upper transect) $\bar{x}$ ± s.e.	Kennedy Lake (hypermaritime) $\bar{x}$ ± s.e.
1.	Blue Grouse *	**0** ± 0	**0** ± 0	**0** ± 0
2.	Ruffed Grouse	**0** ± 0	**0** ± 0	**0** ± 0
3.	Vaux's Swift *	**0** ± 0	**0** ± 0	**0** ± 0
4.	Rufous Hummingbird	**0** ± 0	**0** ± 0	**0.32** ± 0.10
5.	Northern Flicker	**0** ± 0	**0** ± 0	**0.09** ± 0.06
6.	Red-breasted Sapsucker	**0** ± 0	**0** ± 0	**0** ± 0
7.	Hairy Woodpecker	**0.25** ± 0.11	**0.25** ± 0.07	**0** ± 0
8.	Pileated Woodpecker *	**0** ± 0	**0** ± 0	**0** ± 0
9.	Olive-sided Flycatcher	**0** ± 0	**0** ± 0	**0** ± 0
10.	Western Wood Pewee	**0** ± 0	**0** ± 0	**0** ± 0
11.	Hammond's Flycatcher	**0** ± 0	**0.08** ± 0.08	**0** ± 0
12.	Willow Flycatcher	**0** ± 0	**0** ± 0	**0** ± 0
13.	Pacific Slope Flycatcher	**1.00** ± 0.17	**0.79** ± 0.12	**0.18** ± 0.10
14.	Tree Swallow	**0** ± 0	**0** ± 0	**0** ± 0
15.	Violet-green Swallow	**0** ± 0	**0** ± 0	**0** ± 0
16.	Barn Swallow	**0** ± 0	**0** ± 0	**0.05** ± 0.04
17.	Northern Rough-winged Swallow	**0** ± 0	**0** ± 0	**0** ± 0
18.	Steller's Jay	**0** ± 0	**0.46** ± 0.12	**0.14** ± 0.07
19.	Northwestern Crow	**0** ± 0	**0** ± 0	**0** ± 0
20.	Common Raven	**0** ± 0	**0** ± 0	**0.05** ± 0.04
21.	Chestnut-backed Chickadee	**0.75** ± 0.2	**0.54** ± 0.19	**0.14** ± 0.07
22.	Brown Creeper	**0.25** ± 0.09	**0.38** ± 0.1	**0.14** ± 0.07
23.	Red-breasted Nuthatch	**0** ± 0	**0** ± 0	**0** ± 0
24.	House Wren	**0** ± 0	**0** ± 0	**0** ± 0
25.	Winter Wren	**1.88** ± 0.13	**1.50** ± 0.12	**0.68** ± 0.12
26.	Golden-crowned Kinglet	**0.38** ± 0.12	**0.63** ± 0.16	**0.18** ± 0.10
27.	Townsend's Solitaire	**0** ± 0	**0** ± 0	**0** ± 0
28.	Swainson's Thrush	**0.04** ± 0.04	**0.21** ± 0.09	**0.18** ± 0.12
29.	Hermit Thrush	**0** ± 0	**0** ± 0	**0** ± 0
30.	Varied Thrush	**1.04** ± 0.19	**0.67** ± 0.14	**0.23** ± 0.10
31.	American Robin	**0.42** ± 0.12	**0.63** ± 0.18	**0.95** ± 0.19
32.	Cedar Waxwing	**0** ± 0	**0** ± 0	**0** ± 0
33.	European Starling	**0** ± 0	**0** ± 0	**0** ± 0
34.	Hutton's Vireo	**0.04** ± 0.04	**0.25** ± 0.07	**0** ± 0
35.	Solitary Vireo	**0** ± 0	**0** ± 0	**0** ± 0
36.	Warbling Vireo	**0** ± 0	**0** ± 0	**0** ± 0
37.	Orange-crowned Warbler	**0** ± 0	**0** ± 0	**0.36** ± 0.13
38.	Yellow-rumped Warbler	**0** ± 0	**0** ± 0	**0** ± 0
39.	Townsend's Warbler	**0** ± 0	**0** ± 0	**0** ± 0
40.	Black-throated gray Warbler	**0** ± 0	**0** ± 0	**0** ± 0
41.	Yellow Warbler	**0** ± 0	**0** ± 0	**0** ± 0
42.	MacGillivray's Warbler	**0** ± 0	**0** ± 0	**0** ± 0
43.	Wilson's Warbler	**0** ± 0	**0** ± 0	**0.09** ± 0.09
44.	Common Yellowthroat	**0** ± 0	**0** ± 0	**0** ± 0
45.	Rufous-sided Towhee	**0** ± 0	**0** ± 0	**0** ± 0
46.	Song Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
47.	White-crowned Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
48.	Golden-crowned Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
49.	Fox Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
50.	Dark-eyed Junco	**0.04** ± 0.04	**0.08** ± 0.08	**0.68** ± 0.17
51.	Western Tanager	**0** ± 0	**0** ± 0	**0.05** ± 0.04
52.	Pine Siskin	**0** ± 0	**0** ± 0	**0** ± 0
53.	American Goldfinch	**0** ± 0	**0** ± 0	**0** ± 0
54.	Red Crossbill	**0.08** ± 0.08	**0.13** ± 0.09	**0.41** ± 0.16
55.	Purple Finch	**0** ± 0	**0** ± 0	**0** ± 0
	N of sampling stations	**12**	**12**	**11**
	N of species detected	**12**	**14**	**15**
	$\bar{x}$ detections/sampling station	**6.17** ± 0.52	**6.58** ± 0.50	**4.90** ± 0.46

TABLE 8 *continued...*

	SPECIES	Kennedy Lake (Meares Island) $\bar{x}$ ± s.e.	Sproat Lake (Nahmint) $\bar{x}$ ± s.e.	Sproat Lake (Beverly) $\bar{x}$ ± s.e.
1.	Blue Grouse *	**0** ± 0	**0** ± 0	**0.04** ± 0.04
2.	Ruffed Grouse	**0** ± 0	**0** ± 0	**0** ± 0
3.	Vaux's Swift *	**0** ± 0	**0** ± 0	**0.17** ± 0.16
4.	Rufous Hummingbird	**0.08** ± 0.05	**0** ± 0	**0.04** ± 0.04
5.	Northern Flicker	**0** ± 0	**0** ± 0	**0** ± 0
6.	Red-breasted Sapsucker	**0** ± 0	**0.21** ± 0.11	**0.25** ± 0.11
7.	Hairy Woodpecker	**0.04** ± 0.04	**0** ± 0	**0.04** ± 0.04
8.	Pileated Woodpecker *	**0** ± 0	**0** ± 0	**0.08** ± 0.05
9.	Olive-sided Flycatcher	**0** ± 0	**0.04** ± 0.04	**0.04** ± 0.04
10.	Western Wood Pewee	**0** ± 0	**0** ± 0	**0** ± 0
11.	Hammond's Flycatcher	**0** ± 0	**0.58** ± 0.14	**0.67** ± 0.16
12.	Willow Flycatcher	**0** ± 0	**0** ± 0	**0** ± 0
13.	Pacific Slope Flycatcher	**0.83** ± 0.17	**0.67** ± 0.15	**1.21** ± 0.12
14.	Tree Swallow	**0** ± 0	**0** ± 0	**0** ± 0
15.	Violet-green Swallow	**0** ± 0	**0** ± 0	**0** ± 0
16.	Barn Swallow	**0** ± 0	**0** ± 0	**0** ± 0
17.	Northern Rough-winged Swallow	**0** ± 0	**0** ± 0	**0** ± 0
18.	Steller's Jay	**0** ± 0	**0** ± 0	**0.08** ± 0.08
19.	Northwestern Crow	**0.08** ± 0.05	**0** ± 0	**0** ± 0
20.	Common Raven	**0** ± 0	**0** ± 0	**0** ± 0
21.	Chestnut-backed Chickadee	**0.33** ± 0.14	**0.67** ± 0.25	**1.21** ± 0.17
22.	Brown Creeper	**0.21** ± 0.07	**0** ± 0	**0** ± 0
23.	Red-breasted Nuthatch	**0** ± 0	**0.25** ± 0.14	**0.17** ± 0.09
24.	House Wren	**0** ± 0	**0** ± 0	**0** ± 0
25.	Winter Wren	**1.38** ± 0.13	**1.29** ± 0.14	**0.58** ± 0.10
26.	Golden-crowned Kinglet	**0.29** ± 0.14	**0.50** ± 0.19	**0.46** ± 0.18
27.	Townsend's Solitaire	**0** ± 0	**0** ± 0	**0** ± 0
28.	Swainson's Thrush	**0.29** ± 0.11	**0.33** ± 0.12	**0.58** ± 0.18
29.	Hermit Thrush	**0** ± 0	**0** ± 0	**0** ± 0
30.	Varied Thrush	**0.67** ± 0.16	**0.88** ± 0.18	**0.25** ± 0.17
31.	American Robin	**0.46** ± 0.17	**0.50** ± 0.13	**0.08** ± 0.08
32.	Cedar Waxwing	**0** ± 0	**0** ± 0	**0** ± 0
33.	European Starling	**0** ± 0	**0** ± 0	**0** ± 0
34.	Hutton's Vireo	**0** ± 0	**0** ± 0	**0.42** ± 0.12
35.	Solitary Vireo	**0** ± 0	**0** ± 0	**0** ± 0
36.	Warbling Vireo	**0** ± 0	**0** ± 0	**0** ± 0
37.	Orange-crowned Warbler	**0.04** ± 0.04	**0** ± 0	**0.04** ± 0.04
38.	Yellow-rumped Warbler	**0** ± 0	**0** ± 0	**0** ± 0
39.	Townsend's Warbler	**0.25** ± 0.11	**0.13** ± 0.09	**0** ± 0
40.	Black-throated gray Warbler	**0** ± 0	**0** ± 0	**0** ± 0
41.	Yellow Warbler	**0** ± 0	**0** ± 0	**0** ± 0
42.	MacGillivray's Warbler	**0** ± 0	**0** ± 0	**0** ± 0
43.	Wilson's Warbler	**0** ± 0	**0** ± 0	**0.04** ± 0.04
44.	Common Yellowthroat	**0** ± 0	**0** ± 0	**0** ± 0
45.	Rufous-sided Towhee	**0** ± 0	**0** ± 0	**0** ± 0
46.	Song Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
47.	White-crowned Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
48.	Golden-crowned Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
49.	Fox Sparrow	**0** ± 0	**0** ± 0	**0** ± 0
50.	Dark-eyed Junco	**0** ± 0	**0** ± 0	**0.08** ± 0.05
51.	Western Tanager	**0** ± 0	**0.04** ± 0.04	**0.04** ± 0.04
52.	Pine Siskin	**0** ± 0	**0** ± 0	**0** ± 0
53.	American Goldfinch	**0** ± 0	**0** ± 0	**0** ± 0
54.	Red Crossbill	**0.13** ± 0.09	**0.25** ± 0.24	**0** ± 0
55.	Purple Finch	**0** ± 0	**0** ± 0	**0** ± 0
	N of sampling stations	**12**	**12**	**11**
	N of species detected	**14**	**14**	**22**
	$\bar{x}$ detections/sampling station	**5.08** ± 0.42	**6.33** ± 0.67	**6.58** ± 0.68

COMMUNITY ANALYSIS

Diversity, species richness and bird abundance

Species diversity peaked in different age-classes in the 3 areas surveyed (Table 9). At Franklin River, Shannon-Weiner diversity (H') was lowest in the two old-growth stands (1 98), and highest in the 30-35 year-old stand (2.23). At Kennedy Lake, diversity was lowest in the 15-20 year-old stand (2.08), and highest in the two old-growth stands (2.52). At Sproat Lake, H' was lowest in the clearcut (1.87) and highest in the 30-35 year-old stand (2.46).

At Franklin River and Sproat Lake, the highest species richness ($\bar{x}$ n of species/sampling station) and bird abundance ($\bar{x}$ n of individuals/sampling station) was found in old-growth and 30-35 year-old forests (Figures 17 and 18). In general, clearcuts supported fewer species and individuals; this was particularly pronounced at the higher elevation Sproat Lake site. In both study areas, richness and abundance peaked in 30-35 year-old stands, dipped slightly in 50-60 year-old stands, and peaked again in old-growth forests. Kennedy Lake transects were unusual in this regard, showing relatively low richness and abundance in both the "hypermaritime" cedar and Meares Island old-growth forests, together with relatively high diversity and abundance in the clearcut and 15-20 year-old stands.

Overall, clearcuts were the most variable in term of species richness (range of 3.8 to 7.0 species/station), and 30-35 year-old stands were the least variable (6.1 to 6.9 species/station). This pattern also held true for abundance. Again, clearcuts were most variable (range of 3.41 to 6.41 birds/station) and 30-35 year-old stands were least variable (5.91 to 6.62 birds/station).

Using both richness and abundance data, two-factor ANOVA found significant differences among the 5 forest age-classes, but not among the 3 study areas (Table 9). For each study area, differences among age-classes were explored using multiple range tests upon species richness (Table 10) and abundance (Table 11) in order to identify significant between-transect differences. At Franklin River, the upper Klanawa old-growth transect was found to be significantly different from all other transects in richness, but not in abundance. At Kennedy Lake, no significant differences were found between any age-classes for either richness or abundance. At Sproat Lake, the clearcut and 15-20 year-old stands were found to be significantly different from all older forests in both richness and abundance.

Community overlap

Horn's similarity coefficient is an index of community "overlap" between two sites ranging from 0 (no overlap) to 1.0 (complete overlap: Horn 1966). This statistic was calculated for each of the $n(n-1)*0.5=153$ possible transect combinations (Appendix XI). Overall, there was little overlap between clearcuts and old-growth bird communities (R_O values from 0.11 to 0.48). As expected, forests develop increasing similarity to old-growth stands as they grow older (Figure 19).

Table 9: **Bird species richness, diversity and abundance at study transects.**

Age	Transect	$\bar{x}$ ±s.e. *n* of species /station	$\bar{x}$ ±s.e. abundance /station	Diversity Shannon-Weiner *H'*	Dominance Simpson's *C*	Total species detected
5-10	Franklin	5.25 ±0.39	4.86 ±0.54	2.12	0.86	12
	Kennedy	7.00 ±0.48	6.41 ±0.44	2.30	0.88	18
	Sproat	3.75 ±0.46	3.41 ±0.44	1.87	0.81	9
15-20	Franklin	4.75 ±0.46	4.29 ±0.47	2.08	0.82	14
	Kennedy	6.17 ±0.49	6.71 ±0.51	2.08	0.83	15
	Sproat	4.83 ±0.37	4.08 ±0.41	1.98	0.84	9
30-35	Franklin	6.08 ±0.45	5.91 ±0.48	2.23	0.88	12
	Kennedy	6.33 ±0.51	6.46 ±0.81	2.29	0.87	15
	Sproat	6.91 ±0.54	6.62 ±0.62	2.46	0.89	19
50-60	Franklin	4.83 ±0.44	5.12 ±0.66	2.13	0.85	15
	Kennedy	6.25 ±0.43	6.29 ±0.45	2.21	0.86	14
	Sproat	6.17 ±0.30	5.67 ±0.36	2.18	0.85	15
>200	Franklin	5.67 ±0.38	6.17 ±0.52	1.98	0.82	12
	Kennedy	6.27 ±0.59	4.90 ±0.46	2.52	0.90	18
	Sproat	6.00 ±0.54	6.33 ±0.67	2.35	0.89	14
>200	Franklin	7.33 ±0.48	6.58 ±0.50	1.98	0.82	14
	Kennedy	5.50 ±0.38	5.08 ±0.42	2.52	0.90	14
	Sproat	7.00 ±0.61	6.58 ±0.68	2.35	0.89	22

Results of two-factor ANOVA:

Note: Two-factor ANOVA with replication requires equal sample sizes (Sokol and Rohlf 1981). To equalize sample sizes among transects, one sampling station was randomly excluded from those transects where *n*=12.

	Number of species/station	Abundance of birds/station	num/denom. df.
Between study areas *F*=	**2.98**	**3.00**	2/180
Between age-classes *F*=	**3.35** *	**2.94** *	5/180
Interaction (area and age-class) *F*=	**4.20** **	**4.31** **	10/180

* significant at $p<0.05$
** significant at $p<0.01$

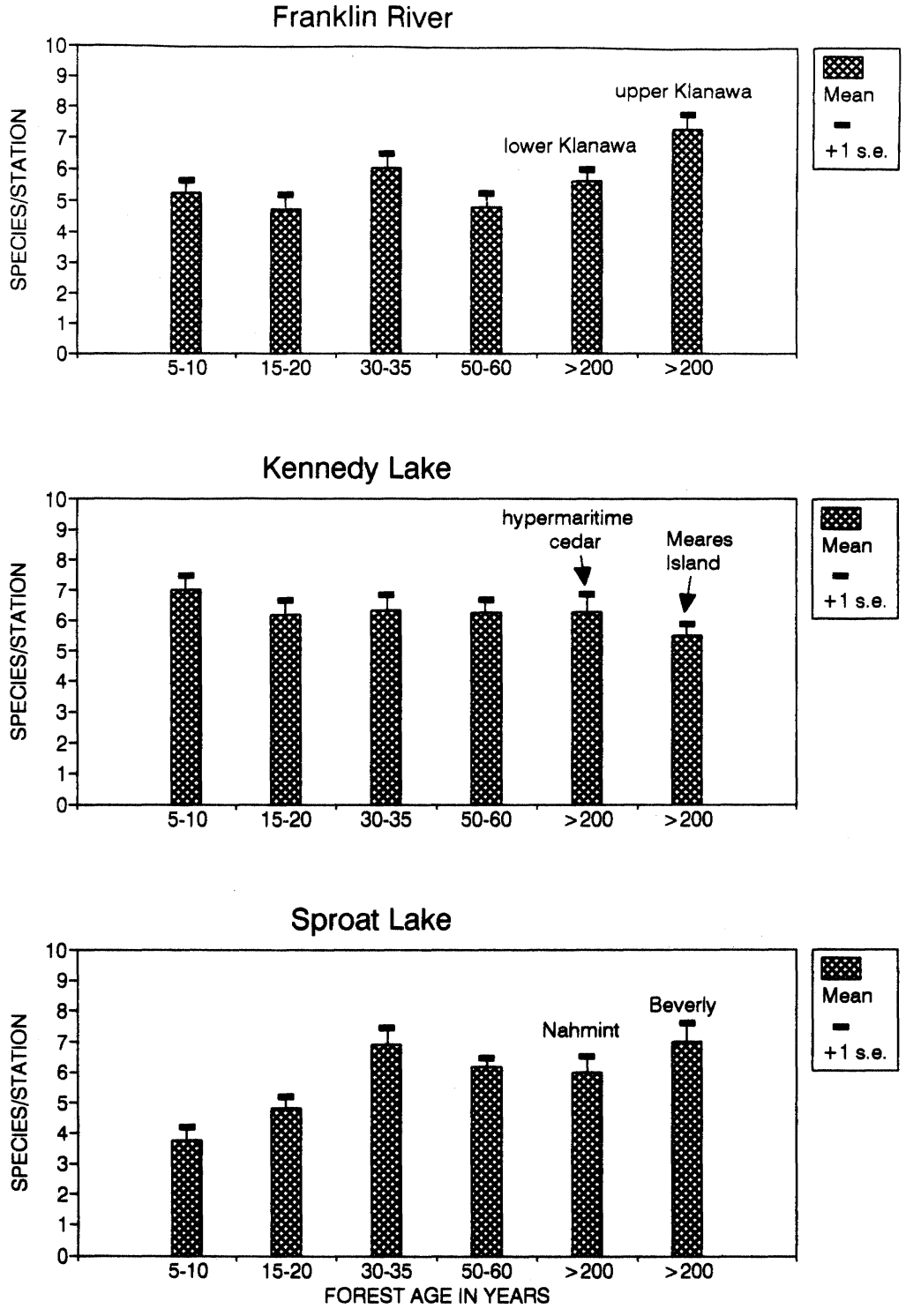

Figure 17: Bird species richness by age-class.

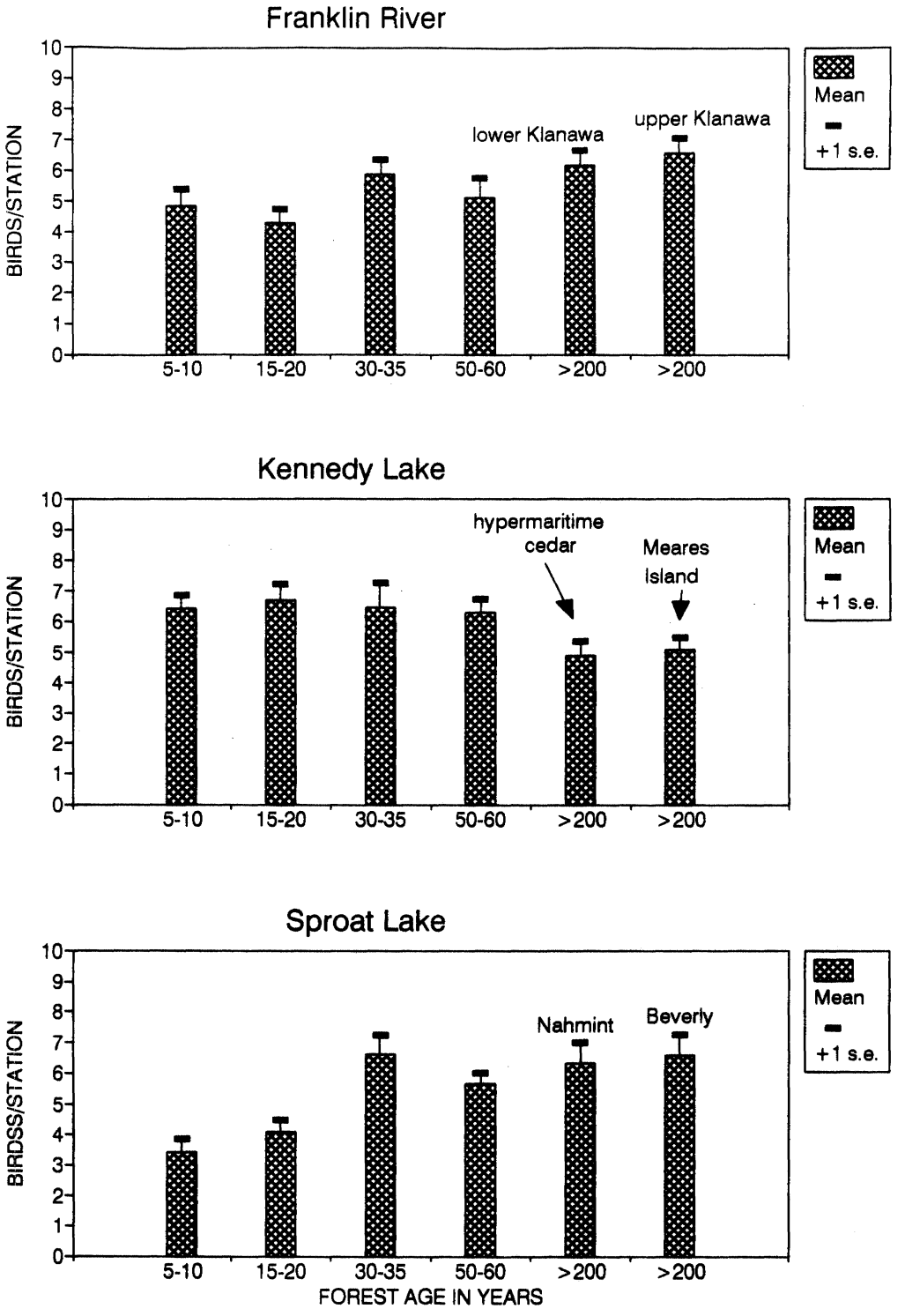

Figure 18: Bird abundance by age-class.

Table 10: Within-area pairwise comparisons of $\bar{x}$ bird diversity/sampling station.
Critical values for the Newman-Kuels Multiple Range test are from Zar (1974).

#	Transect A	Transect B	$\bar{x}_A - \bar{x}_B$	SE	q	p	$q_{critical}$	Significance
Franklin River (results of single-factor ANOVA: F=4.905 with 5/66 df, p<0.01)								
1.	Upper old-growth	15-20 year-old	2.58	0.44	5.93	6	4.096	p<0.01
2.	Upper old-growth	50-60 year-old	2.50	0.44	5.74	5	3.917	p<0.01
3.	Upper old-growth	Clearcut	2.08	0.44	4.78	4	3.685	p<0.01
4.	Upper old-growth	Lower old-growth	1.67	0.44	3.82	3	3.356	p<0.05
5.	Upper old-growth	30-35 year-old	1.25	0.44	2.87	2	2.800	p<0.05
6.	30-35 year-old	15-20 year-old	1.33	0.44	3.06	5	3.917	*ns*
7.	30-35 year-old	50-60 year-old	1.25	0.44	2.87	4	3.685	*ns*
8.	30-35 year-old	Clearcut	0.83	0.44	1.91	3	3.356	*ns*
9.	30-35 year-old	Lower old-growth	0.42	0.44	0.96	2	2.800	*ns*
10.	Lower old-growth	15-20 year-old	0.92	0.44	2.10	4	3.685	*ns*
11.	Lower old-growth	50-60 year-old	0.83	0.44	1.91	3	3.356	*ns*
12.	Lower old-growth	Clearcut	0.42	0.44	0.96	2	2.800	*ns*
13.	Clearcut	15-20 year-old	0.50	0.44	1.15	3	3.356	*ns*
14.	Clearcut	50-60 year-old	0.42	0.44	0.96	2	2.800	*ns*
15.	50-60	15-20 year-old	0.08	0.44	0.19	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} = \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} \neq \mu_{old2}$								
Kennedy Lake (results of single-factor ANOVA: F=0.9998 with 5/65 df, p>0.05)								
1.	Clearcut	Meares old-growth	1.50	0.48	3.14	6	4.096	*ns*
2.	Clearcut	15-20 year-old	0.83	0.48	1.75	5	3.917	*ns*
3.	Clearcut	50-60 year-old	0.75	0.48	1.57	4	3.685	*ns*
4.	Clearcut	Hypermaritime old	0.73	0.49	1.49	3	3.356	*ns*
5.	Clearcut	30-35 year-old	0.67	0.48	1.40	2	2.800	*ns*
6.	30-35 year-old	Meares old-growth	0.83	0.48	1.75	5	3.917	*ns*
7.	30-35 year-old	15-20 year-old	0.17	0.48	0.35	4	3.685	*ns*
8.	30-35 year-old	50-60 year-old	0.08	0.48	0.17	3	3.356	*ns*
9.	30-35 year-old	Hypermaritime old	0.06	0.49	0.12	2	2.800	*ns*
10.	Hypermaritime old	Meares old-growth	0.77	0.49	1.58	4	3.685	*ns*
11.	Hypermaritime old	15-20 year-old	0.11	0.49	0.22	3	3.356	*ns*
12.	Hypermaritime old	50-60 year-old	0.02	0.49	0.05	2	2.800	*ns*
13.	50-60 year-old	Meares old-growth	0.75	0.48	1.57	3	3.356	*ns*
14.	50-60 year-old	15-20 year-old	0.08	0.48	0.17	2	2.800	*ns*
15.	15-20 year-old	Meares old-growth	0.67	0.48	1.40	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} = \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} = \mu_{old2}$								
Sproat Lake (results of single-factor ANOVA: F=6.8643 with 5/66 df, p<0.01)								
1.	Beverly old-growth	Clearcut	3.25	0.48	6.73	6	4.096	p<0.01
2.	Beverly old-growth	15-20 year-old	2.17	0.48	4.49	5	3.917	p<0.05
3.	Beverly old-growth	Nahmint old-growth	1.00	0.48	2.07	4	3.685	*ns*
4.	Beverly old-growth	50-60 year-old	0.83	0.48	1.73	3	3.356	*ns*
5.	Beverly old-growth	30-35 year-old	0.08	0.48	0.17	2	2.800	*ns*
6.	30-35 year-old	Clearcut	3.17	0.48	6.56	5	3.917	p<0.01
7.	30-35 year-old	15-20 year-old	2.08	0.48	4.32	4	3.685	p<0.05
8.	30-35 year-old	Nahmint old-growth	0.92	0.48	1.90	3	3.356	*ns*
9.	30-35 year-old	50-60 year-old	0.75	0.48	1.55	2	2.800	*ns*
10.	50-60 year-old	Clearcut	2.42	0.48	5.01	4	3.685	p<0.01
11.	50-60 year-old	15-20 year-old	1.33	0.48	2.76	3	3.356	*ns*
12.	50-60 year-old	Nahmint old-growth	0.17	0.48	0.35	2	2.800	*ns*
13.	Nahmint old-growth	Clearcut	2.25	0.48	4.66	3	3.356	p<0.01
14.	Nahmint old-growth	15-20 year-old	1.17	0.48	2.42	2	2.800	*ns*
15.	15-20 year-old	Clearcut	1.08	0.48	2.24	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} \neq \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} = \mu_{old2}$								

Table 11: Within-area pairwise comparisons of $\bar{x}$ bird abundance/sampling station. Critical values for the Newman-Kuels Multiple Range test are from Zar (1974).

#	Transect A	Transect B	$\bar{x}_A - \bar{x}_B$	SE	q	p	$q_{critical}$	Significance
Franklin River (results of single-factor ANOVA: F=2.665 with 5/66 df, p>0.05)								
1.	Upper old-growth	15-20 year-old	2.29	0.53	4.30	6	4.096	p<0.05
2.	Upper old-growth	Clearcut	1.71	0.53	3.21	5	3.917	*ns*
3.	Upper old-growth	50-60 year-old	1.46	0.53	2.74	4	3.685	*ns*
4.	Upper old-growth	30-25 year-old	0.67	0.53	1.25	3	3.356	*ns*
5.	Upper old-growth	Lower old-growth	0.42	0.53	0.78	2	2.800	*ns*
6.	Lower old-growth	15-20 year-old	1.88	0.53	3.52	5	3.917	*ns*
7.	Lower old-growth	Clearcut	1.29	0.53	2.42	4	3.685	*ns*
8.	Lower old-growth	50-60 year-old	1.04	0.53	1.96	3	3.356	*ns*
9.	Lower old-growth	30-25 year-old	0.25	0.53	0.47	2	2.800	*ns*
10.	30-35 year-old	15-20 year-old	1.63	0.53	3.05	4	3.685	*ns*
11.	30-35 year-old	Clearcut	1.04	0.53	1.96	3	3.356	*ns*
12.	30-35 year-old	50-60 year-old	0.79	0.53	1.49	2	2.800	*ns*
13.	50-60 year-old	15-20 year-old	0.83	0.53	1.56	3	3.356	*ns*
14.	50-60 year-old	Clearcut	0.25	0.53	0.47	2	2.800	*ns*
15.	Clearcut	15-20 year-old	0.58	0.53	1.09	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} = \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} \neq \mu_{old2}$								
Kennedy Lake (results of single-factor ANOVA: F=2.063 with 5/65 df, p>0.05)								
1.	15-20 year-old	Hypermaritime old	1.80	0.54	3.32	6	4.096	*ns*
2.	15-20 year-old	Meares old-growth	1.63	0.53	3.06	5	3.917	*ns*
3.	15-20 year-old	50-60 year-old	0.42	0.53	0.79	4	3.685	*ns*
4.	15-20 year-old	Clearcut	0.29	0.53	0.55	3	3.356	*ns*
5.	15-20 year-old	30-35 year-old	0.25	0.53	0.47	2	2.800	*ns*
6.	30-35 year-old	Hypermaritime old	1.55	0.54	2.86	5	3.917	*ns*
7.	30-35 year-old	Meares old-growth	1.38	0.53	2.59	4	3.685	*ns*
8.	30-35 year-old	50-60 year-old	0.17	0.53	0.31	3	3.356	*ns*
9.	30-35 year-old	Clearcut	0.04	0.53	0.08	2	2.800	*ns*
10.	Clearcut	Hypermaritime old	1.51	0.54	2.78	4	3.685	*ns*
11.	Clearcut	Meares old-growth	1.33	0.53	2.51	3	3.356	*ns*
12.	Clearcut	50-60 year-old	0.13	0.53	0.24	2	2.800	*ns*
13.	50-60 year-old	Hypermaritime old	1.38	0.54	2.55	3	3.356	*ns*
14.	50-60 year-old	Meares old-growth	1.21	0.53	2.28	2	2.800	*ns*
15.	Meares old-growth	Hypermaritime old	0.17	0.54	0.31	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} = \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} = \mu_{old2}$								
Sproat Lake (results of single-factor ANOVA: F=6.3285 with 5/66 df, p<0.01)								
1.	30-35 year-old	Clearcut	3.21	0.55	5.86	6	4.096	p<0.01
2.	30-35 year-old	15-20 year-old	2.54	0.55	4.64	5	3.917	p<0.05
3.	30-35 year-old	50-60 year-old	0.96	0.55	1.75	4	3.685	*ns*
4.	30-35 year-old	Nahmint old-growth	0.29	0.55	0.53	3	3.356	*ns*
5.	30-35 year-old	Beverly old-growth	0.04	0.55	0.08	2	2.800	*ns*
6.	Beverly old-growth	Clearcut	3.17	0.55	5.78	5	3.917	p<0.01
7.	Beverly old-growth	15-20 year-old	2.50	0.55	4.56	4	3.685	p<0.05
8.	Beverly old-growth	50-60 year-old	0.92	0.55	1.67	3	3.356	*ns*
9.	Beverly old-growth	Nahmint old-growth	0.25	0.55	0.46	2	2.800	*ns*
10.	Nahmint old-growth	Clearcut	2.92	0.55	5.32	4	3.685	p<0.01
11.	Nahmint old-growth	15-20 year-old	2.25	0.55	4.11	3	3.356	p<0.05
12.	Nahmint old-growth	50-60 year-old	0.67	0.55	1.22	2	2.800	*ns*
13.	50-60 year-old	Clearcut	2.25	0.55	4.11	3	3.356	p<0.05
14.	50-60 year-old	15-20 year-old	1.58	0.55	2.89	2	2.800	*ns*
15.	15-20 year-old	Clearcut	0.68	0.55	1.22	2	2.800	*ns*
Overall conclusion: $\mu_{clearcut} = \mu_{15\text{-}20} \neq \mu_{30\text{-}35} = \mu_{50\text{-}60} = \mu_{old1} = \mu_{old2}$								

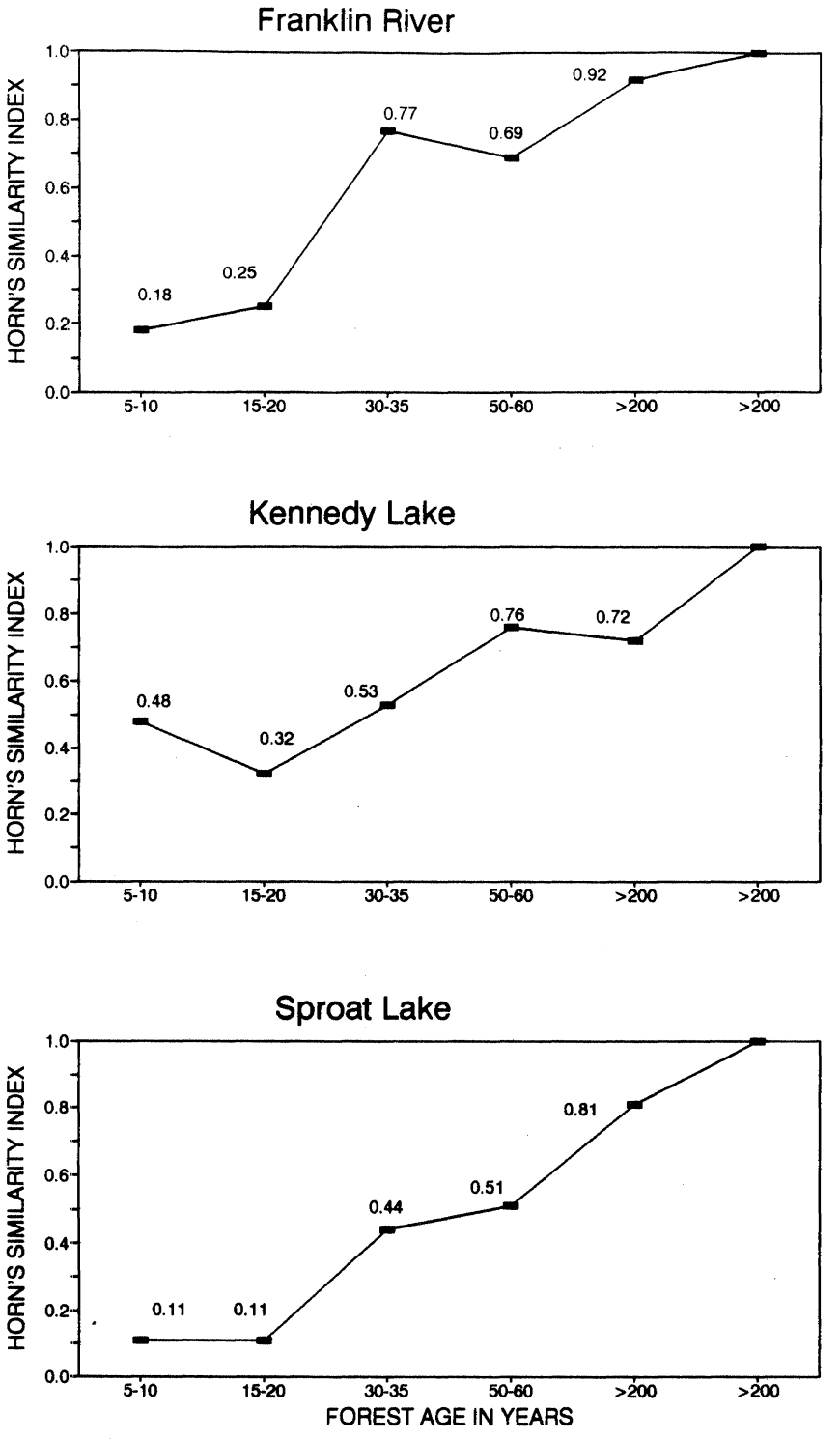

Figure 19: Avian community overlap between regenerating and old-growth forests.

The "hypermaritime" cedar forest at Kennedy Lake showed moderate overlap with Meares Island old-growth (R_O=0.72); indeed, it showed less overlap than did the 50-60 year-old stand (R_O=0.76). The Douglas-fir-dominated old-growth at Sproat Lake showed moderate overlap with the nearby cedar-hemlock-fir old-growth (R_O=0.81). Overlap between the clearcut and old-growth stands at Kennedy Lake is also interesting (R_O=0.48); most of the resemblance appears to have been caused by persistence of Pacific Slope Flycatchers and Swainson's Thrushes in the clearcut, together with absence of Steller's Jay and Red Crossbill from the "hypermaritime" transect and Meares Island. Finally, the Sproat Lake 50-60 year-old stand, although containing some old-growth vegetation characteristics, showed comparatively low overlap with old-growth stands in the same area (R_O=0.51).

There was considerable variation between the three study regions (Figure 20). Some transects showed greater overlap with younger or older stands than they did with the same age-class forest in a different area (R_O values from 0.52 to 0.88). Even clearcuts showed substantial differences among areas (R_O values from 0.52 to 0.77). Despite age or vegetation similarities, bird community data reveal that one forest stand is not necessarily ecologically equivalent to another.

Relative abundance of migrants and residents

Bird communities in regenerating forests are mostly comprised of species which migrate out of Canada during winter (hummingbirds, flycatchers, wood warblers, sparrows: Figure 21). In contrast, old-growth bird communities are mostly comprised of resident species (woodpeckers, jays, chickadees, creepers, nuthatches and kinglets). Although some "residents" probably migrate altitudinally between winter and summer territories, old-growth and managed forest bird communities differ dramatically in this respect.

Relative abundance of ground, tree and cavity-nesting species

Ground and shrub-nesting species (grouse, hummingbirds, Orange-crowned Warbler, sparrows) account for the majority of birds detected in clearcuts and 15-20 year-old forests (Figure 22). Tree-nesting species (flycatchers, wood warblers) predominate in 30-35 and 50-60 year-old stands. In old-growth forests, cavity-nesting species (woodpeckers, chickadees, creepers and nuthatches) comprise a substantial fraction of the overall avifauna, while ground and shrub-nesting species are present only in small numbers.

Relationships between habitat and bird communities

Relatively few of the habitat variables were significantly correlated with bird community indices, and most correlations were weak (Table 12). Species richness was inversely related to site elevation, as was bird abundance. The amount of canopy closure was the best predictor of the number of birds at each station. Similarly, bird species diversity was correlated with canopy closure. The total number of species observed was most strongly associated with stand basal area, but was also positively correlated with crown height, snag density, woody debris and distance-to-coast.

Bird communities result from individual species responding to site-specific habitat

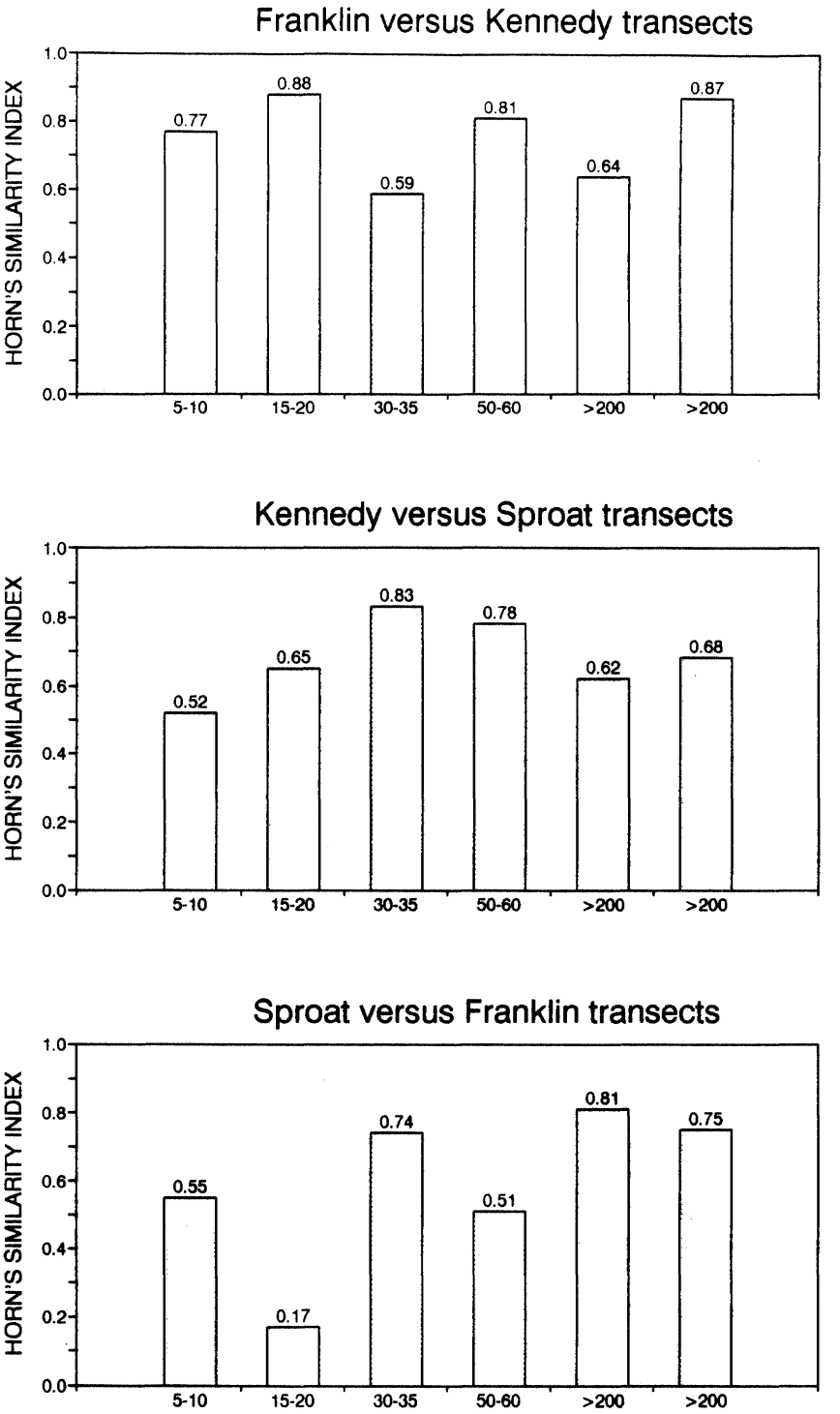

Figure 20: Avian community overlap between similar-age forests in different study areas.

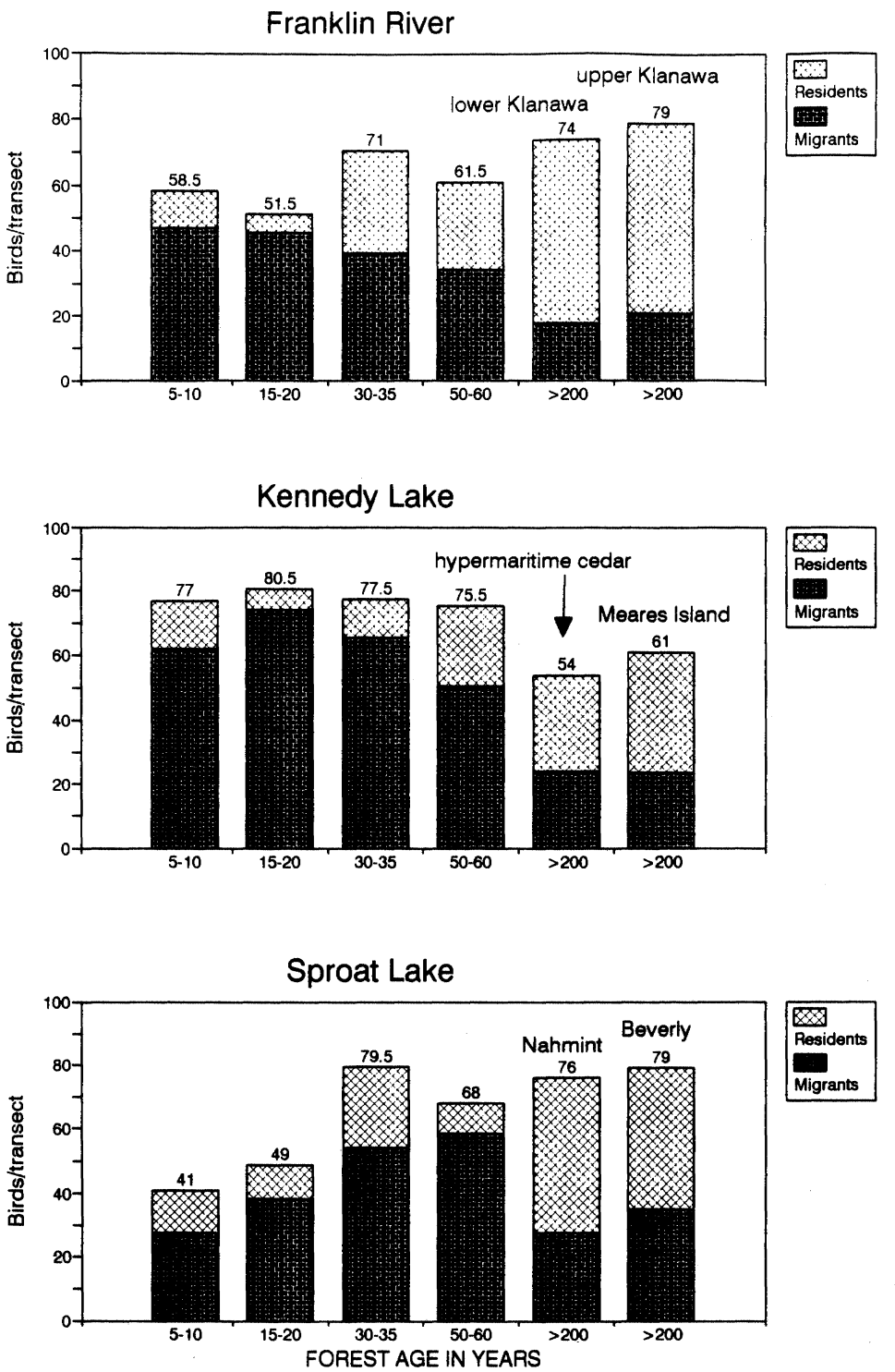

Figure 21: Relative abundance of resident and migratory species.

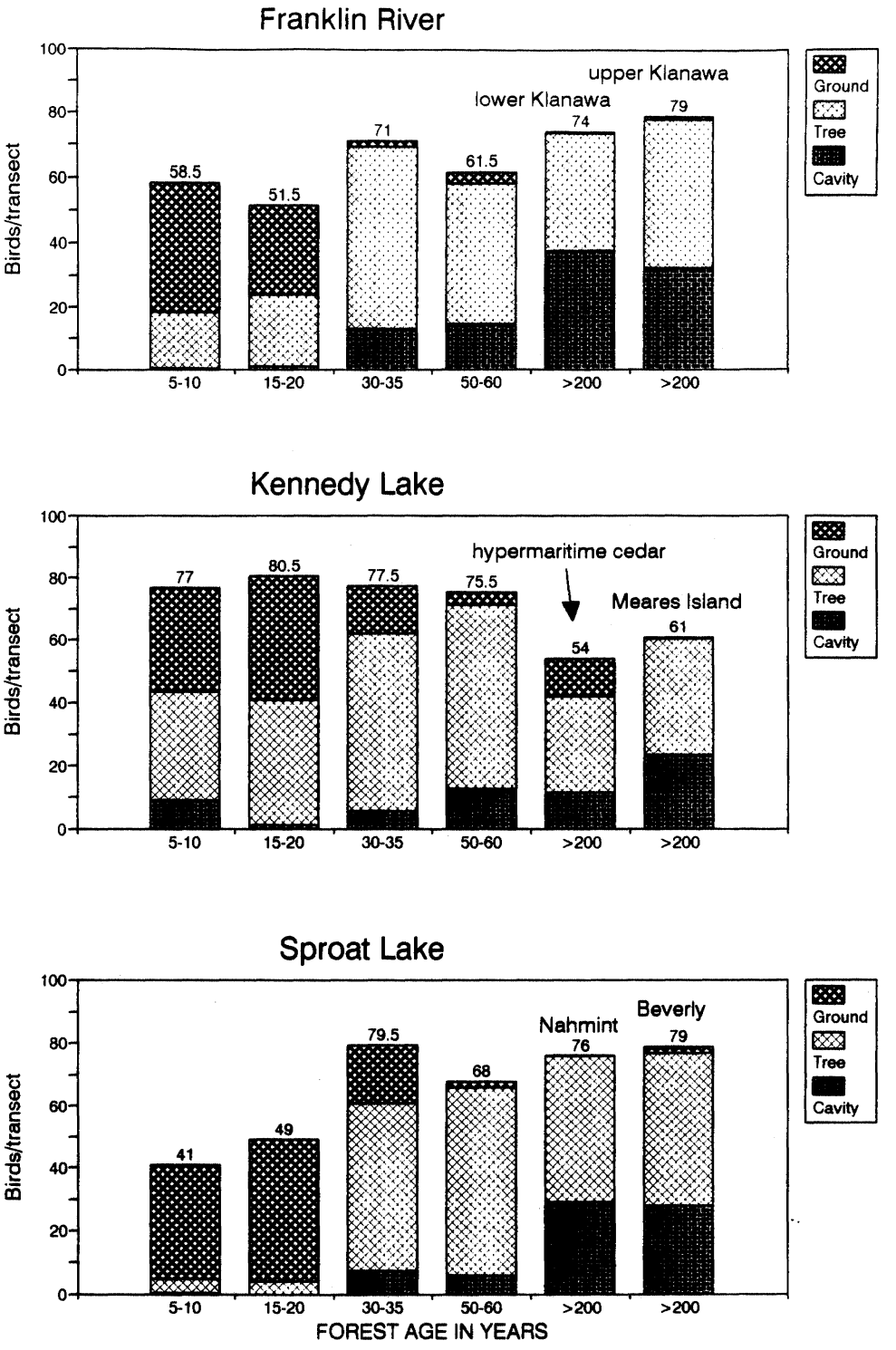

Figure 22: Relative abundance of ground, tree and cavity-nesting species.

TABLE 12: Correlation of bird community indices with habitat variables. Values in bold type indicate a significant correlation at the $p<0.05$ (*) and $p<0.01$ (**) levels.

	COMMUNITY INDEX				
VARIABLE	$\bar{x}$ species /station	$\bar{x}$ birds /station	Diversity *H'*	Dominance *C*	Cumulative spp./transect
Elevation [1]	**-0.49***	**-0.49***	-0.32	-0.16	0.06
Distance to coast [2]	0.23	0.32	0.06	0.18	**0.81****
Basal area [3]	0.40	0.36	0.29	0.25	**0.83****
Tree density [4]	-0.08	-0.02	-0.27	-0.19	-0.44
Snag density [5]	0.35	0.27	0.41	0.34	**0.64****
Crown height [6]	0.35	0.31	0.30	-0.25	**0.81****
Canopy closure [7]	**0.44***	**0.50***	**0.47***	**0.44***	**0.48***
Woody debris [8]	0.12	0.13	-0.38	-0.06	**0.72****

NOTES:

[1] Elevation (metres).

[2] Distance to coast (kilometres).

[3] Basal area (sq. metres/hectare).

[4] Tree density (stems/hectare).

[5] Snag density (stems/hectare).

[6] Canopy height (metres).

[7] Canopy closure (% data were arcsine-transformed).

[8] Woody debris (pieces/100 metres).

Critical *r* values with n=18 observations: p<0.05 0.444

p<0.01 0.561

conditions. Data suggest that some species can be described as "early-successional" (Orange-crowned Warbler, Song Sparrow, Dark-eyed Junco; Figure 23), "mid-successional" (Swainson's Thrush, Townsend's Warbler, Wilson's Warbler; Figure 24) or "late-successional" (Pacific Slope Flycatcher, Brown Creeper, Varied Thrush; Figure 25).

Results of χ^2 tests using detection/non-detection frequencies indicate that 16 species were significantly more likely to be encountered in some forest age-classes (Table 13). Correlation analysis revealed several significant trends among these species (Table 14). MacGillivray's Warblers and Dark-eyed Juncos were positively (but weakly) correlated with elevation. Pacific Slope Flycatchers and Chestnut-backed Chickadees were positively associated with distance-to-the-coast. Five species (Pacific Slope Flycatcher, Chestnut-backed Chickadee, Winter Wren, Golden-crowned Kinglet and Varied Thrush) were positively associated with increasing basal area, and 4 others (Rufous Hummingbird, Orange-crowned Warbler, MacGillivray's Warbler and Song Sparrow) showed significant negative correlations with basal area. In general, these species showed similar (but reversed) correlations with tree density and crown height, an expected result given higher tree densities and smaller trees in clearcuts and young regenerating forests.

SPECIES ACCOUNTS

Grouse, swifts and hummingbirds

1. Blue Grouse

Blue Grouse were detected in all age-classes, but were most numerous in clearcuts and 15-20 year-old stands. Virtually all birds detected were males. Declining numbers of detections between May and June surveys reflect early breeding (50% of recorded clutches between 21 May and 12 June: Campbell *et al.* 1990). The Maximum-all-detections index is probably a better estimate of true breeding density. Based on that measure, relative abundance varied between areas from 0.17 to 1.0 detections/station in clearcuts, and from 0.33 to 0.92 detections/station in 15-20 year-old stands.

2. Ruffed Grouse

Ruffed Grouse were detected occasionally in 30-35 and 50-60 year-old stands, and were most numerous at Franklin River. All birds detected were males. As with Blue Grouse, this species is an early breeder (53% of clutches recorded between 13 and 27 May: Campbell *et al.* 1990) and Maximum-all detections data are probably a better estimate of breeding density. The only regular detections occurred at Franklin River in a 30-35 year-old stand.

3. Vaux's Swift

Vaux's Swifts were detected infrequently in old-growth, rarely in 50-60 year-old stands (Kennedy and Sproat) and once in 15-20 year-old forest (Sproat). Foraging birds are highly vocal and detectable from a great distance, particularly in open habitats. Invariably, we detected small flocks of birds rather than solitary individuals. Birds were consistently

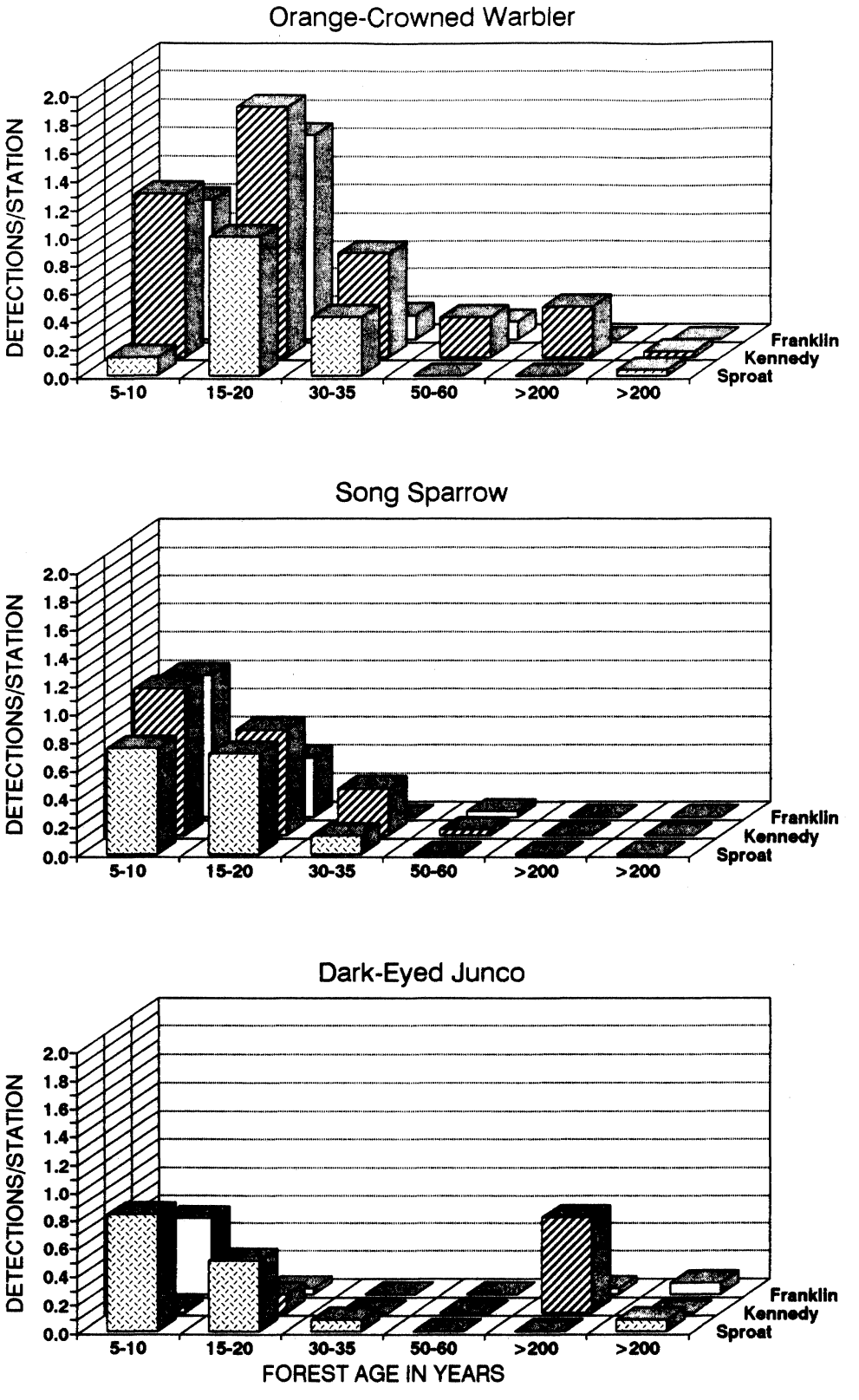

Figure 23: Three early-successional species.

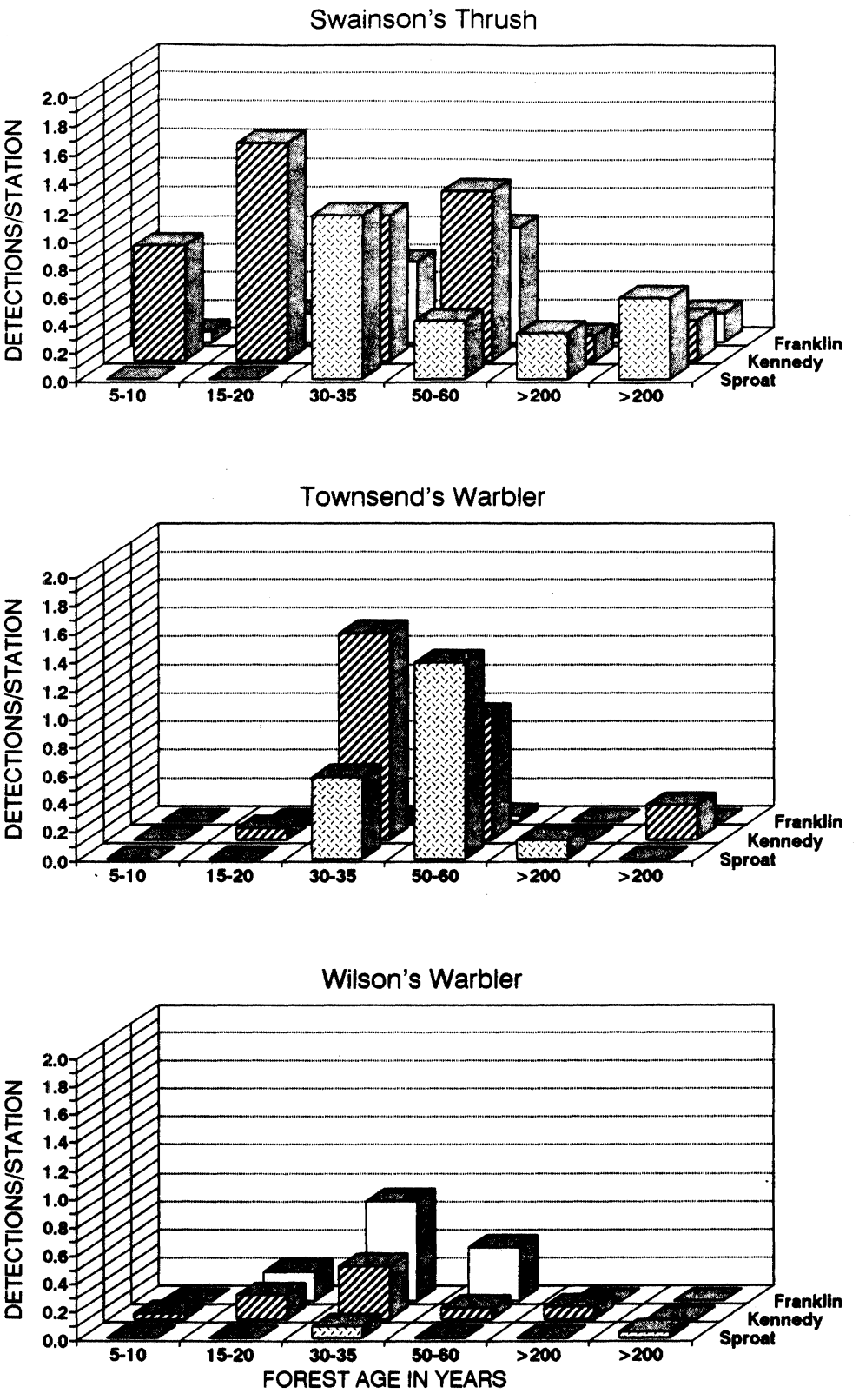

Figure 24: Three mid-successional species.

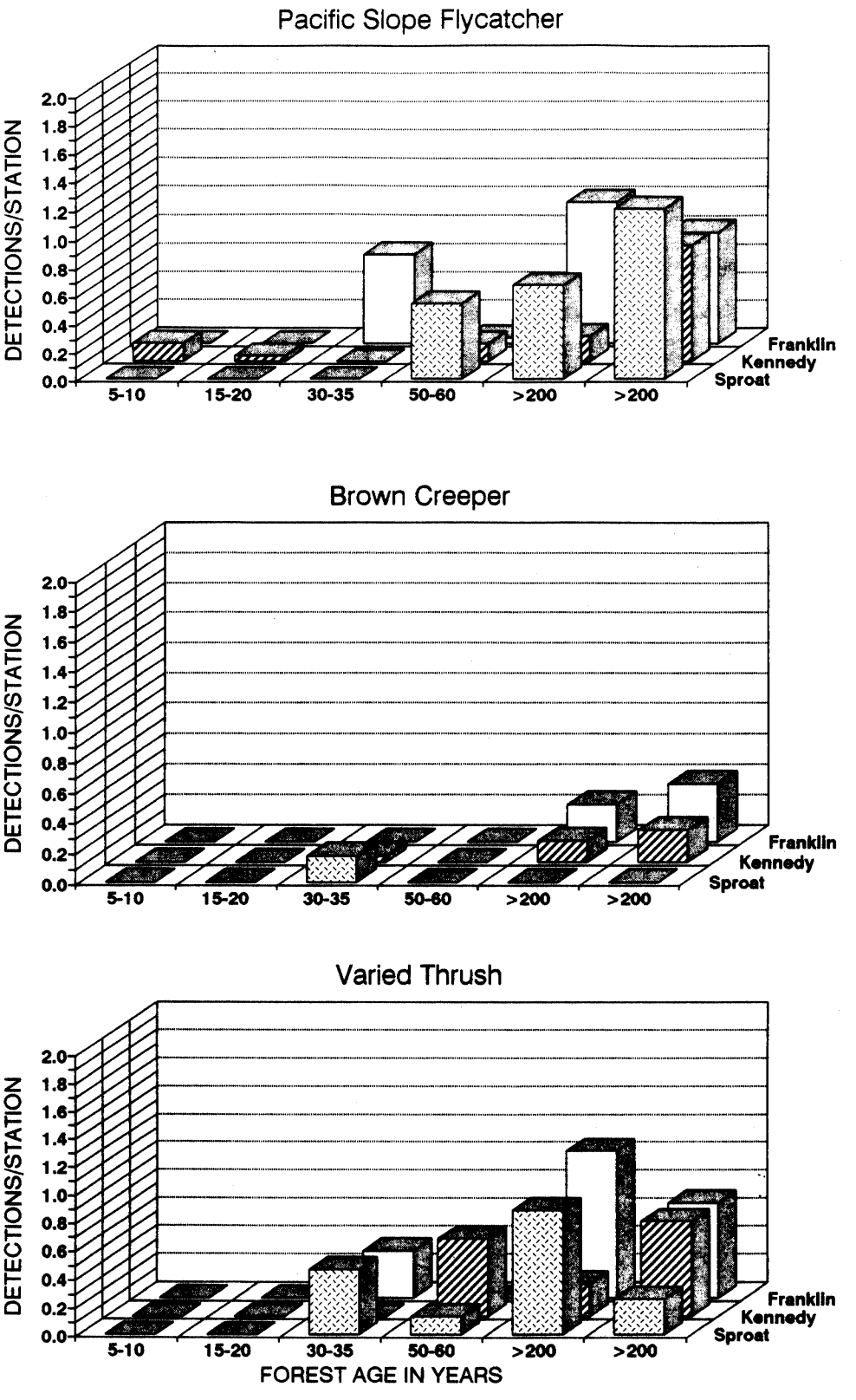

Figure 25: Three late-successional species.

TABLE 13: χ^2 **test of equal frequency of occurrence across age-classes.** Data are number of stations at which individual species were detected using the Median-all detections index. Species for which expected frequencies <5 were not tested.

		AGE-CLASS and *n* of stations where detected						
	SPECIES	5-10	15-20	30-35	50-60	>200	χ^2	*P*
1	Blue Grouse	6	7	-	1	1		
2	Ruffed Grouse	-	-	-	1	-		
3	Vaux's Swift	-	-	-	-	1		
4	Rufous Hummingbird	21	24	4	4	9	60.4	<0.001***
5	Northern Flicker	-	-	1	-	2		
6	Red-breasted Sapsucker	-	-	-	-	7		
7	Hairy Woodpecker	2	-	-	-	12		
8	Pileated Woodpecker	-	-	-	-	2		
9	Olive-sided Flycatcher	-	-	-	-	2		
10	Western Wood Pewee	-	-	-	-	-		
11	Hammond's Flycatcher	-	-	-	4	17		
12	Willow Flycatcher	-	-	1	-	-		
13	Pacific Slope Flycatcher	2	1	9	13	56	88.3	<0.001***
14	Tree Swallow	-	-	-	-	-		
15	Violet-green Swallow	-	-	-	1	-		
16	Barn Swallow	-	-	-	-	1		
17	Northern Rough-winged Swallow	-	-	-	-	-		
18	Steller's Jay	2	7	3	13	11	15.0	<0.01**
19	Northwestern Crow	1	1	-	-	2		
20	Common Raven	1	-	-	-	1		
21	Chestnut-backed Chickadee	-	-	3	6	40	71.7	<0.001***
22	Brown Creeper	-	-	8	-	20		
23	Red-breasted Nuthatch	-	-	-	-	7		
24	House Wren	-	-	-	-	-		
25	Winter Wren	8	4	23	25	68	96.3	<0.001***
26	Golden-crowned Kinglet	-	-	16	17	33	48.0	<0.001***
27	Townsend's Solitaire	-	-	-	-	-		
28	Swainson's Thrush	13	16	30	29	24	39.2	<0.001***
29	Hermit Thrush	-	-	-	-	-		
30	Varied Thrush	-	-	10	11	42	60.4	<0.001***
31	American Robin	23	14	31	36	38	41.8	<0.001***
32	Cedar Waxwing	1	1	2	-	-		
33	European Starling	-	-	-	-	-		
34	Hutton's Vireo	-	-	10	8	14	20.2	<0.001***
35	Solitary Vireo	-	-	-	-	-		
36	Warbling Vireo	-	-	3	3	-		
37	Orange-crowned Warbler	23	36	19	8	8	90.6	<0.001***
38	Yellow-rumped Warbler	-	-	-	-	-		
39	Townsend's Warbler	-	1	19	19	7	65.0	<0.001***
40	Black-throated gray Warbler	-	-	-	7	-		
41	Yellow Warbler	-	-	1	-	-		
42	MacGillivray's Warbler	13	12	13	4	-	35.8	<0.001***
43	Wilson's Warbler	1	9	12	6	2	26.2	<0.001***
44	Common Yellowthroat	-	-	-	-	-		
45	Rufous-sided Towhee	12	4	-	-	-		
46	Song Sparrow	32	23	6	2	-	124.5	<0.001***
47	White-crowned Sparrow	9	12	1	-	-		
48	Golden-crowned Sparrow	-	-	-	-	-		
49	Fox Sparrow	3	-	-	-	-		
50	Dark-eyed Junco	16	13	1	-	11	37.5	<0.001***
51	Western Tanager	-	-	-	-	3		
52	Pine Siskin	-	-	-	-	-		
53	American Goldfinch	1	1	-	-	-		
54	Red Crossbill	-	-	-	-	11		
55	Purple Finch	1	-	2	-	-		
	N of sampling stations	36	36	36	36	71		

TABLE 14: **Correlation of Median bird detection-rates with habitat variables.** Bold face values indicate significant correlations at the $p<0.05$ (*) and $p<0.01$ (**) levels.

		VARIABLE							
#	SPECIES[1]	ELEV[2]	DIST[3]	BASL[4]	DENS[5]	SNAG[6]	CANH[7]	CLOS[8]	WOOD[9]
1	Rufous Hummingbird	0.31	**-0.47***	**-0.57****	**0.73****	**-0.60****	**-0.58****	**-0.78****	-0.01
2	Pacific Slope Flycatcher	-0.06	**0.56****	**0.86****	**-0.45***	**0.72****	**0.82****	**0.50***	0.61
3	Steller's Jay	-0.33	-0.04	0.21	-0.08	0.05	0.16	0.00	0.26
4	Chestnut-backed Chickadee	0.06	**0.81****	**0.83****	**-0.44***	**0.64****	**0.80****	**0.48***	**0.72****
5	Winter Wren	-0.26	0.27	**0.80****	**-0.42**	**0.70****	**0.78****	**0.62****	0.38
6	Golden-crowned Kinglet	-0.01	**0.44***	**0.51***	**-0.53***	**0.48***	**0.47***	**0.85****	0.06
7	Swainson's Thrush	-0.39	-0.04	-0.26	0.20	-0.19	-0.26	0.25	-0.24
8	Varied Thrush	-0.04	0.41	**0.76****	**-0.52***	**0.64****	**0.73****	**0.58****	0.29
9	American Robin	**-0.46***	-0.36	-0.07	-0.17	0.26	0.00	**0.50***	**-0.44***
10	Hutton's Vireo	0.06	0.34	0.21	-0.13	0.23	0.15	0.35	0.08
11	Orange-crowned Warbler	-0.22	-0.43	**-0.73****	**0.67****	**-0.77****	**-0.73****	**-0.74****	-0.28
12	Townsend's Warbler	-0.32	-0.19	-0.06	-0.31	0.11	-0.02	**0.46***	-0.41
13	MacGillivray's Warbler	**0.47***	-0.17	**-0.54***	0.17	**-0.46***	**-0.55***	-0.24	-0.51*
14	Wilson's Warbler	-0.19	-0.14	-0.28	0.01	-0.13	-0.31	0.25	-0.46*
15	Song Sparrow	0.17	-0.36	**-0.76****	**0.88****	**-0.87****	**-0.77****	**-0.89****	-0.20
16	Dark-eyed Junco	**0.50***	-0.17	-0.32	0.18	-0.28	-0.31	**-0.58****	-0.07

NOTES:

[1] Species not equally distributed across age-classes (from Table 6).

[2] Elevation (metres).

[3] Distance to coast (kilometres).

[4] Basal area (sq. metres/hectare).

[5] Tree density (stems/hectare).

[6] Snag density (stems/hectare).

[7] Canopy height (metres).

[8] Canopy closure (% data were arcsine-transformed).

[9] Woody debris (pieces/100 metres).

Critical *r* values with n=18 observations: p<0.05 0.444

p<0.01 0.561

found at one sampling station (Sproat Lake "Beverly" old-growth), where behavior led the observer (AB) to suspect breeding.

The breeding biology of this species is poorly understood (Campbell *et al.* 1990, Baldwin and Zackowski 1963); it is thought to be dependent upon cavities in large standing snags. Detections in other areas were invariably of flocks foraging well above the forest canopy. This species is a rare colonial nester in snags in old-growth habitats. In the southern Washington Cascades, Vaux's Swifts were detected more frequently in old-growth forest (250-700 years old) than in mature (95-190 years old) or younger forests (55-80 years old; Manuwal 1991). Within the old-growth forest, Vaux's swift were more numerous in wet forests than in Mesic forest and least numerous in dry forest (Manuwal 1991).

4. Rufous Hummingbird

Rufous Hummingbirds were widespread, but most abundant in clearcut and 15-20 year-old stands. Most detections were of males. As birds were rarely detected at distances >10 metres, our data probably underestimate true abundance. Because Rufous Hummingbirds are not highly vocal, most detections were visual and estimates of abundance are possibly biased toward more open habitats. Manuwal and Carey (1991) also state that obtaining an accurate assessment of breeding density is difficult because nonbreeders may intrude into the habitat at any time. Numbers of detections were highest in May, possibly because of the passage of migrants. Numbers were similar in early and mid-June, and lowest in late June. The Median-all detections index probably best reflects actual breeding densities.

Rufous Hummingbirds were detected most often in clearcuts and 15-20 year-old forests (Table 13). They were equally frequently encountered in these 2 age-classes (χ^2=0.53 with 1 df, p>0.05). Based on the Median-all detections index, Rufous Hummingbirds were less abundant at Sproat Lake than at Franklin River or Kennedy Lake. This may be due to the higher elevation of the 5-20 year-old forest transect at Sproat Lake (>500 m compared to <250m in the other two areas). Rufous Hummingbird abundance was positively correlated with tree density (r=0.73), and negatively correlated with distance-to-coast (r=-0.47), basal area (r=-0.57), snag density (r=-0.60), crown height (r=-0.58) and canopy closure (r=-0.78; Table 14). Several nests were found during the project; of particular interest was one found 1 metre above ground in an coniferous tree amidst cedar-hemlock old-growth forest on Meares Island (RT).

Our data largely corroborate the findings of previous researchers. Roe (1974) found this species to be most abundant in 24 year-old unplanted forest in Pacific Rim National Park. Carey *et al.* (1991), working in the southern Oregon Coast Range, recorded more Rufous Hummingbird detections in old-growth (250-525 year-old) forests than in mature (80-120 year-old) or young (40-72 year-old) forests. However, they also recorded nearly twice as many detections in 40-72 year-old stands than in 80-120 year-old stands. In the southern Washington Coast Range, Manuwal (1991) recorded twice as many detections in 95-190 year-old forests than in 55-80 year-old forests but, like Carey *et al.* (1991), found the highest level of detections in old-growth forests (note that neither study examined forests <40 years old). Manuwal (1991) determined that Rufous Hummingbirds were more

numerous in dry and mesic stands than in wet stands.

Our data indicate that Rufous Hummingbirds frequent all forest age-classes, but are most abundant in clearcuts and 15-20 year-old stands.

Woodpeckers

5 Northern Flicker ("red-shafted" race)

Northern Flickers were uncommon, but most numerous in 30-35 year-old stands. They were not detected at Franklin River. Flicker vocalizations are loud and easily detected, but as Manuwal and Carey (1991) point out, all woodpeckers are difficult to detect because they have large home ranges, and call relatively infrequently. Declining number of detections between May and June may suggest reduced detectability as the breeding season progressed. We found that territorial "drumming" behavior generally ceased after late May. Detections included females, but inconsistent presence at sampling stations result in large differences between Median and Maximum indices; the latter probably best reflects actual breeding density.

This cavity-nester (Campbell *et al.* 1990) spends much of its time feeding on the ground in open areas (Terres 1987). Most detections in clearcuts and 15-20 year-old stands probably represent foraging individuals. Presence in old-growth stands was limited to the Kennedy Lake "hypermaritime" cedar stand, a site characterized by open canopy conditions. One nest was detected at this site (both adults observed and young heard using cavity 15 metres above ground in a standing Sitka spruce snag beside road: AB).

6. Red-breasted Sapsucker

Red breasted Sapsuckers were detected sporadically in old-growth stands and once in 50-60 year-old forest at Kennedy Lake. They were most abundant in Sproat Lake old-growth transects. Manuwal and Carey (1991) describe Red-breasted Sapsuckers as a relatively quiet woodpecker, with vocalizations and drumming being infrequent even during the height of the nesting cycle. Increasing numbers of detections between May and June may reflect enhanced conspicuousness of this species when young are being fed by parents. Detections included females, but inconsistent presence at sampling stations result in large differences between Median and Maximum indices; the latter may be a more accurate reflection of breeding density. Based on the latter, Red-breasted Sapsuckers were detected more frequently in old-growth forest (20/71 stations) than in 50-60 year-old forests (1/36 stations; χ^2=9.76 with 1 df, p<0.005).

Of interest was the rarity of this species at the Franklin River old-growth transects despite much evidence of drilling upon trees. They were especially scarce in the lower old-growth transect, where road construction was more advanced. Although it is impossible to rule out fragmentation effects, Campbell *et al.* (1990) state that populations of this species often fluctuate widely in numbers from year-to-year. Roe (1974) did not detect this species in Pacific Rim National Park. Carey *et al.* (1991) in Oregon, and Manuwal (1991) in Washington, found this species more frequently in old-growth (>200 years) than in 80-

120 year-old forests. Red-breasted Sapsuckers appear to prefer old-growth forests but their relatively low abundance in this study cautions against strong generalizations. Recent studies in B.C. (A. Bryant unpublished data) indicates that Red-breasted Sapsuckers may be more numerous in high elevation forests.

7. Hairy Woodpecker

Hairy Woodpeckers were detected sporadically in all age-classes, but were detected most often in old-growth forests. Among woodpeckers, Hairy Woodpeckers are particularly vocal and easily detected. Declining number of detections between May and June suggest reduced detectability as the breeding season progressed. Detections included females, but note that males are thought to forage farther away from the nest than females (Morrision and With 1987). Inconsistent presence at sampling stations resulted in very large differences between Median and Maximum-all detection indices. Although the latter is probably a more accurate reflection of breeding density, data for the Hairy Woodpecker present a good example of how bird behavior can make interpretation of results more difficult.

We recorded relatively high levels of detections in clearcuts using both Median and Maximum indices (Tables 3 and 4), despite absence of suitable nest trees in such habitats (Figure 12). This presumably reflects the fact that all clearcuts sampled were adjacent to old-growth forests, and that foraging individuals are highly conspicuous in clearcuts. Note that Median detections were three times higher in old-growth habitats than in clearcuts. Hairy Woodpeckers were most abundant at the Franklin River old-growth transects (Table 8). We found one nest at the lower Franklin River old-growth transect (both adults observed and young heard using cavity 4 metres above ground in a live Douglas-fir >20 metres from road: AB).

In Pacific Rim National Park, Roe (1974) found Hairy Woodpeckers most often in a 24 year-old unplanted regenerating forest. In the southern Washington Cascades, Manuwal (1991) found the highest densities of Hairy Woodpeckers in old-growth forests. Dry old-growth stands and young forests (50-80 years) had lower densities (Manuwal 1991). Similarly, in Oregon, Carey *et al.* (1991) recorded higher level of detections in old-growth forests than in 40-180 year-old forests. Both studies recorded the presence of Hairy Woodpeckers in 40-120 year-old forests; however, their study areas had a legacy of old trees and snags from the past which may have satisfied some of the requirements of that species. Gilbert and Allwine (1991) found a strong positive correlation between Hairy Woodpeckers abundance and the presence of large trees. They also found a preference by Hairy Woodpeckers for mesic and wet old-growth stands as opposed to dry ones.

8. Pileated Woodpecker

Pileated Woodpeckers were detected occasionally in old-growth stands (Sproat Lake) and once in 30-35 year-old forest (Kennedy Lake). Both sexes have very loud and easily detected calls, but calling is infrequent. Ehrlich *et al.* (1988) suggest that Pileated Woodpeckers maintain a year-round territory. While the Maximum-all detections index

may be the better measure of actual breeding abundance, we believe our survey methods are not well-suited for such a wide-ranging species.

Behavior and consistent detection at both Sproat Lake old-growth suggested breeding at those sites. Pileated Woodpecker excavations were also observed at the lower Franklin River old-growth transect (AB). This species requires trees of at least 25.8 cm DBH in which to build nests (Campbell *et al.* 1990). Roe (1974) did not find this species in Pacific Rim National Park. In Oregon, Carey *et al.* (1991) recorded the species mostly in old-growth forests (80+ years) but not in 40-80 year-old forests.

Flycatchers

9. Olive-sided Flycatcher

This species was detected rarely in all age-classes, but was consistently found at only 2 sampling stations (Sproat Lake old-growth). All detections were of males. The timing of detections suggested arrival on territories in late May or the first week of June. Loud voice and bird movements may indicate that Median-all detections index underestimated actual breeding density, because birds were seldom recorded at the same station on multiple surveys. This was particularly true at the Franklin River clearcut, where the Maximum index revealed >5 individuals, and the Median index revealed none.

Roe (1974) detected this species only once in Pacific Rim National Park, and Wetmore *et al.* (1985) found it rarely in logged and unlogged forests near Four Mile Creek on the B.C. mainland.

10. Western Wood Pewee

This species was detected once (Kennedy Lake "hypermaritime" old-growth, June 24th). Erhlich *et al.* (1988) describe this species as primarily inhabiting deciduous or mixedwood forests. Roe (1974) did not report it from Pacific Rim National Park.

11. Hammond's Flycatcher

Hammond's Flycatchers were detected in all age-classes, but were consistently recorded only in old-growth and 50-60 year-old stands at Sproat Lake. Males are vocal and easily detected; females were not detected. Declining number of detections between May and June suggests movement of migrants through study transects and/or reduced detectability as the breeding season progressed. The Median-all detections index is probably a reasonable index of breeding density.

There was no difference in frequency of occurrence between old-growth (17/71 stations) and 50-60 year-old forests (4/36 stations; $\chi^2=2.49$ with 1 df, $p>0.05$). The high density of Hammond's Flycatchers at Sproat Lake is notable, particularly given the abundance of Pacific Slope Flycatchers there as well (Tables 7 and 8). In particular, both species were detected at virtually every sampling station in old-growth stands. Beaver and Baldwin (1975) suggest that where these species are sympatric, one is typically common and the

other is uncommon or absent; they describe several behavioral mechanisms which may allow these two species to "partition" resources and so avoid competitive exclusion. The Sproat Lake old-growth transects may provide an excellent opportunity for additional research on this subject.

Roe (1974) did not report this species for Pacific Rim National Park. In Oregon, Carey *et al.* (1991) recorded more Hammond's Flycatcher in 40-72 year-old than in 80-120 year-old forests. Numbers dropped by half from 80-120 year-old forests to old-growth forests. Manuwal (1991) however, observed a reversed trend in the southern Washington Cascades. In that area, Hammond's Flycatcher were rarely detected in 55-80 year-old forest, and were more abundant in 95-190 year-old and mesic old-growth stands.

12. Willow Flycatcher

Willow Flycatchers were detected rarely in all age-classes except old-growth, where it was absent. They were consistently detected at only 1 station in 30-35 year-old forest (Sproat Lake). Invariably, we detected Willow Flycatchers in red alder thickets near small streams. Ehrlich *et al.* (1988) describe it as a species of swamp and thicket. Roe (1974) made one detection in Pacific Rim National Park.

13. Pacific Slope Flycatcher (formerly "Western" Flycatcher)

Pacific Slope Flycatchers were detected in all age-classes, but were consistently found only in old-growth and 50-60 year-old stands. Unlike Hammond's Flycatchers, Pacific Slope Flycatchers were abundant in all three study areas. Males are vocal and easily detected, but females were only occasionally detected. Increasing number of detections between May and June indicates that this species is a relatively late migrant. Most birds apparently arrived on territory after June 15th. Because Pacific Slope Flycatchers numbers stabilized only in the 3rd and 4th surveys (Table 1), median values are not representative and detections from the last two surveys should be used instead. In this case, the Maximum-all detections index provides a better measure of breeding abundance across age-classes and areas.

Based on the Maximum all detections index, Pacific Slope Flycatchers were encountered at twice as many old-growth stations (67/71) than in either 30-35 year-old (17/36 stations) or 50-60 year-old (18/36 stations) forests. Differences among these age-classes were highly significant (χ^2=36.7 with 2 df, p<0.001). This species was not detected at Kennedy Lake 30-35 year-old stands, but was relatively numerous at Franklin River (1.08 individuals/station) and Sproat Lake 30-35 year-old stands (0.75 individuals/station). The stand at Kennedy Lake was lower in elevation, and had lower densities of snags and trees (Appendix II).

Abundance of Pacific Slope Flycatchers was positively correlated with distance-to-the-coast (r=0.56), basal area (r=0.86), snag density (r=0.72), crown height (r=0.82), canopy closure (r=0.50) and woody debris (r=0.59: Table 14). It was negatively associated with tree density (r=-0.45). Sympatry of Pacific Slope Flycatchers and Hammond's Flycatchers

at Sproat Lake old-growth transects is noteworthy (Beaver and Baldwin 1975). Three newly-fledged young were observed being fed by adults at the Franklin River 50-60 year-old stand on July 7th (AB); the nest was not found.

Roe (1974) found this species primarily in old-growth stands in Pacific Rim National Park. Carey *et al.* (1991) recorded higher densities in old-growth stands than in 40-120 year-old stands. However, Pacific Slope Flycatchers were still relatively abundant in younger stands. In the southern Washington Cascades, Manuwal (1991) found little difference in the abundance of Pacific Slope Flycatchers among stands ranging from 40-500 years old; however, wet old-growth stands typically contained twice the number of Pacific Slope Flycatchers than did younger stands.

Swallows and corvids

14. Tree Swallow

One individual was observed foraging over the Kennedy Lake clearcut on May 13th (RT). Roe (1974) did not report it for Pacific Rim National Park.

15. Violet-green Swallow

This species was rarely observed in mid-successional stands, and was absent from clearcuts and old-growth. It was consistently found at only 1 sampling station (50-60 year-old forest at Kennedy Lake). Declining number of detections from May to June suggests migration through study transects. Roe (1974) made 2 detections in Pacific Rim National Park.

16. Barn Swallow

Barn Swallows were detected twice at one old-growth station (Kennedy Lake "hypermaritime" old-growth). Several nearby abandoned buildings could have provided nesting habitat. Roe (1974) made a single detection in nearby Pacific Rim National Park.

17. Northern Rough-winged Swallow

Three birds were observed foraging at the Kennedy Lake clearcut on May 13th (RT). The species was not detected in nearby Pacific Rim National Park (Roe 1974).

18. Steller's Jay

Steller's Jays were consistently detected in all age-classes and all study areas, but were most common in 50-60 year-old stands. Both sexes are highly vocal and easily-detected. Similar numbers of detections were recorded in May and June. As this species forages widely, moves quickly and often congregates in flocks at feeding sites (Ehrlich *et al.* 1988), the Median-all detections index probably overestimates actual breeding density, particularly in young forests. Manuwal and Carey (1991) also warn that because this species can be heard from great distances, it is possible to overestimate actual numbers of birds.

Abundance of Steller's Jays was not significantly correlated with any of the measured habitat variables, a finding which is consistent with characterization of this species as an "edge" species able to use a variety of habitats (Terres 1987). Newly-fledged young were observed at Kennedy Lake (50-60 year-old stand) on July 4th (AB).

Roe (1974) found Steller's Jays to be most common in an 8 year-old replanted forest in Pacific Rim National Park, a habitat probably not suitable for breeding (Terres 1987). In Oregon, Carey *et al.* (1991) found similar numbers of Steller's Jays in 80-120 year-old and old-growth forests. In one of their 2 sampling years, Steller's Jays were equally abundant in the 40-80 year-old forest, but were only half as numerous in the second year. Manuwal (1991) found Steller's Jay nearly four times more often in wet old-growth than dry old-growth stands.

19. Northwestern Crow

Northwestern Crows were detected rarely in all age-classes except 30-35 year-old stands, and detected consistently but rarely in clearcuts, 15-20 year-old and old-growth forests. Both sexes are vocal and easily detected. As with Steller's Jay, this tree-nesting species forages widely, moves quickly and often congregates in flocks at feeding sites. The Median-all detections index probably overestimates actual breeding density, particularly in clearcuts and 15-20 year-old stands, where observer visibility was improved, and where the majority of detections occurred.

20. Common Raven

Ravens were detected rarely in clearcuts and old-growth stands. Both sexes are vocal and easily detected. As with Stellers' Jay and Northwestern Crow, this tree-nesting species forages widely, moves quickly and often congregates in flocks at feeding sites. The Median-all detections index probably overestimates actual breeding density, particularly in clearcuts, where detection was easier given improved observer visibility.

Chickadees, creepers and nuthatches

21. Chestnut-backed Chickadee

Chestnut-backed Chickadees were locally abundant. They were detected consistently in 30-35 year-old, 50-60 year-old, and old-growth stands. Both sexes are highly vocal and easily detected. More chickadees were detected in the second survey than in the first, possibly reflecting the end of incubation and greater detectability during the feeding of young. Estimates of relative abundance based on the Median and Maximum indices differed considerably and produced different distribution patterns.

Based on the Median index, Chestnut-backed Chickadees were most abundant in old-growth stands, where they were consistently found at 40/71 stations, compared with 6/36 stations in 50-60 year-old stands and 3/36 stations in 30-35 year-old stands (Table 2). Differences among these age-classes were highly significant (χ^2=31.1 with 2 df, p<0.001)

At Sproat Lake, nearly twice as many birds were detected in the Beverly Creek old-growth transect than the upper Nahmint one (Table 8). These two old-growth stands differed in tree species composition with Douglas-fir being much less abundant, and Western Red Cedar much more abundant, at the Beverly transect (Fig 6). Chestnut backed Chickadees were also slightly more numerous at Meares Island old-growth than at the "hypermaritime" cedar stand (Table 8). Canopy height at the former was nearly twice as high, possibly providing more foraging substrate (Figure 13). Abundance of this cavity-nester was positively correlated with distance-to-the-coast (r=0.81), basal area (r=0.83), snag density (r=0.64), crown height (r=0.80), canopy closure (r=0.48) and woody debris (r=0.72), and negatively correlated with tree density (r=-0.44: Table 14).

In the southern Washington Cascade Range, Manuwal (1991) found that Chestnut-backed Chickadees were more numerous in old-growth stands than in younger stands (55-190 years old), and were particularly abundant in wet old-growth stands. In Oregon, Gilbert and Allwine (1991) determined that Chestnut-backed Chickadees were significantly associated with old-growth stands. Similarly, Carey *et al.* (1991) found nearly twice as many Chestnut-backed Chickadees in old-growth stands than in the younger stands of the Oregon Coast Range.

22. Brown Creeper

Brown Creepers were detected in 30-35 year-old, 50-60 year-old, and old-growth stands, but were consistently found only in old-growth and 30-35 year-old stands. Brown Creepers are relatively quiet; calling birds generally cannot be detected from distances much greater than 30 metres, while singing males are loud and could be detected out to the 75 metre plot perimeter. Because of this, males were probably detected more frequently than females. Numbers of detections were similar in May and June. Estimates of abundance based on Maximum and Median indices differ considerably (Tables 3 and 4); due to low overall detectability, the former may present a more accurate estimate of actual abundance.

Based on the Maximum index, Brown Creepers were observed in 39/71 old-growth stations, 6/36 50-60 year-old stations, and 7/36 30-35 year-old stations (Table 3). Differences among these 3 age-classes were highly significant (χ^2=21.1 with 2 df, p<0.001). Using the Median index, Brown Creepers were absent from Sproat Lake old-growth transects and all 50-60 year-old stands. However, Median data corroborate the overall trend of greater abundance in Franklin and Kennedy Lake old-growth transects (Figure 25).

Curiously, Roe (1974) made only one detection in Pacific Rim National Park; Hatler *et al.* (1978) describe it as a rare resident in the same area. Manuwal (1991) found Brown Creepers to be equally numerous in mature (95-190 year-old) forests and old-growth (200-700 year-old) forests of the southern Washington Cascades. Similar results were obtained by Carey *et al.* (1991) and Gilbert and Allwine (1991) in Oregon forests of similar age.

23 Red-breasted Nuthatch

Red-breasted Nuthatches were detected in 50-60 year-old stands and old-growth; they were consistently detected at only 8% (6/71) of old-growth stations. Both sexes have loud and easily detected vocalizations, but calling is infrequent (Manuwal and Carey 1991). Roe (1974) did not find this species in Pacific Rim National Park, but Hatler *et al.* (1978) describe it as a rare resident in coastal old-growth. Manuwal (1991) found the species to be most abundant in dry old-growth forest, and Carey *et al.* (1991) recorded most detections in forests over 200 years old.

Wrens, kinglets and solitaires

24 House Wren

This species was detected once in 50-60 year-old forest (Sproat Lake, June 24th: AB).

25 Winter Wren

Winter Wrens were abundant and widespread. The species was detected in all age-classes and all study areas, but was most numerous in old-growth, 50-60 year-old and 30-35 year-old forest. Males are highly vocal, extremely loud and easily detected. Virtually all detections were of territorial males. Similar numbers of detections were recorded in May and June. The Median-all detections index is probably a realistic estimate of breeding density.

Winter Wrens were present at 68/71 old-growth stations, 23/36 stations in 30-35 year-old stands and 25/36 stations in 50-60 year-old stands (Table 2). Differences among these 3 age-classes were highly significant (χ^2=20.1 with 2 df, p<0.001). Winter Wrens were absent from Franklin and Sproat Lake clearcuts and Sproat Lake 15-20 year-old forest. Abundance was positively correlated with basal area (r=0.80), snag density (r=0.70), crown height (r=0.78) and canopy closure (r=0.62: Table 14).

In Pacific Rim National Park, Roe (1974) found Winter Wrens to be most abundant in a 2 year-old clearcut and a 24 year-old replanted forest. Our data show similar trends only at nearby Kennedy Lake transects, where Winter Wrens were fairly common in the clearcut. Possibly abundance of this species in coastal clearcuts may be related to high shrub-cover (particularly salal *gaultheria shallon*); Winter Wrens are known to inhabit treeless coastal habitats in the Aleutian and Pribilof Islands (Terres 1987). In the southern Oregon coast range, Winter Wrens were slightly more numerous in old-growth stands than in 80-120 years old stands and more abundant in 80-120 years old stands than in 40-72 years old stands (Carey *et al.* 1991). They were, however, one of the three most numerous species in all 3 age-classes. Manuwal (1991) recorded a similar high abundance of Winter Wrens in the 3 forest age-classes he studied in the southern Washington Cascades, with the lowest numbers being found in the younger forest. Wet old-growth stands had nearly twice as many Winter Wrens as did drier stands (Manuwal 1991).

26. Golden-crowned Kinglet

Golden crowned Kinglet were consistently detected in old-growth, 50-60 year-old forest and 30-35 year-old forest (Table 3). Both males and females were detected. This species is vocal but not easily detected at distances >30 metres. Moreover, their high-pitched vocalizations are difficult to place accurately; Manuwal and Carey (1991) suggest that some observers may not hear them at all. Declining numbers of detections between May and June probably reflect declining frequency of song as the breeding season progressed (Table 1). As Golden-crowned Kinglets are early breeders, numbers recorded in the first two surveys probably best reflect their actual breeding abundance. For this reason the Maximum-all detections index is a more appropriate measure of abundance.

Golden-crowned Kinglets were present at similar proportions in old-growth, 30-35 and 50-60 year-old stations (57/71, 27/36 and 29/36 sampling stations respectively; Table 3). There was no difference in frequency of occurrence among the 3 age-classes (χ^2=3.7 with 2 df, p>0.05). Abundance of this tree-nesting species was positively correlated with distance-to-coast (r=0.44), basal area (r=0.51), snag density (r=0.48), crown height (r=0.47) and canopy closure (r=0.85), and was negatively correlated with tree density (r=-0.53: Table 14). Golden-crowned Kinglets are a mid-to-late-successional species.

Curiously, Roe (1974) did not report this species from Pacific Rim National Park, but Hatler *et al.* (1974) corroborate our finding that this species is common and widespread in mid-successional and older forests. Carey *et al.* (1991) and Manuwal (1991) found the species equally abundant in mature (80-190 year-old) and old-growth (200-700 year-old) forests of Washington and Oregon. The species, although slightly less numerous, was also abundant in the 40-80 year-old forests they surveyed.

27. Townsend's Solitaire

This species was detected once in 15-20 year-old forest (Sproat Lake, May 27th: RT).

Thrushes

28. Swainson's Thrush

Swainson's Thrushes were abundant and widespread. They were consistently detected in all age-classes,.but were most frequently encountered in 30-35 year-old and 50-60 year-old stands (30/36 and 29/36 stations respectively), where they were equally common (χ^2=0.1 with 1 df, p>0.05). Males are vocal and easily detected; females were sometimes detected. Increasing numbers of detections between May and June reflect the late arrival of the species in the study area. The Median-all detections index is probably a realistic estimate of relative abundance.

Abundance of this shrub and tree-nesting species was not significantly correlated with any of the measured habitat variables (Table 14).

The Swainson's Thrush is a very adaptable species, able to use a wide variety of habitat types (Terres 1987). Roe (1974) did not detect this species in old-growth forests in Pacific Rim National Park. We found it only rarely in the Kennedy Lake "hypermaritime" cedar stand, but commonly in cedar-hemlock forest on Meares Island (Figure 24). Studies in Oregon confirm the use of old-growth and younger forests by Swainson's Thrush (Carey *et al.* 1991), but Manuwal (1991) found it significantly more abundant in mesic and dry old-growth forests in Washington than in younger forests.

29. Hermit Thrush

Hermit Thrushes were detected rarely in old-growth, 50-60 year-old, 30-35 year-old and 15-20 year-old stands. They were not consistently detected at any transect. Males are vocal and easily detected; females were not detected. Declining numbers of detections between May and June suggest migration through study areas in mid-May. Hatler *et al.* (1978) describe it as an uncommon resident in Pacific Rim National Park. Carey *et al.* (1991) and Manuwal found similar numbers of Hermit Thrushes in young (40-90 years) and old-growth forests (>200 years) of Oregon and Washington.

30. Varied Thrush

Varied Thrushes were consistently detected in old-growth, 50-60 year-old and 30-35 year-old forest. Males are vocal and easily detected; females rarely detected. Detections were slightly higher during the first survey, possibly suggesting the birds had not completely settled into breeding territories by then (Table 1). The Median-all detections index is probably a realistic estimate of breeding density.

Based on the Median index, Varied Thrushes were more frequently encountered in old-growth (42/71 stations) than in 50-60 year-old (11/36 stations) or 30-35 year-old (10/36 stations) forests (χ^2=13.1 with 2 df, p<0.005). In addition, relative abundance in a given age-class varied considerably between areas. Among 30-35 year-old stands, abundance was similar at Sproat Lake (0.46±0.17 individuals/station) and Franklin River (0.33±0.14 individuals/station), but the species was not detected at Kennedy Lake. Tree density, snag density and crown height were lower in the 30-35 years old forest at Kennedy than at the other two areas (Figures, 11, 12 and 13).

At Sproat Lake and Franklin River, Varied Thrush abundance declined in 50-60 year-old forests, while it increased at Kennedy Lake (Figure 25). Abundance also varied among old-growth stands, ranging from 0.23 individuals/station at Kennedy Lake to 1.04 individuals/station at Sproat Lake. At both Sproat and Kennedy Lakes, sites of higher elevation had the highest densities. Abundance of this tree-nesting species was positively correlated with basal area (r=0.76), snag density (r=0.64), crown height (r=0.73) and crown closure (r=0.53), and negatively correlated with tree density (r=-0.52).

The Varied Thrush is a late-successional species. Curiously, Roe (1974) does not report this species from Pacific Rim National Park, although Hatler *et al.* (1978) describe it as a common resident. Carey *et al.* (1991), Gilbert and Allwine (1991) and Manuwal (1991) all

reported highest Varied Thrush abundance in forests over 80 years old.

31. American Robin

American Robins were abundant and widespread in all age-classes. They were most numerous in 50-60 year-old and 30-35 year-old forest (71/71, and 29/36 stations respectively: Tables 2 and 13). Both males and females are vocal and easily detected. Declining numbers of detections between May and June suggest decreased singing as the breeding season progressed. The Median-all detections index is probably a realistic estimate of breeding density.

Abundance of this tree-nesting species was positively correlated with crown closure (r=0.50), and negatively correlated with distance-to-coast (r=-0.46) and woody debris, (r=-0.44: Table 14).

Although able to use a variety of habitats, the American Robin is primarily a mid-successional species (Terres 1987). Roe (1974) found it most commonly in a 24 year-old regenerating forest in Pacific Rim National Park, and Hatler *et al.* (1978) indicate that some birds overwinter in coastal habitats. Overall, this species was the most abundant bird detected during the study. The location of our sampling points along roads may have contributed to the high abundance of this "edge" species.

Waxwings and Starlings

32. Cedar Waxwing

Cedar Waxwings were rarely detected in clearcuts, 15-20 year-old and 30-35 year-old stands. Both males and females are vocal and easily detected. Increasing numbers of detections in late May and June reflect the late arrival of this species on breeding grounds (Table 1). For this reason the Maximum-all detections index is probably a better estimate of relative abundance.

Based on the Maximum index, detections were most frequent in 15-20 year-old stands (11/36 stations: Table 3). In general, this species was not very abundant in our study sites. One nest was found (2 metres above ground in red alder thicket alongside road, lower end of Franklin River clearcut, 4 eggs, July 6th: AB).

Roe (1974) found Cedar Waxwings to be most common in a 24 year-old regenerating stand in Pacific Rim National Park.

33. Eurasian Starling

This species was detected once in old-growth forest (Kennedy Lake "hypermaritime" stand, May 15th: AB). Populations of this introduced species are well established in Pacific Rim National Park and the Tofino and Ucluelet urban areas (Hatler *et al.* 1978). However, it was not present in any numbers at any of our study areas.

Vireos and warblers

34. Hutton's Vireo

Hutton's Vireos were consistently detected in 30-35 year-old, 50-60 year-old and old-growth stands. Males are vocal and easily detected; females were not detected. Numbers of detections between May and June were similar. The Median-all detections index is probably a realistic index of breeding density.

Hutton's Vireos were equally frequently encountered in 30-35 year-old (10/36 stations), 50-60 year-old (5/26 stations) and old-growth (14/71 stations) forests (χ^2=2.2 with 2 df, p>0.05). However, it was not equally distributed among study areas (Tables 6, 7 and 8). In particular, Hutton's Vireo was absent from all transects in the Kennedy Lake study area. At Sproat Lake, it was relatively abundant in the Beverly old-growth (0.42±12 individuals/station), but was not recorded from the nearby Nahmint old-growth or 30-35 year-old stands.

Hutton's Vireo is a mid-to-late-successional species. Hatler *et al.* (1974) describe it as a rare resident in Pacific Rim National Park. In Oregon, Carey *et al.* (1991) found higher densities of this vireo in young (40-72 year-old) than older forests.

35 Solitary Vireo

This species was detected once in 50-60 year-old forest (Sproat Lake, May 16th: RT).

36 Warbling Vireo

Warbling Vireos were rarely detected at Sproat Lake in 30-35 year-old and 50-60 year-old forests. Males are vocal and easily detected; females were not detected. Numbers of detections in May and June were similar. The Median-all detections index is probably a realistic index of breeding density.

Too few detections were made to assess any distributional pattern in relation to forest age. In other areas, this species is mostly associated with deciduous trees and usually abundant in mature riparian areas (Ehrlich *et al.* 1988). Roe (1974) made a single detection in Pacific Rim National Park; Hatler *et al.* (1978) describe it as a very rare summer species in the same area.

37. Orange-crowned Warbler

Orange-crowned Warblers were abundant and widespread. They were consistently detected in all age-classes and all study areas. Declining numbers of detections between May and June indicate migration through study transects (Table 1). "Waves" of migrating birds were very much in evidence. Because of this, the Median-all detections index is probably a better index of breeding density than the Maximum index.

Orange-crowned Warblers were most numerous in clearcuts (23/36 stations), 15-20 year-

old (36/36 stations) and 30-35 year-old (19/36 stations) stands (Table 2). Differences among these age-classes were significant (χ^2=21.9 with 2 df, p<0.001). The abundance of Orange-crowned Warblers was highest in 15-20 year-old forests in all three areas (Figure 23). Among clearcuts, the Sproat Lake site had few birds (0.13±0.09 individuals/station) compared to Franklin River (1.0±0.17 individuals/station) or Kennedy Lake (1.17±0.18 individuals/station: Table 4). Several nests of this species were found, including Kennedy clearcut (on ground at base of red alder, June 24th: RT) and Kennedy old-growth (Meares Island, on ground at base of salmonberry shrub, July 5th: AB).

Abundance of this ground or low shrub-nesting species was positively correlated with tree density (r=0.67), and negatively correlated with basal area (r=-0.73), snag density (r=-0 77), crown height (r=-0.73) and crown closure (r=-0.74).

The Orange-crowned Warbler is primarily an early-successional species, but it also breeds in small clearings amidst dense forests. Roe (1974) found it most commonly in a 24 year-old regenerating forest in Pacific Rim National Park. In Oregon, Carey *et al.* (1991) found the species most often in forests younger than 80 years of age.

38. Yellow-rumped Warbler ("Audubon's" race)

This species was rarely detected in 15-20 and 30-35 year-old stands. It was not consistently found at any transect. Numbers of detections are too small to assess migration dates (Table 1). Hatler *et al.* (1978) describe it as an uncommon spring and fall migrant in Pacific Rim National Park.

39. Townsend's Warbler

Townsend's Warblers were abundant and widespread. They were detected consistently in all age-classes except clearcuts, but were most numerous in 30-35 year-old and 50-60 year-old stands (Table 13 and Figure 24). Males were more commonly detected. Declining numbers of detections between May and June indicate migration through study transects; "waves" of migrating birds were very much in evidence (Table 1). For this reason the Median-all detections index is probably a better index of breeding density.

Overall, Townsend's Warblers were equally frequently encountered in 30-35 and 50-60 year-old forests (19/36 stations for both age-classes). However, there were large differences in abundance among the 3 study areas. Kennedy and Sproat Lake transects showed relatively high abundance of this species (Tables 6 and 7). In contrast, Townsend's Warblers were virtually absent from the Franklin River transects, being detected at only one station in the 50-60 year-old forest. Abundance of this tree-nesting species was positively correlated with crown closure (r=0.46: Table 14). However, crown closure does not explain the relative dearth of Townsend's Warblers in the Franklin River area (Figure 14).

The Townsend's Warbler is primarily a mid-successional species which persists (in lower densities) in old-growth forests (Figure 24). Manuwal (1991) found the species to be most

numerous in forests under 80 years of age. Within old-growth forests, they were nearly 3 to 4 times more numerous in dry stands than in mesic and wet stands. However Manuwal and Meslow (1984) reported lower number of Townsend's Warblers in managed stands (85 years old) dominated by Douglas-fir and Ponderosa pine than in old-growth stands (>220 years). They attributed this difference to the presence of an understory of Grand fir in the old-growth stands.

We noticed dramatic variation in song patterns in this species between study areas, a trend reported elsewhere (Stein 1962). In particular, songs of birds at the Sproat Lake 50-60 year-old forest were extraordinarily variable. Morrison (1983) used morphometric analyses to distinguish two populations of Townsend's Warblers, one breeding on the Queen Charlotte Islands and wintering in California and Oregon, with the remainder breeding elsewhere and wintering in Mexico and Central America. Analysis of 18 specimens suggest that both groups are represented on Vancouver Island (Morrison 1983), and it is possible that we detected individuals from both populations.

40. Black-throated Gray Warbler

This species was locally common in 50-60 year-old stands (Table 2). However, all birds were detected at Sproat Lake, with the exception of one bird consistently found at Kennedy Lake. Lower numbers of detections in the first survey indicate that all birds had not yet arrived by mid-May (Table 1). Detections were similar in all other surveys. Singing males are highly vocal and easily detected. Females were not detected. The Median-all detections index is probably a realistic index of breeding density.

Presence of this tree-nesting species in numbers at Sproat Lake is noteworthy, and suggests a more northerly range than that portrayed by Peterson (1990). Munro and Cowan (1947) indicate no records for Vancouver Island. Godfrey (1986) suggests recent expansion on Vancouver Island. The species has not been reported from Pacific Rim National Park (Roe 1974, Hatler *et al.* 1978). In Oregon, Carey *et al.* (1991) found the species to be 3 times more abundant in young (0-72 year-old) forest than old-growth (>250 year-old) forests.

41. Yellow Warbler

Yellow Warblers were detected rarely in clearcuts, 15-20 year-old and 30-35 year-old stands (Table 3). They were consistently detected only at the Sproat Lake 30-35-year-old transect (Table 6). Numbers of detections in May and June were similar (Table 1). The Median-all detections index is probably a realistic index of breeding density at our study areas.

Yellow Warblers generally inhabit wet 2nd growth forests or riparian thickets (Ehrlich *et al.* 1988). Hatler *et al.* (1974) describe the Yellow Warbler as an uncommon summer resident and uncommon fall migrant in Pacific Rim National Park.

42. MacGillivray's Warbler

MacGillivray's Warblers were detected in all age-classes (Table 3), and were consistently found in all age-classes except old-growth (Table 2). Singing males are highly vocal and easily detected. Females and juvenile birds were occasionally detected. Similar numbers of detections during all surveys suggest arrival on territories before early May (Table 1). Both the Median and Maximum indices should provide adequate estimates of relative abundance; the former is probably a better estimate of breeding density..

MacGillivray's Warblers were most numerous in clearcuts, 15-20 year-old and 30-35 year-old stands (Table 13). Among these 3 age-classes, there was no difference in frequency of occurrence (13/36, 12/36 and 13/36 stations respectively, χ^2=0.1 with 2 df, p>0.05). In clearcuts and 15-20 year-old stands, MacGillivray's Warblers were generally equally abundant among the 3 study areas (Tables 4 and 5). However, they were absent from the 30-35 year-old stand at Franklin River, and were 4 times more abundant at Sproat Lake (0.71±0.12 individuals/station) than at Kennedy Lake (0.21±0.11 individuals/station).

Abundance of this shrub and ground-nesting species was positively correlated with elevation (r=0.47). and negatively correlated with basal area (r=-0.54), snag density (r=-0.46), crown height (r=-0.55) and woody debris (r=-0.51: Table 14).

The MacGillivray's Warbler is primarily an early-to-mid-successional species. In Pacific Rim National Park, Roe (1974) found it most commonly in a 12 year-old replanted clearcut. In Oregon, Carey *et al.* (1991) found the species in old-growth (>250 year-old) but not younger stands (40-120 years old). In Washington, Manuwal (1991) did not detect this species in 55-80 year-old forests, and found it only rarely in mature (95-190 year-old) and old-growth (210-730 year-old) forests.

43. Wilson's Warbler

This species was consistently detected in all age-classes (Table 2). Singing males are very loud and easily detected. Females were not detected. Similar numbers of detections during May and June suggest early arrival on territories (Table 1). The Median-all detections index is probably a good index of breeding density.

Wilson's Warblers were most commonly detected in 15-20 year-old (9/36 stations) and 30-35 year-old (18/36 stations) forests (Table 13). Differences between these 2 age-classes were significant (χ^2=4.8 with 1 df, p<0.05). In both age-classes, Wilson's Warblers were rare at Sproat lake compared to the other two areas (Tables 5 and 6). Abundance of this shrub and ground-nesting migratory species was negatively correlated with woody debris (r=-0.46: Table 14).

Our results suggest that on western Vancouver Island, Wilson's Warbler is primarily a mid-successional species which persists (in low densities) in old-growth forest. In Pacific Rim National Park, Roe (1974) also found it most commonly in a 24 year-old regenerating forest. In Oregon, Carey *et al.* (1991) found Wilson's Warblers to be equally common in

young and mature (40-120 year-old) forests, with a 50% reduction in abundance within old-growth (>250 year-old) stands. In the Washington Cascade Range, however, a contrasting pattern emerged. Manuwal (1991) determined that Wilson's Warblers were the 2nd most abundant warbler (after Hermit Warbler) in all Douglas-fir stands older than 95 years of age, were the dominant understory warbler in all areas, and were particularly abundant in wet old-growth (300-730 year-old) forests.

44. Common Yellowthroat

This species was detected once in 30-35 year-old forest (Kennedy Lake; June 6th: RT).

Towhees, sparrows and juncos

45. Rufous-sided Towhee

Rufous-sided Towhees were detected in all age-classes except 50-60 year-old forest (Table 3), but were consistently found only in clearcuts and 15-20 year-old forests (Table 2). Most detections were of males. Similar numbers of Rufous-sided Towhees were detected in all four surveys (Table 1). Both the Median and Maximum indices should reflect relative abundance, however, as with most species there are large differences in the picture of towhee distribution derived from the 2 measures (Tables 2 and 3). The Median-all detections index is probably a reasonable estimate of breeding density.

Using the Median index, towhees were recorded in 12/36 clearcut stations and 4/36 15-20 year-old stations; this difference is significant (χ^2=5.1 with 1 df, p<0.025). Using the Maximum index, frequency of occurrence is greatly increased (to 24/36 and 13/36 stations respectively) although the difference among age-classes is still significant (χ^2=6.7 with 1 df, p<0.001). The choice of index used also has effects on between-area differences. For example, the Median index suggests that Rufous-sided Towhees are rare at Franklin River clearcuts (0.08±0.08 individuals/station) and 15-20 year-old stands (0.04±0.04 individuals/station), whereas the Maximum index indicates that towhees are relatively abundant (0.50±0.19 and 0.58±0.18 individuals/station respectively). Rufous-sided Towhees were absent from the 15-20 year-old stand at Kennedy Lake but abundant in similar-age stands at Sproat Lake and Franklin River.

We found particularly high abundance in the Kennedy Lake clearcut near Ucluelet (0.29± 0.07 individuals/station). Curiously, Roe (1974) did not report this ground-nester from Pacific Rim National Park, and Hatler *et al.* (1978) describe it as an uncommon resident in that area.

46. Song Sparrow

Song Sparrows were detected in all age-classes (Table 3), and were consistently detected in all age-classes except old-growth (Table 2). Males are loud, highly vocal and easily detected from long distances. Females were only rarely detected. Similar numbers of detections during May and June suggest arrival on breeding territories prior to mid-May (Table 1). The Median-all detections index is probably an accurate reflection of breeding

density.

Song Sparrows were most abundant in clearcuts and 15-20 year-old stands (32/36 and 23/36 stations respectively; Table 13). Among these 2 age-classes, they were significantly more likely to be encountered in clearcuts (χ^2=6.2 with 1 df, p<0.025). Song Sparrows were particularly common in Franklin and Kennedy clearcuts (1.00±0.10 and 1.04±0.18 individuals/station respectively). Abundance of this shrub-nesting species was positively correlated with tree density (r=0.88) and negatively correlated with basal area (r=-0.76), snag density (r=-0.87), crown height (r=-0.77) and canopy closure (r=0.89: Table 14).

The Song Sparrow is an early-successional species which persists (in low densities) in mid-successional forests. Roe (1974) found it to be most abundant in an 8 year-old replanted clearcut in Pacific Rim National Park.

47. White-crowned Sparrow

White-crowned Sparrows were detected in all age-classes except old-growth (Table 3), but were consistently found only in clearcuts, 15-20 year-old, and 30-35 year-old stands (Table 2). Males are highly vocal and easily detected, and females were sometimes detected. Similar numbers of detections during May and June suggest arrival on territory prior to mid-May (Table 1). The Median-all detections index is probably an accurate reflection of breeding density.

White-crowned Sparrows were not equally distributed among clearcuts, 15-20 and 30-35 year-old stands (7/36, 12/36 and 1/26 stations respectively, χ^2=11.2 with 2 df, p<0.005), but there was no difference between clearcut and 15-20 year-old stands (χ^2=1.8 with 1 df, p>0.05). White-crowned Sparrows were particularly common at Sproat Lake transects (0.83±0.21 birds/station in clearcuts and 0.71±0.14 birds/station in 15-20 year-old stands). They were relatively rare at Franklin River (0.04±0.04 birds/station in clearcuts and 0.13± 0.06 birds/station in 15-20 year-old stands), and were completely absent from Kennedy Lake (Tables 4 and 5).

Our results from Kennedy Lake are curious; Roe (1974) recorded 35 White-crowned Sparrow detections in an 8 year-old replanted clearcut in Pacific Rim National Park, and Hatler *et al.* (1978) describe it as an uncommon summer resident in the same area.

48. Golden-crowned Sparrow

Golden-crowned Sparrows were detected in clearcuts, 15-20 year-old forests, and old-growth stands during the 1st survey rotation, but were not consistently detected at any transect (Tables 2 and 3). Lack of detections after late-May indicates migration through study areas (Table 1). This species apparently did not breed on study transects. Hatler *et al.* (1978) describe it as a common summer resident in Pacific Rim National Park, although it is not known to breed there.

49 Fox Sparrow

Fox Sparrows were consistently detected in the clearcut at Kennedy Lake (3/36 stations: Table 2). Roe (1974) detected it only rarely in nearby Pacific Rim National Park.

50 Dark-eyed Junco

Dark-eyed Juncos were abundant and widespread. They were detected in all age-classes (Table 3) and consistently detected in all age-classes except 50-60 year-old forest (Table 2). Both males and females were detected. Declining numbers of detections during the between May and June probably reflect lower detectability later in the season (Table 1). The Median-all detections index is probably a reasonable estimate of breeding abundance.

Dark-eyed Juncos were most abundant in clearcuts and 15-20 year-old stands (Table 13). Among these 2 age-classes, there was no difference in frequency of occurrence (detected at 16/36 and 13/36 stations respectively, $\chi^2=0.52$ with 1 df, $p>0.05$). Dark-eyed Juncos were particularly abundant at Franklin River and Sproat Lake clearcuts (0.54±0.17 and 0.83±0.21 individuals/station). They were rare at the low-elevation Kennedy Lake clearcut (0.04±0.04 individuals/station). Among old-growth stands, they were common only at the Kennedy Lake "hypermaritime" cedar stand (0.68±0.17 individuals/station), where most singing males were apparently located close to ground level. In other old-growth stands and 50-60 year-old forests, singing males were detected using the upper canopy. Manuwal (1983) suggests that treetop singing may be related to insect (e.g., spruce budworm) outbreaks. Abundance of this ground-nesting species was positively correlated with elevation ($r=0.50$), and negatively correlated with canopy closure ($r=-0.58$: Table 14).

The Dark-eyed Junco is primarily an early-successional species which persists (in low numbers) in mid-to-late successional forests. Roe (1974) found it most commonly in a 2 year-old clearcut in Pacific Rim National Park. In the Oregon coast range, Dark-eyed Juncos were nearly twice as numerous in 40-72 year-old forests than in 80-120 year-old or old-growth (>200 years) forests (Carey *et al.* 1991). Patterns were similar in the southern Washington Cascades (Manuwal 1991) with the exception of dry old-growth stands, where Dark-eyed Junco densities were higher than those in younger forests.

Tanagers, finches and crossbills

51. Western Tanager

Western Tanagers were detected only in 50-60 year-old and old-growth forests (Tables 3), and were consistently found only at 3 old-growth stations (Table 2). It is considered a rare migrant in Pacific Rim National Park (Hatler *et al.* 1978).

52. Pine Siskin

Pine Siskins were widespread but sporadic. They were detected in all age-classes (Table 3), but not consistently detected at any transect (Table 2).

53. American Goldfinch

American Goldfinches were rarely detected in clearcut, 15-20 year-old and 30-35 year-old stands (1/36 stations in each age-class: Table 3). Both males and females were detected. Increasing numbers of detections between May and June indicate that this species is a late migrant (Table 1). Roe (1974) rarely detected this species in Pacific Rim National Park.

54. Red Crossbill

Red Crossbills were abundant but sporadic. They were detected in clearcuts, 30-35 year-old, 50-60 year-old and old-growth areas (Table 3), but were consistently detected only in old-growth stands (11/71 stations: Table 2). Both males and females are extremely vocal and easily detected, but typically large foraging flocks make accurate counts difficult (Manuwal and Carey 1991). Increasing detections between May and June may indicate altitudinal migration. The Median-all detections index is probably an accurate reflection of breeding density. Red Crossbills were particularly abundant at the Kennedy Lake "hypermaritime" cedar stand (Table 8).

Roe (1974) found Red Crossbills exclusively in old-growth forest in Pacific Rim National Park. Manuwal (1991) found them to be concentrated in mesic old-growth (250-700 year-old) forests in the southern Washington Cascades.

55. Purple Finch

Purple Finches were consistently but rarely detected in clearcut and 30-35 year-old stands at Kennedy Lake (Table 2). Males are highly vocal; females were not detected. The Purple Finch is described as an uncommon resident in Pacific Rim National Park (Hatler *et al.* 1978).

MISCELLANEOUS OBSERVATIONS

Marbled Murrelets

Bird surveys were not designed to detect Marbled Murrelets, and surveys conducted after 0700 hours will tend to underestimate numbers; in addition, there is an unclear relationship between vocal birds and breeding status (Rodway *et al.* 1991). However, as surveys began at equivalent times in all habitat types, our data provide an index of use in various habitats. Marbled Murrelets were detected at 12 of the 18 study transects, but most detections were in old-growth (Figure 26).

The highest detection rates were found at the top-end of the Meares Island transect, and at the top-end of the Franklin River old-growth transect. At Sproat Lake, more murrelets occurred in lowland old-growth. Although we did not climb trees, murrelets probably nested at Meares Island (UTM 925 527), at Franklin River (UTM 630 029), and in the upper Nahmint (UTM 425 520). In no case did we suspect breeding in habitats other than old-growth. Invariably, whenever birds were observed in 2nd growth habitats, birds were flying high over the study plot.

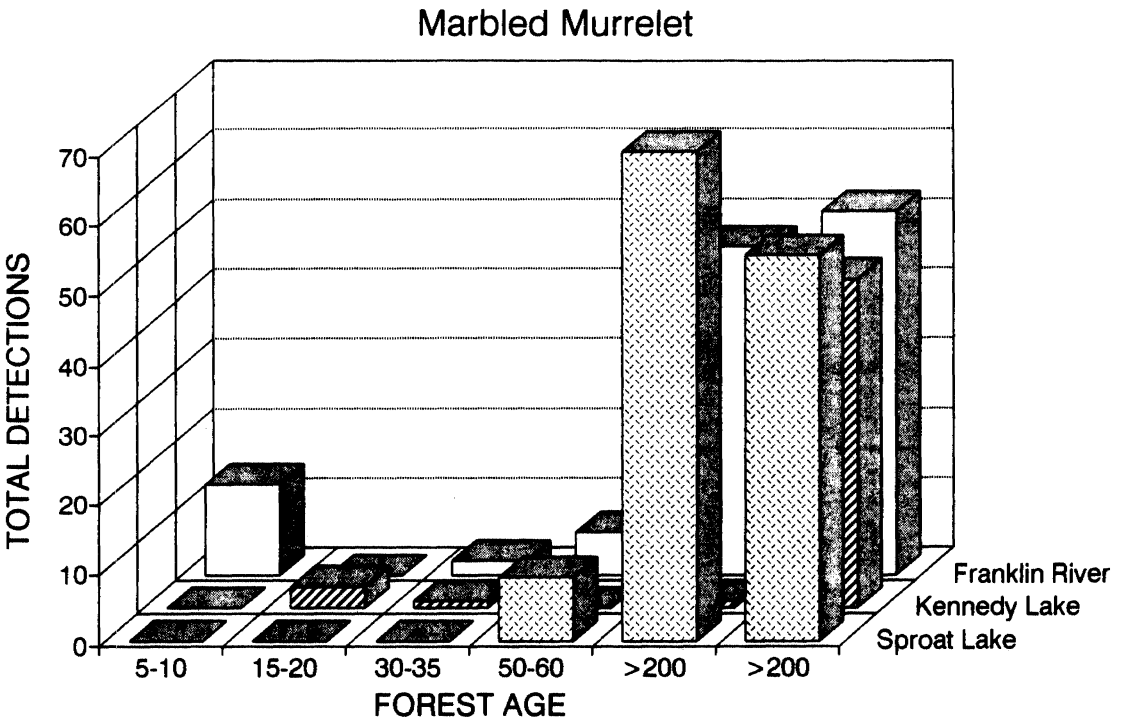

Figure 26: Marbled Murrelet detections.

Raptors

We believe that our survey techniques were inadequate to provide indices of relative abundance, because it was easier to detect raptors in early-successional habitats. However, some incidental records are notable.

Bald Eagle

Three nests were observed in large trees along the Kennedy Lake clearcut transect near Loudon Channel. One nest produced 2 young.

Golden Eagle

On June 2nd, a pair of Golden eagles was observed circling NW of the "Lone Cone" on Meares Island (UTM 895 555). Pair-bonding behavior (swooping) was observed. One juvenile was observed in the same area on August 29th (AB). This observation is noteworthy given the lack of confirmed breeding records from the west coast of Vancouver Island (Campbell *et al.* 1990).

Northern Goshawk

One male was observed below the Franklin River clearcut transect on June 7th (UTM 445 135). Another (perhaps the same bird) was seen in the same area on August 2nd.

Barred Owl

Barred Owls were heard on 3 occasions while camped at Arden Creek on the north arm of Alberni Inlet (UTM 678 445). Another was detected in the upper Nahmint old-growth transect (UTM 435 535). These records suggest a continuing westward range expansion of this species, first detected in British Columbia in 1943 (Munro and Cowan 1949). Campbell *et al.* (1990) list no records for western Vancouver Island.

Screech Owl

We observed a breeding pair at the Arden Creek Forest Recreation Site (UTM 678 445); at least four owls fledged from this nest. According to local fishermen, screech owls have been breeding at this location for several years.

Pygmy Owl

Detected twice during the project; on Meares Island on June 5th (UTM 917 528), and in old-growth forest adjacent to the Sproat Lake clearcut on June 17th (UTM 605 465).

DISCUSSION

LIMITATIONS OF THE STUDY

Many researchers have discussed the limitations of using point-counts to assess bird communities (e.g., Verner 1985, Kessler and Milne 1982, Best 1981, Dawson 1981, Emlen and DeJong 1981). Manuwal and Carey (1991) give a particularly useful synopsis for researchers working in the Pacific Northwest. Like most efforts, our study included some inherent limitations, as follows:

Differential detectability of species

Because of differences in behavior among species, we undoubtedly missed some birds within the 75 metre radius study plots. Loud and persistent singers (e.g., Winter Wren) were probably seldom missed whereas relatively quiet, inconspicuous species (e.g., Brown Creeper) were probably frequently missed. Some researchers (e.g., Verner 1985) have attacked this problem by calculating "detectability coefficients" for individual species. Although this was not the intent of our study, data are recorded in a fashion which would permit such analysis (detections were recorded as a function of distance-from-observer). However, Raphael (1987) showed that unadjusted counts were often as good as index of abundance as did adjusted counts.

For the above reasons, we caution the reader against trying to translate survey results into absolute numbers of birds/plot. Although this makes comparison of relative abundance among species more difficult, it should not affect comparisons between habitats, which was our intent.

Effect of habitat on detectability of species

Habitat conditions also influence detectability of species (Manuwal and Carey 1991, Raphael 1987, Verner 1985). In our study, several wide-ranging species (e.g., Steller's Jay, Northwestern Crow, Common Raven) were detected more often in clearcuts and 15-20 year-old forests than might be expected given known life-history traits (Ehrlich *et al.* 1988, Terres 1987). In general, species detected visually were more likely to be seen from clearcuts. Although we did not test whether habitat conditions influenced detectability of species, data are recorded in a fashion which would permit such analyses. Another important factor is the often mountainous nature of the area. On steep slopes, few birds are detected from above the observer, creating a downward bias in estimates of relative abundance.

Omission of some species

We consider our methods inadequate to survey eagles, forest hawks and owls. This is a fundamental limitation, and one which biases estimates of community species diversity, evenness and dominance. Because most raptors found on Vancouver Island nest in large trees or snags (e.g., Campbell *et al.* 1990, Ehrlich *et al.* 1988, Johnsgard 1988), omission

of these groups from our data presumably leads to underestimation of actual diversity in old-growth and 50-60 year-old stands. On the community level, care must be taken when comparing our results with other studies which include forest raptors (e.g., Carey *et al.* 1991, Wetmore *et al.* 1985, Meslow and Wight 1975, Roe 1974).

Unknown influence of edge and fragmentation effects

Edge effects influence forest bird communities in terms of species diversity and abundance (e g., Kroodsma 1984, Strelke and Dickson 1980, Anderson *et al.* 1977). Size of forest blocks (i.e., "patch" size) is also known to play an important role in determining avian community composition (e.g., Whitcomb *et al.* 1981, Galli *et al.* 1976, Forman *et al.* 1976).

With the exception of Meares Island, our study transects were situated along roads. For this reason, edge and fragmentation effects are factors to be considered in addition to successional trends. We argue that for "managed" forests, construction of roads has become an integral component of the Vancouver Island landscape, and that "edge-influenced" bird communities should be considered "normal". However, our old-growth survey transects along roads may not accurately reflect bird communities in large, pristine blocks of contiguous forest.

Non-uniform logging technology and forest successional trends

Forest harvesting methods have changed dramatically on Vancouver Island since the mid 1930s. The railway-logged 50-60 year-old forest at Sproat Lake was characterized by many standing snags and some large live trees; apparently 10-15% of the original trees were left standing when this stand was "high-graded" during the 1930s. Most 30-35 year-old stands also had at least some standing snags. More recently harvested cut-blocks (clearcuts and 15-20 year-old stands) were typically larger in size, and more commonly dominated by replanted Douglas-fir; standing trees were completely absent.

Our data therefore reflect not only changing forest age, but changing harvest practices. It would be unrealistic to assume that sampled clearcuts or 15-20 year-old stands will resemble the 50-60 year-old stands in another 30 years.

RELATIVE ABUNDANCE OF RESIDENTS AND MIGRANTS

West coast coniferous forests generally harbour fewer neotropical migrants (i.e., those which winter south of the Tropic of Cancer) than do eastern deciduous forests, eastern coniferous forests, boreal forests or Rocky Mountain deciduous forests (Terborgh 1989, MacArthur 1972). In the mature temperate rainforests of coastal B.C., most species are resident, altitudinal or short-distant migrants. Long-distance migrants make up an increasing proportion of the avifauna in younger forests. In our study areas, the proportion of species wintering outside of B.C. varied from a low of 25-41% in old-growth stands to a high of 77-97% in 15-20 year-old forests.

The lower abundance of neotropical migrants in old-growth forests compared to younger

seral stages is similar to patterns observed in Europe (Monkkonen and Helle 1989). Possible reasons for this trend include greater structural similarity between winter habitats and early successional forests, or increased availability of ephemeral food resources in younger forests. In many cases, neotropical migrants may display greater latitude in habitat selection or foraging behavior (Hunter 1992), allowing them to more easily utilize relatively "new" habitats.

RELATIVE ABUNDANCE OF CAVITY-NESTING SPECIES

Increased abundance of cavity-nesting species in older forests is a common feature of most studies dealing with various-age forests (Zarnowitz and Manuwal 1985, Mannan and Meslow 1984, Mannan *et al.* 1980, Haapanen 1965). In coastal temperate rainforests, cavity-nesters account for a large proportion of the avifauna. Many of these species are also year-round residents. Hunter (1992) argues that it is precisely these types of habitat specialists, often with large home range requirements, that are most likely to be most sensitive to clearcutting and large-scale habitat alteration.

ANNUAL FLUCTUATIONS IN BIRD ABUNDANCE

Large annual fluctuations in bird abundance can result from a variety of factors (e.g., De Sante 1990, Helle and Monkkonen 1986, Holmes *et al.* 1986, Anderson *et al.* 1981, Klomp 1980, Svensson 1977, Holmes and Sturges 1975, Kendeigh and Baldwin 1937). Because our data were obtained in a single breeding season, the relative abundance documented may not always reflect "normal" conditions for a particular species in a given forest age-class. Our study presents a snapshot in time, and this should be kept in mind when interpreting results.

The magnitude of population fluctuations between years may differ between seral stages, between species, and between groups of species. For example, Blake *et al.* (1992) detected significant declines in 8 neotropical migratory species after a prolonged draught in Michigan, while short-distance migrants and resident species remained stable. Similarly, both Carey *et al.* (1991) and Gilbert and Allwine (1991), who studied habitats not unlike ours in Oregon, documented significant changes in the relative abundance of some species between years.

BIRD DIVERSITY

The use of diversity indices, once widespread, has come under severe criticism (e.g., Hurlbert 1971, Maguran 1988) and its use appears to be decreasing . All indices of diversity assume that the relative abundance of all species is equally estimated by the survey technique used, which is not the case in most studies. Furthermore, most indices are influenced by sample sizes.

In our study, sample sizes were similar among age-classes but all species were not quantified with the same accuracy and precision. Our results indicate considerable variation in the pattern of avian diversity in relation to forest succession.

SUCCESSIONAL PATTERNS

Many studies have documented the avifaunal changes associated with forest succession for a variety of forest types (Catt 1991, Moskat and Skeleky 1989, Morgan and Freedman 1986, Helle 1985, Taylor and Barmore 1980, Schwab 1979, Shugart *et al.* 1978, Meslow and Wight 1975, Kricher 1973, Shugart and James 1973, Haapanen 1965, Johnstone and Odum 1956). In general, bird abundance and richness increases with successional age but the pattern of increase, and the age-class which contains the most birds or species, often differs between studies and areas. What is uniform is a progressive change in species composition, with forest-associated species invariably being absent from early seral stages. The age at which forest-associated species begin to reappear varies with area and type of succession. Fox (1983), who summarized several North American studies on post-fire succession, concluded that bird abundance increases with age, generally peaking at the sapling stage, whereafter it decreases slightly as the vegetation approaches climax.

Most studies which relate avian abundance and diversity to forest succession have been conducted in single years, or have been hindered by small sample sizes in each of the age-classes examined. This makes some of the patterns found questionable, and may partly explain some of the variability observed between studies. Our study shares some of these shortcomings. Data were collected during a single breeding season. In addition, with 3 replicate transects in each age-class, repeated surveys and reasonably large sample sizes, our results reveal considerable variation among forest stands of a given age-class. There is clearly a need for even larger studies, distributed over a greater geographical area.

Studies in Oregon and Washington old-growth forests revealed large differences in the relative abundance of birds along a moisture gradient (Gilbert and Allwine 1991, Manuwal 1991). Haapanen (1965) and Helle (1985) found bird densities to be almost doubled in moist versus dry old-growth forests in Finland, although a similar pattern was not found in younger forests. The problem of spatial heterogeneity is particularly acute in B.C. forests, where, because of the mountainous terrain, slope, exposure, moisture and soil conditions can vary tremendously within a relatively small area (Mannan 1980). In a modeling exercise, Urban and Smith (1989) showed the importance of considering microhabitat patterns in order to understand the structure of forest bird communities. Admittedly, incorporating all such elements into future B.C. studies will represent a considerable challenge to researchers and managers alike.

CONCLUSIONS

Despite these limitations, our data are sufficient to draw several conclusions about the effects of forest clearcutting, and forest succession, on coastal temperate avian communities on western Vancouver Island.

1. Clearcutting of temperate rainforests on western Vancouver Island produced significantly altered bird communities. Clearcutting led to reduced species richness and abundance for at least 15-20 years after harvest; this effect was more pronounced at inland sites above 500 metres in elevation. Bird diversity

and abundance generally increased in 30-35 year-old stands, dipped slightly in 50-60 year-old stands, and peaked in old-growth cedar-hemlock fir forests. Coastal "hypermaritime" cedar old-growth forests showed considerably lower bird species diversity and abundance than did cedar-hemlock fir stands.

2. Bird communities in "managed" (harvested) forests consist mostly of species which winter outside of Canada. Old-growth bird communities are comprised largely of resident species (year-round inhabitants of B.C.).

3. Bird communities in clearcuts and 15-20 year-old forests consist mostly of ground or shrub-nesting species, whereas old-growth communities contained primarily tree and cavity-nesters. Mid-successional bird communities are intermediate in composition.

4. Individual species responded differently to forest age. Ground and shrub-nesting species (e.g., Orange-crowned Warbler, Song Sparrow and Dark-eyed Junco) were most abundant in recently-logged environments. Cavity-nesting species (e.g., Hairy Woodpecker, Brown Creeper and Chestnut-backed Chickadee) and some insectivores (Winter Wren, Varied Thrush, Pacific Slope Flycatcher) were most abundant in unlogged old-growth forests. Some species (Vaux's Swift, Red-breasted Sapsucker, Pileated Woodpecker, Red-breasted Nuthatch, Western Tanager and Red Crossbill) were found primarily or exclusively in old-growth forests. A few species (MacGillivray's Warbler, Townsend's Warbler, Wilson's Warbler) are most abundant in mid-successional forests.

6. Avian communities varied considerably among study areas. For example, among old-growth forests, Red-breasted Sapsuckers and Hammond's Flycatchers were relatively common at Sproat Lake, but scarce elsewhere. Brown Creepers were relatively abundant at Franklin River and Kennedy Lake, but rarely encountered at Sproat Lake. Wilson's and Townsend's Warblers were present in low densities at Kennedy and Sproat Lake, but absent from Franklin River transects. Similar differences were observed among bird communities in other forest age-classes. Elevation and proximity to the coast apparently influence avian community composition on western Vancouver Island.

RESEARCH NEEDS

This study identified several areas in which data were insufficient to make appropriate conservation decisions. Several additional studies should be carried out, as follows:

Influence of forest-age on reproductive success

Point-count data do not reflect reproductive success. It is possible that a species rarely encountered in old-growth forests (e.g., Wilson's Warbler) may exhibit higher reproductive rates there than in younger forests (or *vice versa*). Further studies should attempt to correlate presence with demographic data; species widely distributed in several

habitats (e.g., Winter Wren, Swainson's Thrush) may provide the opportunity to test such hypotheses.

Effect of habitat conditions on uncommon species

Uncommon, wide-ranging species (e.g., Red-breasted Sapsucker, Hairy Woodpecker, Red-breasted Nuthatch) are underrepresented in the data due to low detectability. Because uncommon habitat "specialists" may be the species most vulnerable to habitat change, further studies should correlate presence/absence data with forest patch size, degree of fragmentation and inter-patch distances.

Differences in avian communities between areas

The non-uniform distribution of some species within a given forest age-class is intriguing and begs for additional research. Are such differences due to differences in the geographical range of individual species, or are they caused by subtle differences in stand structure, species composition, or other microhabitat conditions? If differences are caused by subtle stand attributes, then conceivably we might eventually be able to manipulate a given forest stand so as to attract particular species.

Use of maturing forests by "old-growth" species

The relative lack of "old-growth" species (Vaux's Swift, woodpeckers, Red-breasted Nuthatch, Western Tanager) using 50-60 year-old forests is curious. Additional work is needed to determine what factors limit the recolonization of older regenerating forest by "old-growth" species, and whether these limitations can be overcome through changes in forest management practices. Defining the attributes associated with the presence of such species in younger forests may allow land managers to manipulate stands so that they become attractive to "old-growth" species more quickly.

Development of predictive models

Considerable ecological differences may exist between old-growth stands that superficially appear to be similar. For conservation planning purposes, additional surveys are needed to correlate species occurrence with physiographic, climatic and vegetation patterns. Development of predictive models, in which easily-obtained site data could be used to predict species composition, should be a priority. Such models should be based on multi-year studies to remove bias caused by annual changes in bird abundance.

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APPENDIX I: transect descriptions

Transect Code	M&B map[a]	1:50,000 map[b]	UTM grid[c]	primary road[d]	secondary road[e]	harvested in[f]
FRANKLIN RIVER						
FR1	East	92 C/14	465 135	502	-	1983
FR2	East	92 C/15	545 090	207	208	1975
FR3	East	92 C/14	525 093	328	Darling ML	1958
FR4	East	92 C/14	479 126	409	-	1940
FR5	East	92 C/15	620 030	Newstead ML	-	old-growth[g]
FR6	East	92 C/15	640 033	Newstead ML	-	old-growth
KENNEDY LAKE						
KY1	West	92 C/14	240 270	Barclay ML	-	1985
KY2	West	92 F/4	040 380	?	?	1976
KY3	West	92 F/4	074 390	Landfill Rd.	Grice Bay Rd.	1958
KY4	West	92 F/4	090 360	West ML	Grice Bay Rd.	1938
KY5	West	92 C/14	195 230	"Vet" Rd.	?	old-growth
KY6	West	92 F/4	917 528	Miner's Bay trail	-	old-growth
SPROAT LAKE						
SP1	East	92 F/2	610 450	1114D	-	1983
SP2	East	92 F/2	592 456	1114D	-	1972
SP3	East	92 F/2	525 093	Cous ML	448	1960
SP4	East	92 F/2	650 380	Nahmint ML	-	1932
SP5	East	92 F/3	473 515	Nahmint ML	-	old-growth
SP6	East	92 F/3	465 530	Beverly ML	-	old-growth

[a] MacMillan Bloedel Limited. 1990. Recreation and Logging Road Guide Series (Alberni Region). East and West Maps.

[b] Department of Energy, Mines and Resources. 1980. National Topographic Series (1:50,000).

[c] Universal Transverse Mercator Grid Reference at start of transect.

[d] Road on which majority of transect is based ("ML" is "main line").

[e] Additional road which is part of transect.

[f] According to M&B forest cover maps and/or local personnel.

[g] Old-growth transects are referred to in the text as (from top to bottom), Lower Klanawa, Upper Klanawa, Ucluelet hypermaritime cedar forest, Meares Island, Nahmint Valley and Beverly Creek.

APPENDIX II: Summary of habitat data.

Data are $\bar{x}$ (±s.e.) values/transect and are based on *n*=4 plots for each transect.

Age-class	Location	Elevation (metres ASL)	Proximity to coast (km)	Total Basal area m^2/hectare	Tree density trees/ hectare	Canopy height (metres)	Canopy closure (%)
Clearcut							
	Franklin	235 (30.5)	1.3 (0.2)	0.3 (0.0)	920 (105)	1.2 (0.2)	-
	Kennedy	20 (0.2)	0.2 (0.0)	0.3 (0.1)	1320 (265)	1.4 (0.6)	-
	Sproat	620 (22.4)	7.6 (0.8)	0.3 (0.1)	758 (68)	0.9 (0.9)	-
15-20 year-old							
	Franklin	105 (13.0)	0.8 (0.2)	1.4 (0.6)	565 (68)	2.1 (0.3)	-
	Kennedy	32 (2.2)	3.2 (0.4)	1.7 (0.5)	940 (142)	1.9 (1.0)	-
	Sproat	535 (47.6)	8.8 (1.2)	1.4 (0.8)	460 (62)	2.0 (1.0)	-
30-35 year-old							
	Franklin	220 (15.8)	7.3 (0.5)	16.1 (6.1)	542 (65)	6.7 (1.1)	80.0 (12.5)
	Kennedy	37 (2.2)	3.8 (0.2)	11.6 (6.7)	396 (60)	5.3 (1.8)	85.0 (12.5)
	Sproat	350 (40.9)	8.3 (0.4)	13.1 (8.1)	446 (42)	6.9 (4.2)	85.0 (10.5)
50-60 year-old							
	Franklin	205 (4.3)	7.0 (2.1)	28.7 (9.7)	440 (95)	21.2 (3.0)	85.0 (7.5)
	Kennedy	40 (7.1)	8.4 (0.2)	26.3 (7.9)	212 (18)	18.4 (6.1)	90.0 (8.5)
	Sproat	72 (9.6)	0.6 (0.0)	36.2 (10.2)	292 (62)	26.2 (12.1)	75.0 (5.5)
Old-growth [1]							
	Franklin	115 (16.4)	9.8 (1.1)	61.2 (11.0)	355 (45)	35.5 (4.7)	70.5 (10.5)
	Franklin	165 (8.3)	10.8 (1.2)	74.8 (12.5)	320 (61)	38.0 (3.1)	70.0 (9.5)
	Kennedy	30 (3.5)	0.2 (0.4)	45.2 (26.2)	212 (68)	28.6 (1.8)	50.5 (18.5)
	Kennedy	135 (59.7)	0.6 (0.7)	64.4 (8.1)	246 (42)	36.5 (5.3)	80.0 (5.5)
	Sproat	380 (10.0)	28.0 (1.5)	66.0 (12.6)	324 (71)	38.5 (7.0)	77.5 (10.5)
	Sproat	280 (14.1)	32.0 (2.2)	68.5 (9.6)	350 (55)	38.0 (4.5)	75.0 (14.5)

[1] Data for old-growth transects are in the following order (from top to bottom): Lower Klanawa, Upper Klanawa, Ucluelet hypermaritime cedar forest, Meares Island, Nahmint Valley and Beverly Creek.

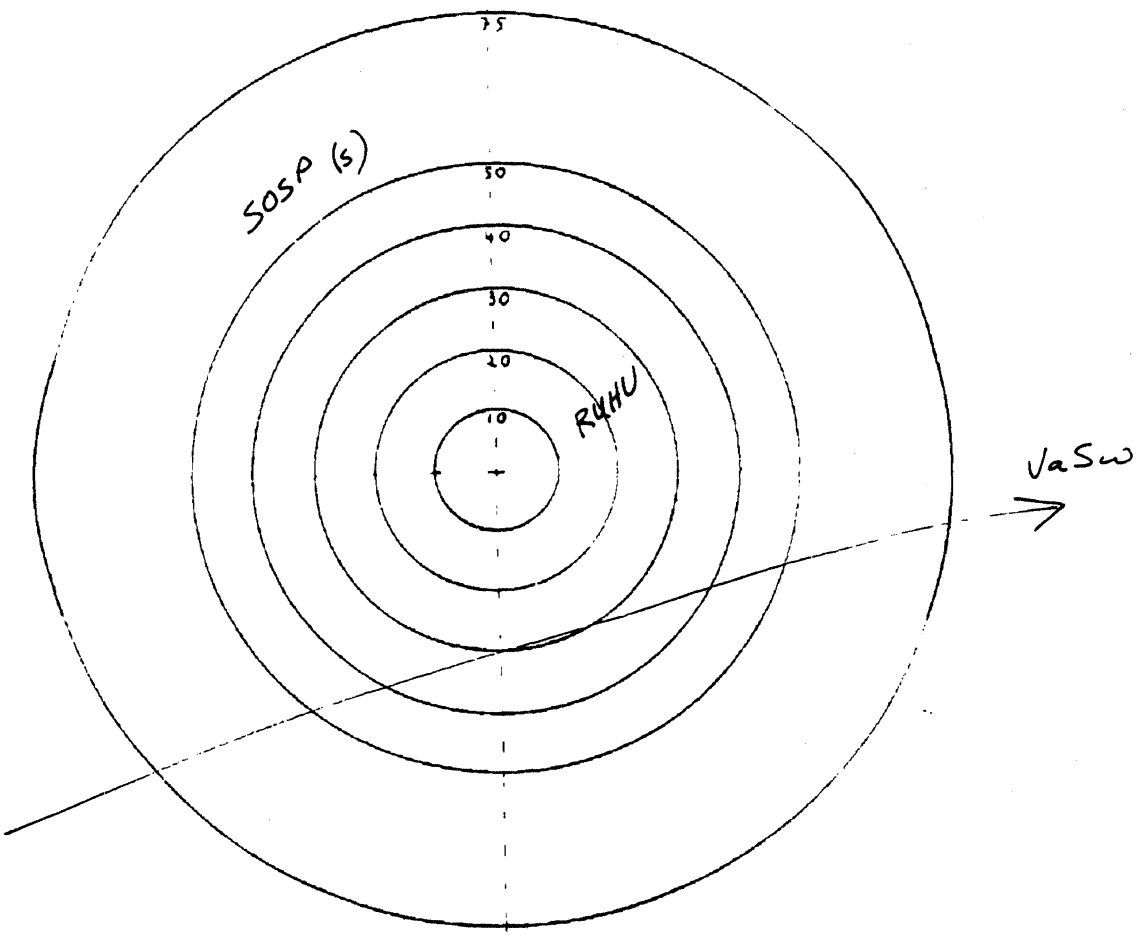
APPENDIX III: sample bird data sheet

NOTE
Data sheets actually used in the field were 8.5x14 inches in size and contained 3 circles. A different circle was used to records heard within each 4 minute sampling period, for a total of 12 minutes/station.

The sample data show a Rufous Hummingbird (RUHU) detected within the 20 metre circle, a Song Sparrow singing within the 75 metre circle, and a Vaux's Swift which flew over the plot (the latter would not have been included for analysis).

PLOT_____STATION NO._____DATE_____TIME-START_____OBSERVER_____

WEATHER_____COMMENTS_____



APPENDIX IV: species for which survey methods are suitable.

NOTE
In our experience, the following species can be reliably detected by sound alone. All were detected at least once during the survey.

1. Blue Grouse
2. Ruffed Grouse
3. Vaux's Swift
4. Rufous Hummingbird
5. Northern Flicker
6. Red-breasted Sapsucker
7. Hairy Woodpecker
8. Pileated Woodpecker
9. Olive-sided Flycatcher
10. Western Wood Pewee
11. Hammond's Flycatcher
12. Willow Flycatcher
13. Pacific Slope Flycatcher
14. Tree Swallow
15. Violet-green Swallow
16. Barn Swallow
17. Rough-winged Swallow
18. Steller's Jay
19. Northwestern Crow
20. Common Raven
21. Chestnut-backed Chickadee
22. Brown Creeper
23. Red-breasted Nuthatch
24. House Wren
25. Winter Wren
26. Golden-crowned Kinglet
27. Townsend's Solitaire
28. Swainson's Thrush
29. Hermit Thrush
30. Varied Thrush
31. American Robin
32. Cedar Waxwing
33. European Starling
34. Hutton's Vireo
35. Solitary Vireo
36. Warbling Vireo
37. Orange-crowned Warbler
38. Yellow-rumped Warbler
39. Townsend's Warbler
40. Black-throated Grey Warbler
41. Yellow Warbler
42. MacGillivray's Warbler
43. Wilson's Warbler
44. Common Yellowthroat
45. Rufous-sided Towhee
46. Song Sparrow
47. White-crowned Sparrow
48. Golden-crowned Sparrow
49. Fox Sparrow
50. Dark-eyed Junco
51. Western Tanager
52. Pine Siskin
53. American Goldfinch
54. Red Crossbill
55. Purple Finch

APPENDIX V: list of "difficult" species

NOTE
In several species, "song" is difficult to distinguish from "call". In others, there is essentially no "song" at all. For the following 18 species, all detections were tabulated as "song" for analyses. For between-area and between-age-class comparisons, differences between SINGING-MALE and ALL-DETECTION results are therefore due to differences in other species. Species numbers are as in Appendix IV.

3. Vaux's Swift
4. Rufous Hummingbird
5. Northern Flicker
6. Red-breasted Sapsucker
7. Hairy Woodpecker
8. Pileated Woodpecker
14. Tree Swallow
15. Violet-green Swallow
16. Barn Swallow
17. Rough-winged Swallow
18. Steller's Jay
19. Northwestern Crow
20. Common Raven
21. Chestnut-backed Chickadee
23. Red-breasted Nuthatch
26. Golden-crowned Kinglet
27. Townsend's Solitaire
32. Cedar Waxwing

APPENDIX VI: Median-all-detections bird data

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *median* count of *all* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- No attempt is made to distinguish singing males from other birds.

Summary Sheet: Average and Standard Errors of MEDIAN number of bird detections/sample station.

TRANSECT LOCATION:		FR1	FR2	FR3	FR4	FR5	FR6
Franklin River		avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.29 ±0.09	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.67 ±0.14	0.79 ±0.14	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaWo	Hairy Woodpecker	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.11	0.25 ±0.07
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0.63 ±0.13	0.04 ±0.04	1 ±0.17	0.79 ±0.12
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0.25 ±0.11	0.04 ±0.04	0.08 ±0.08	0 ± 0	0.46 ±0.12
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.25 ±0.13	0.25 ±0.17	0.75 ± 0.2	0.54 ±0.19
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.09	0.38 ± 0.1
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0.08 ±0.05	0.83 ± 0.2	0.96 ±0.27	1.88 ±0.13	1.5 ±0.12
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.46 ±0.24	0.71 ±0.25	0.38 ±0.12	0.63 ±0.16
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.08 ±0.08	0.21 ±0.09	0.58 ±0.16	0.83 ± 0.2	0.04 ±0.04	0.21 ±0.09
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.33 ±0.14	0 ± 0	1.04 ±0.19	0.67 ±0.14
AmRo	American Robin	0.58 ±0.13	0.42 ±0.22	1.13 ±0.16	1.25 ±0.22	0.42 ±0.12	0.63 ±0.18
CeWa	Cedar Waxwing	0.17 ±0.16	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.75 ±0.11	0.25 ±0.13	0.04 ±0.04	0.25 ±0.07
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	1 ±0.17	1.46 ± 0.2	0.17 ±0.09	0.13 ±0.06	0 ± 0	0 ± 0
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.38 ± 0.1	0.13 ±0.06	0 ± 0	0.08 ±0.05	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0.21 ±0.09	0.71 ±0.17	0.38 ±0.13	0 ± 0	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.08 ±0.08	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1 ± 0.1	0.42 ±0.16	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.04 ±0.04	0.13 ±0.06	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.54 ±0.17	0.04 ±0.04	0 ± 0	0 ± 0	0.04 ±0.04	0.08 ±0.08
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.13 ±0.09
PuFi	Purple Finch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MEDIAN number of bird detections/sample station.

TRANSECT LOCATION: Kennedy Lake		KY1 avg ±s.e.	KY2 avg ±s.e	KY3 avg ±s.e.	KY4 avg ± s.e	KY5 avg ±s.e.	KY6 avg ±s.e.
BlGr	Blue Grouse	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.67 ±0.12	0.96 ±0.07	0.13 ±0.06	0 ± 0	0.32 ± 0.1	0.08 ±0.05
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.06	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.13 ±0.09	0.04 ±0.04	0 ± 0	0.13 ±0.09	0.18 ± 0.1	0.83 ±0.17
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.05 ±0.04	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.08 ±0.05	0.13 ±0.06	0.04 ±0.04	0.17 ±0.09	0.14 ±0.07	0 ± 0
NoCr	Northwestern Crow	0.04 ±0.04	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.05
CoRa	Common Raven	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0.05 ±0.04	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.12	0.14 ±0.07	0.33 ±0.14
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0.14 ±0.07	0.21 ±0.07
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.75 ± 0.2	0.08 ±0.05	0.42 ±0.15	0.79 ±0.14	0.68 ±0.12	1.38 ±0.13
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.5 ±0.22	0.42 ± 0.1	0.18 ± 0.1	0.29 ±0.14
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.83 ±0.09	1.54 ±0.21	1.04 ±0.17	1.21 ±0.14	0.18 ±0.12	0.29 ±0.11
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	0.54 ±0.12	0.23 ± 0.1	0.67 ±0.16
AmRo	American Robin	0.88 ±0.16	0.29 ±0.09	0.83 ±0.19	1.38 ±0.18	0.95 ±0.19	0.46 ±0.17
CeWa	Cedar Waxwing	0 ± 0	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	1.17 ±0.18	1.79 ± 0.2	0.75 ±0.13	0.29 ±0.11	0.36 ±0.13	0.04 ±0.04
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0.08 ±0.08	1.46 ±0.34	0.88 ±0.26	0 ± 0	0.25 ±0.11
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.08 ±0.05	0.5 ±0.13	0.21 ±0.11	0 ± 0	0 ±. 0	0 ± 0
WiWa	Wilson's Warbler	0.04 ±0.04	0.17 ±0.11	0.38 ± 0.1	0.08 ±0.08	0.09 ±0.09	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.29 ±0.07	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1.04 ±0.18	0.75 ±0.15	0.33 ±0.15	0.04 ±0.04	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.17 ±0.09	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.04 ±0.04	0.13 ±0.06	0 ± 0	0 ± 0	0.68 ±0.17	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.05 ±0.04	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0.08 ±0.08	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.41 ±0.16	0.13 ±0.09
PuFi	Purple Finch	0.04 ±0.04	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MEDIAN number of bird detections/sample station.

	TRANSECT LOCATION:	SP1	SP2	SP3	SP4	SP5	SP6
	Sproat Lake	avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0 ± 0	0.17 ±0.07	0.17 ±0.09	0.04 ±0.04	0 ± 0	0.04 ±0.04
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.16
RuHu	Rufous Hummingbird	0.21 ±0.11	0.08 ±0.08	0.08 ±0.08	0.13 ±0.06	0 ± 0	0.04 ±0.04
NoFl	Northern Flicker	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.21 ±0.11	0.25 ±0.11
HaWo	Hairy Woodpecker	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.05
OSFl	Olive-sided Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.04 ±0.04
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.07	0.58 ±0.14	0.67 ±0.16
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0 ± 0	0.54 ±0.09	0.67 ±0.15	1.21 ±0.12
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0.08 ±0.08
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0 ± 0	0.13 ±0.09	0.67 ±0.25	1.21 ±0.17
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.17 ±0.07	0 ± 0	0 ± 0	0 ± 0
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.14	0.17 ±0.09
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	0.42 ±0.12	0.38 ± 0.1	1.29 ±0.14	0.58 ± 0.1
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.75 ±0.17	0.08 ±0.05	0.5 ±0.19	0.46 ±0.18
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0 ± 0	0 ± 0	1.33 ±0.22	0.42 ± 0.1	0.33 ±0.12	0.58 ±0.18
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.46 ±0.17	0.13 ±0.09	0.88 ±0.18	0.25 ±0.17
AmRo	American Robin	0.17 ±0.07	0.25 ±0.11	0.96 ±0.25	1.38 ± 0.2	0.5 ±0.13	0.08 ±0.08
CeWa	Cedar Waxwing	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0.42 ±0.12
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.13 ±0.09	0.13 ±0.06	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.13 ±0.09	1 ± 0.1	0.42 ±0.14	0 ± 0	0 ± 0	0.04 ±0.04
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0.58 ±0.14	1.38 ±0.28	0.13 ±0.09	0 ± 0
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.63 ±0.25	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.21 ±0.09	0.46 ±0.11	0.71 ±0.12	0.13 ±0.09	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0 ± 0	0.08 ±0.05	0 ± 0	0 ± 0	0.04 ±0.04
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.25 ±0.11	0.21 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	0.75 ±0.14	0.71 ±0.16	0.13 ±0.09	0 ± 0	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.83 ± 0.2	0.71 ±0.14	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.83 ±0.21	0.5 ± 0.1	0.08 ±0.08	0 ± 0	0 ± 0	0.08 ±0.05
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.04 ±0.04
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.24	0 ± 0
PuFi	Purple Finch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

APPENDIX VII: Maximum-all-detections bird data

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *maximum* count of *all* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- No attempt is made to distinguish singing males from other birds.

Summary Sheet: Average and Standard Errors of MAXIMUM number of bird detections/sample station.

TRANSECT LOCATION: Franklin River		FR1 avg ±s.e.	FR2 avg ±s.e	FR3 avg ±s.e.	FR4 avg ± s.e	FR5 avg ±s.e.	FR6 avg ±s.e.
BlGr	Blue Grouse	1 ±0.17	0.5 ±0.19	0.17 ±0.11	0 ± 0	0.08 ±0.08	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.5 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0
VaSw	Vaux s Swift	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.24	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	1.33 ±0.14	1.33 ±0.14	0.25 ±0.13	0.17 ±0.11	0.25 ±0.17	0.17 ±0.11
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.33 ±0.18
HaWo	Hairy Woodpecker	0.5 ±0.14	0 ± 0	0 ± 0	0 ± 0	0.83 ±0.16	1.25 ±0.13
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.42 ±0.14	0.08 ±0.08	0 ± 0	0.17 ±0.11	0.08 ±0.08	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0.25 ±0.13	0 ± 0	0.17 ±0.11	0.33 ±0.14
WiFl	Willow Flycatcher	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.17 ±0.11	0 ± 0	1.08 ±0.14	0.25 ±0.13	2.08 ±0.18	1.75 ±0.29
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.5 ±0.14	0.83 ±0.23	0.67 ±0.18	0.58 ±0.28	0.5 ±0.14	1.33 ±0.22
NoCr	Northwestern Crow	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.58 ±0.22	1.17 ±0.54	2.25 ±0.41	1.33 ±0.22
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	1 ±0.12	1 ± 0.2
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.25 ±0.13
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0.17 ±0.11	1.33 ±0.25	1.83 ±0.35	2.83 ±0.23	2.5 ±0.28
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	2.67 ±0.92	1.42 ±0.34	1.92 ±0.36	1.58 ±0.18
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.58 ±0.22	1.17 ±0.23	1.33 ±0.32	2.25 ±0.24	0.67 ±0.18	1.08 ± 0.3
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0.25 ±0.13	0 ± 0	0 ± 0	0.42 ±0.14
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.92 ±0.22	0.08 ±0.08	2.33 ±0.27	1.75 ±0.27
AmRo	American Robin	1.17 ±0.23	0.92 ±0.28	2.58 ±0.22	2.17 ±0.33	1.67 ±0.32	1.75 ±0.21
CeWa	Cedar Waxwing	0.33 ±0.18	0.67 ±0.27	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	1.42 ±0.18	1.08 ±0.14	0.5 ±0.22	1.25 ±0.24
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	2 ±0.31	2.08 ±0.36	0.75 ±0.13	1 ±0.33	0.17 ±0.11	0 ± 0
YRWa	Yellow-rumped Warbler	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0.5 ±0.19	0.33 ±0.18	0.42 ±0.14	0.08 ±0.08
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	1.17 ±0.16	0.83 ±0.11	0.08 ±0.08	0.42 ±0.18	0.08 ±0.08	0 ± 0
WiWa	Wilson's Warbler	0.33 ±0.14	0.58 ±0.18	1.33 ±0.22	1 ± 0.2	0.25 ±0.13	0.33 ±0.14
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.5 ±0.19	0.58 ±0.18	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1.33 ±0.14	1.17 ±0.16	0 ± 0	0.42 ±0.14	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.17 ±0.11	0.5 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.33 ±0.14	0.67 ±0.18	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13
FoSp	Fox Sparrow	0.08 ±0.08	0 ± 0	0.42 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	1.83 ± 0.2	0.83 ±0.16	0.33 ±0.14	0.08 ±0.08	0.42 ±0.25	0.75 ±0.21
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0
AmGo	American Goldfinch	0.75 ±0.57	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11	1.17 ±0.64	3.75 ±1.09
PuFi	Purple Finch	0.17 ±0.11	0 ± 0	0.17 ±0.11	0.25 ±0.13	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MAXIMUM number of bird detections/sample station.

TRANSECT LOCATION: Kennedy Lake		KY1 avg ±s.e.	KY2 avg ±s.e	KY3 avg ±s.e.	KY4 avg ± s.e	KY5 avg ±s.e.	KY6 avg ±s.e.
BlGr	Blue Grouse	0.17 ±0.11	0.33 ±0.14	0.08 ±0.08	0.08 ±0.08	0.09 ±0.09	0.08 ±0.08
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	1.17 ± 0.2	1.17 ±0.11	1 ± 0.2	0.33 ±0.18	1 ± 0	0.75 ±0.17
NoFl	Northern Flicker	0 ± 0	0.33 ±0.18	0.25 ±0.17	0.42 ±0.18	0.27 ±0.19	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0.25 ±0.13
HaWo	Hairy Woodpecker	0.25 ±0.13	0.08 ±0.08	0 ± 0	0.08 ±0.08	0.55 ±0.15	0.5 ±0.14
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.17 ±0.11	0 ± 0	0.08 ±0.08	0 ± 0	0.18 ±0.12	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
HaFl	Hammond's Flycatcher	0.17 ±0.11	0 ± 0	0.17 ±0.11	0.08 ±0.08	0.09 ±0.09	0.08 ±0.08
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.25 ±0.17	0.33 ±0.18	0 ± 0	0.25 ±0.13	1 ±0.18	1.42 ±0.25
TrSw	Tree Swallow	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0.08 ±0.08	0.5 ±0.34	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
NRWS	Northern Rough-winged Swall	0.25 ±0.24	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.42 ±0.14	0.75 ±0.13	0.25 ±0.13	0.83 ±0.16	0.91 ± 0.2	0.08 ±0.08
NoCr	Northwestern Crow	0.42 ±0.14	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0	0.58 ±0.22
CoRa	Common Raven	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0.55 ±0.24	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.92 ±0.25	0.73 ±0.19	1.42 ±0.22
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.17 ±0.16	0.33 ±0.14	0.55 ± 0.2	0.67 ±0.18
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13	0 ± 0	0.33 ±0.22
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.92 ±0.22	0.33 ±0.14	1.25 ±0.24	1.5 ±0.25	1.73 ±0.19	2 ± 0.2
GCKi	Golden-crowned Kinglet	0 ± 0	0.17 ±0.11	1.75 ±0.36	1.25 ±0.17	0.73 ±0.23	1.08 ±0.28
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	1.83 ± 0.2	3 ± 0.2	2.92 ± 0.3	2.92 ± 0.3	1.09 ± 0.3	0.83 ±0.23
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	1.67 ±0.25	1.18 ±0.31	1.42 ±0.14
AmRo	American Robin	1.83 ±0.31	1.25 ±0.29	2 ± 0.2	2.5 ±0.25	2 ±0.29	1.33 ±0.18
CeWa	Cedar Waxwing	0.33 ±0.22	0.42 ±0.18	0.58 ±0.25	0 ± 0	0.45 ±0.35	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
HuVi	Hutton's Vireo	0.08 ±0.08	0.08 ±0.08	0.33 ±0.14	0.33 ±0.18	0.09 ±0.09	0.25 ±0.13
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	2.08 ±0.22	2.92 ± 0.3	2.42 ±0.34	0.92 ±0.14	1.36 ±0.23	0.67 ±0.22
YRWa	Yellow-rumped Warbler	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0.08 ±0.08	0.25 ±0.17	3.17 ±0.44	1.92 ±0.38	0.64 ± 0.3	0.83 ± 0.2
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.25 ±0.13	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.33 ±0.14	1.08 ±0.18	0.92 ±0.28	0.08 ±0.08	0.36 ±0.19	0 ± 0
WiWa	Wilson's Warbler	0.25 ±0.13	0.58 ±0.18	1.17 ±0.16	0.5 ±0.14	0.55 ± 0.2	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.83 ±0.11	0.08 ±0.08	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
SoSp	Song Sparrow	1.33 ±0.18	1.92 ±0.22	1.25 ±0.36	0.17 ±0.11	0.27 ±0.13	0 ± 0
WCSp	White-crowned Sparrow	0.17 ±0.11	0 ± 0	0 ± 0	0.17 ±0.16	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.33 ±0.14	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.33 ±0.14	2.17 ±0.31	0.25 ±0.13	0.08 ±0.08	2.18 ±0.57	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0.08 ±0.08
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.18 ±0.17	0 ± 0
AmGo	American Goldfinch	0.17 ±0.16	0.5 ±0.25	0.33 ±0.22	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0.08 ±0.08	0 ± 0	0.92 ±0.64	0.08 ±0.08	3.36 ±1.39	0.92 ±0.28
PuFi	Purple Finch	0.17 ±0.11	0.17 ±0.11	0.58 ±0.18	0.08 ±0.08	0.18 ±0.17	0 ± 0

Summary Sheet: Average and Standard Errors of MAXIMUM number of bird detections/sample station.

TRANSECT LOCATION:		SP1	SP2	SP3	SP4	SP5	SP6
Sproat Lake		avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.5 ±0.14	0.92 ±0.22	0.75 ±0.21	0.33 ±0.14	0.33 ±0.14	0.33 ±0.14
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0.17 ±0.16	0 ± 0	0 ± 0	0.17 ±0.16	0.42 ± 0.4
RuHu	Rufous Hummingbird	0.33 ±0.14	0.83 ±0.28	0.33 ±0.14	0.5 ±0.14	0 ± 0	0.33 ±0.14
NoFl	Northern Flicker	0 ± 0	0.08 ±0.08	0.25 ±0.17	0.08 ±0.08	0 ± 0	0.08 ±0.08
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.5 ±0.14	0.83 ±0.23
HaWo	Hairy Woodpecker	0.42 ±0.18	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08	0.42 ±0.14	0.25 ±0.13
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13	0.17 ±0.11
OSFl	Olive-sided Flycatcher	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08	0 ± 0	0.08 ±0.08	0.17 ±0.11
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0.17 ±0.16	0.08 ±0.08	0.92 ±0.28	1.58 ±0.25	1.33 ± 0.3
WiFl	Willow Flycatcher	0.08 ±0.08	0.5 ±0.22	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0.75 ±0.21	1.58 ±0.14	1.5 ±0.14	1.92 ±0.22
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0.33 ±0.14	0.33 ±0.14	0 ± 0	0.25 ±0.17
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.33 ±0.18	0.92 ±0.22	1.92 ±0.42	2.25 ±0.29
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.58 ±0.18	0.08 ±0.08	0.25 ±0.13	0.42 ±0.14
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.67 ±0.25	0.5 ±0.22
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	1 ± 0.2	1.25 ±0.13	2.5 ±0.22	1.33 ±0.22
GCKi	Golden-crowned Kinglet	0 ± 0	0.17 ±0.11	1.92 ±0.46	0.92 ±0.28	2.67 ±0.56	1.08 ±0.22
ToSo	Townsend's Solitaire	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.08 ±0.08	0.75 ±0.21	2.58 ±0.28	1.08 ±0.22	0.92 ±0.18	1.42 ±0.32
HeTh	Hermit Thrush	0 ± 0	0.08 ±0.08	0.42 ±0.28	0.08 ±0.08	0 ± 0	0.08 ±0.08
VaTh	Varied Thrush	0 ± 0	0.08 ±0.08	1.42 ± 0.4	0.75 ±0.21	2.08 ±0.28	1.25 ±0.29
AmRo	American Robin	0.67 ±0.14	1.33 ±0.18	1.75 ±0.31	2.33 ±0.27	2 ±0.26	1.17 ±0.28
CeWa	Cedar Waxwing	0.08 ±0.08	0.33 ±0.22	0.33 ±0.32	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.42 ±0.18	0.42 ±0.32	0.17 ±0.16	1 ± 0
SoVi	Solitary Vireo	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.5 ±0.19	0.58 ±0.18	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.75 ±0.17	1.58 ±0.22	1.25 ±0.24	0.17 ±0.11	0 ± 0	0.42 ±0.14
YRWa	Yellow-rumped Warbler	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0.08 ±0.08	1.08 ±0.18	3.08 ± 0.4	0.83 ±0.23	0.17 ±0.11
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	1.5 ±0.32	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0.08 ±0.08	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.75 ±0.17	0.92 ±0.14	1.25 ±0.21	0.58 ±0.18	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0.25 ±0.13	0.42 ±0.22	0.17 ±0.11	0.08 ±0.08	0.08 ±0.08
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.92 ±0.18	1.25 ±0.17	0.17 ±0.11	0 ± 0	0 ± 0	0.08 ±0.08
SoSp	Song Sparrow	1.58 ±0.22	1.33 ±0.27	0.5 ±0.22	0 ± 0	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	1.83 ±0.33	1.25 ±0.21	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.25 ±0.17	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	2.58 ±0.46	2.25 ±0.53	0.42 ±0.18	0 ± 0	0 ± 0	0.33 ±0.18
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08
PiSi	Pine Siskin	0.17 ±0.16	0.33 ±0.14	0.5 ±0.48	0.08 ±0.08	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	1.75 ±1.01	1 ±0.55
PuFi	Purple Finch	0 ± 0	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08

APPENDIX VIII: Average-all-detections bird data

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *average* count of *all* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- No attempt is made to distinguish singing males from other birds.

Summary Sheet: Average and Standard Errors of AVERAGE number of bird detections/sample station.

	TRANSECT LOCATION:	FR1		FR2		FR3		FR4		FR5		FR6	
	Franklin River	avg	±s.e.	avg	±s.e	avg	±s.e.	avg	± s.e	avg	±s.e.	avg	±s.e.
BlGr	Blue Grouse	0.38	±0.07	0.17	±0.07	0.04	±0.03	0	± 0	0.02	±0.02	0	± 0
RuGr	Ruffed Grouse	0	± 0	0	± 0	0.13	±0.04	0.04	±0.04	0	± 0	0	± 0
VaSw	Vaux s Swift	0	± 0	0	± 0	0	± 0	0.06	±0.06	0	± 0	0	± 0
RuHu	Rufous Hummingbird	0.63	±0.09	0.75	± 0.1	0.06	±0.03	0.06	±0.04	0.06	±0.04	0.04	±0.03
NoFl	Northern Flicker	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
RBSa	Red-breasted Sapsucker	0	± 0	0	± 0	0	± 0	0	± 0	0.02	±0.02	0.08	±0.05
HaWo	Hairy Woodpecker	0.15	±0.05	0	± 0	0.02	±0.02	0	± 0	0.33	±0.09	0.44	±0.04
PiWo	Pileated Woodpecker	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
OSFl	Olive-sided Flycatcher	0.1	±0.04	0.02	±0.02	0	± 0	0.04	±0.03	0.02	±0.02	0	± 0
WWPe	Western Wood Pewee	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
HaFl	Hammond's Flycatcher	0	± 0	0	± 0	0.06	±0.03	0	± 0	0.04	±0.03	0.1	±0.05
WiFl	Willow Flycatcher	0.02	±0.02	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
PSFl	Pacific Slope Flycatcher	0.04	±0.03	0	± 0	0.58	±0.09	0.08	±0.05	1.02	±0.11	0.83	±0.11
TrSw	Tree Swallow	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
VGSw	Violet-green Swallow	0	± 0	0.02	±0.02	0	± 0	0	± 0	0	± 0	0	± 0
BaSw	Barn Swallow	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
NRWS	Northern Rough-winged Swall	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
StJa	Steller's Jay	0.13	±0.04	0.33	± 0.1	0.19	±0.05	0.19	± 0.1	0.13	±0.04	0.52	±0.09
NoCr	Northwestern Crow	0	± 0	0.02	±0.02	0	± 0	0	± 0	0	± 0	0	± 0
CoRa	Common Raven	0	± 0	0	± 0	0	± 0	0	± 0	0.02	±0.02	0	± 0
CBCh	Chestnut-backed Chickadee	0	± 0	0	± 0	0.27	± 0.1	0.42	±0.21	1	± 0.2	0.6	±0.13
BrCr	Brown Creeper	0	± 0	0	± 0	0	± 0	0.02	±0.02	0.38	±0.06	0.42	±0.09
RBNu	Red-breasted Nuthatch	0	± 0	0	± 0	0	± 0	0	± 0	0.02	±0.02	0.06	±0.03
HoWr	House Wren	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
WiWr	Winter Wren	0	± 0	0.08	±0.05	0.83	±0.18	0.98	±0.23	1.88	±0.13	1.54	±0.17
GCKi	Golden-crowned Kinglet	0	± 0	0	± 0	0.92	±0.28	0.69	± 0.2	0.67	±0.14	0.71	±0.12
ToSo	Townsend's Solitaire	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
SwTh	Swainson's Thrush	0.17	±0.06	0.4	± 0.1	0.65	±0.15	0.96	±0.13	0.19	±0.06	0.38	±0.11
HeTh	Hermit Thrush	0	± 0	0	± 0	0.06	±0.03	0	± 0	0	± 0	0.1	±0.04
VaTh	Varied Thrush	0	± 0	0	± 0	0.4	±0.12	0.02	±0.02	1.17	±0.16	0.75	±0.13
AmRo	American Robin	0.56	±0.11	0.44	±0.17	1.31	±0.13	1.21	±0.19	0.63	±0.11	0.75	±0.14
CeWa	Cedar Waxwing	0.13	±0.08	0.19	±0.07	0	± 0	0	± 0	0	± 0	0	± 0
EuSt	European Starling	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
HuVi	Hutton's Vireo	0	± 0	0	± 0	0.77	± 0.1	0.4	±0.09	0.15	±0.07	0.44	±0.09
SoVi	Solitary Vireo	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
WaVi	Warbling Vireo	0	± 0	0	± 0	0.06	±0.04	0	± 0	0	± 0	0	± 0
OCWa	Orange-crowned Warbler	1.06	±0.15	1.35	±0.22	0.27	±0.06	0.31	±0.09	0.04	±0.03	0	± 0
YRWa	Yellow-rumped Warbler	0.02	±0.02	0	± 0	0	± 0	0	± 0	0	± 0	0.02	±0.02
ToWa	Townsend's Warbler	0	± 0	0	± 0	0.13	±0.05	0.1	±0.06	0.1	±0.04	0.02	±0.02
BTGW	Black-throated Grey Warbler	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
YeWa	Yellow Warbler	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
MGWa	MacGillivray's Warbler	0.46	±0.08	0.27	±0.05	0.02	±0.02	0.15	±0.06	0.02	±0.02	0	± 0
WiWa	Wilson's Warbler	0.08	±0.03	0.27	± 0.1	0.73	±0.12	0.44	±0.11	0.06	±0.03	0.08	±0.03
CoYe	Common Yellowthroat	0	± 0	0	± 0	0	± 0	0.04	±0.03	0	± 0	0	± 0
RSTo	Rufous-sided Towhee	0.15	±0.05	0.17	±0.05	0	± 0	0	± 0	0	± 0	0	± 0
SoSp	Song Sparrow	0.92	±0.09	0.5	±0.11	0	± 0	0.13	±0.05	0	± 0	0	± 0
WCSp	White-crowned Sparrow	0.06	±0.04	0.19	±0.06	0.02	±0.02	0	± 0	0	± 0	0	± 0
GCSp	Golden-crowned Sparrow	0.08	±0.03	0.17	±0.05	0	± 0	0	± 0	0	± 0	0.06	±0.03
FoSp	Fox Sparrow	0.02	±0.02	0	± 0	0.1	±0.04	0.02	±0.02	0	± 0	0	± 0
DEJu	Dark-eyed Junco	0.75	±0.13	0.23	±0.05	0.08	±0.03	0.02	±0.02	0.13	±0.07	0.21	±0.06
WeTa	Western Tanager	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0	0	± 0
PiSi	Pine Siskin	0	± 0	0	± 0	0	± 0	0	± 0	0.02	±0.02	0	± 0
AmGo	American Goldfinch	0.19	±0.14	0.02	±0.02	0	± 0	0	± 0	0	± 0	0	± 0
ReCr	Red Crossbill	0	± 0	0	± 0	0	± 0	0.04	±0.03	0.33	±0.17	1	±0.27
PuFi	Purple Finch	0.04	±0.03	0	± 0	0.04	±0.03	0.06	±0.03	0	± 0	0	± 0

Summary Sheet: Average and Standard Errors of AVERAGE number of bird detections/sample station.

	TRANSECT LOCATION:	KY1	KY2	KY3	KY4	KY5	KY6
	Kennedy Lake	avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.04 ±0.03	0.15 ±0.07	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.65 ± 0.1	0.81 ±0.06	0.31 ±0.07	0.08 ±0.05	0.38 ±0.06	0.23 ±0.06
NoFl	Northern Flicker	0 ± 0	0.08 ±0.05	0.06 ±0.04	0.1 ±0.05	0.1 ±0.07	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0.06 ±0.03
HaWo	Hairy Woodpecker	0.06 ±0.03	0.02 ±0.02	0 ± 0	0.02 ±0.02	0.13 ±0.04	0.15 ±0.05
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.04 ±0.03	0 ± 0	0.02 ±0.02	0 ± 0	0.04 ±0.03	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
HaFl	Hammond's Flycatcher	0.04 ±0.03	0 ± 0	0.04 ±0.03	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.08 ±0.06	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.13 ±0.09	0.1 ±0.06	0 ± 0	0.13 ±0.07	0.31 ±0.07	0.77 ±0.14
TrSw	Tree Swallow	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0.02 ±0.02	0.17 ±0.12	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0
NRWS	Northern Rough-winged Swall	0.06 ±0.06	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.15 ±0.05	0.25 ±0.05	0.08 ±0.05	0.29 ±0.07	0.27 ±0.07	0.02 ±0.02
NoCr	Northwestern Crow	0.13 ±0.05	0.1 ±0.06	0 ± 0	0 ± 0	0 ± 0	0.19 ±0.07
CoRa	Common Raven	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0.15 ±0.07	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.31 ±0.11	0.23 ±0.06	0.52 ± 0.1
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.06 ±0.06	0.08 ±0.03	0.19 ±0.07	0.27 ±0.07
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0.06 ±0.03	0 ± 0	0.08 ±0.05
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.63 ±0.17	0.13 ±0.06	0.52 ±0.12	0.85 ±0.15	0.75 ±0.11	1.29 ±0.12
GCKi	Golden-crowned Kinglet	0 ± 0	0.04 ±0.03	0.71 ±0.18	0.52 ±0.07	0.25 ±0.09	0.42 ±0.12
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.85 ±0.09	1.52 ±0.15	1.27 ±0.12	1.33 ± 0.1	0.33 ±0.11	0.35 ± 0.1
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	0.69 ±0.11	0.38 ±0.11	0.73 ±0.12
AmRo	American Robin	0.88 ±0.11	0.46 ± 0.1	0.94 ±0.12	1.42 ±0.18	0.92 ±0.16	0.56 ±0.11
CeWa	Cedar Waxwing	0.08 ±0.05	0.1 ±0.05	0.21 ± 0.1	0 ± 0	0.1 ±0.08	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
HuVi	Hutton's Vireo	0.02 ±0.02	0.02 ±0.02	0.08 ±0.03	0.08 ±0.05	0.02 ±0.02	0.06 ±0.03
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	1.08 ±0.12	1.71 ±0.19	1.04 ±0.12	0.38 ±0.07	0.48 ±0.11	0.19 ±0.07
YRWa	Yellow-rumped Warbler	0 ± 0	0.04 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0.02 ±0.02	0.1 ±0.08	1.56 ±0.28	0.96 ±0.22	0.15 ±0.07	0.38 ± 0.1
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.1 ±0.07	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.08 ±0.05	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.13 ±0.06	0.52 ± 0.1	0.35 ±0.12	0.02 ±0.02	0.08 ±0.05	0 ± 0
WiWa	Wilson's Warbler	0.08 ±0.05	0.23 ±0.09	0.44 ±0.06	0.19 ±0.08	0.17 ±0.08	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.35 ±0.05	0.02 ±0.02	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
SoSp	Song Sparrow	0.96 ±0.14	0.94 ±0.14	0.54 ±0.16	0.06 ±0.04	0.06 ±0.03	0 ± 0
WCSp	White-crowned Sparrow	0.04 ±0.03	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.17 ±0.07	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.1 ±0.05	0.6 ±0.07	0.06 ±0.03	0.02 ±0.02	0.81 ±0.21	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.02 ±0.02
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0
AmGo	American Goldfinch	0.08 ±0.08	0.15 ±0.07	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0.02 ±0.02	0 ± 0	0.23 ±0.16	0.02 ±0.02	0.96 ±0.32	0.29 ± 0.1
PuFi	Purple Finch	0.06 ±0.04	0.04 ±0.03	0.21 ±0.08	0.02 ±0.02	0.04 ±0.04	0 ± 0

Summary Sheet: Average and Standard Errors of AVERAGE number of bird detections/sample station.

TRANSECT LOCATION: Sproat Lake		SP1 avg ±s.e.	SP2 avg ±s.e	SP3 avg ±s.e.	SP4 avg ± s.e	SP5 avg ±s.e.	SP6 avg ±s.e.
BlGr	Blue Grouse	0.13 ±0.04	0.31 ±0.08	0.25 ±0.09	0.1 ±0.05	0.08 ±0.03	0.1 ±0.05
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0.04 ±0.04	0.19 ±0.18
RuHu	Rufous Hummingbird	0.19 ±0.08	0.27 ±0.11	0.13 ±0.06	0.19 ±0.06	0 ± 0	0.1 ±0.05
NoFl	Northern Flicker	0 ± 0	0.02 ±0.02	0.08 ±0.06	0.02 ±0.02	0 ± 0	0.02 ±0.02
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.23 ±0.08	0.33 ± 0.1
HaWo	Hairy Woodpecker	0.13 ±0.06	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.1 ±0.04	0.08 ±0.05
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.06 ±0.03	0.08 ±0.05
OSFl	Olive-sided Flycatcher	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0 ± 0	0.04 ±0.04	0.06 ±0.04
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0.04 ±0.04	0.02 ±0.02	0.31 ±0.09	0.69 ±0.11	0.71 ±0.15
WiFl	Willow Flycatcher	0.02 ±0.02	0.13 ±0.06	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0.19 ±0.05	0.67 ±0.06	0.69 ±0.09	1.04 ± 0.1
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0.1 ±0.05	0.08 ±0.03	0 ± 0	0.1 ±0.08
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.08 ±0.05	0.29 ±0.09	0.77 ±0.19	1.17 ±0.16
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.23 ±0.07	0.02 ±0.02	0.06 ±0.03	0.1 ±0.04
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.31 ±0.14	0.21 ± 0.1
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	0.48 ±0.09	0.5 ±0.07	1.25 ± 0.1	0.67 ± 0.1
GCKi	Golden-crowned Kinglet	0 ± 0	0.04 ±0.03	0.88 ±0.19	0.27 ±0.09	0.88 ±0.17	0.52 ±0.14
ToSo	Townsend's Solitaire	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.02 ±0.02	0.19 ±0.05	1.25 ±0.16	0.48 ±0.09	0.38 ±0.09	0.6 ±0.15
HeTh	Hermit Thrush	0 ± 0	0.02 ±0.02	0.1 ±0.07	0.02 ±0.02	0 ± 0	0.02 ±0.02
VaTh	Varied Thrush	0 ± 0	0.02 ±0.02	0.63 ±0.19	0.25 ±0.08	0.92 ±0.13	0.44 ±0.14
AmRo	American Robin	0.25 ±0.06	0.48 ± 0.1	0.85 ±0.15	1.4 ±0.18	0.71 ±0.11	0.33 ± 0.1
CeWa	Cedar Waxwing	0.02 ±0.02	0.08 ±0.05	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.1 ±0.05	0.13 ± 0.1	0.04 ±0.04	0.44 ±0.05
SoVi	Solitary Vireo	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.15 ±0.05	0.21 ±0.07	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.25 ±0.08	0.94 ±0.11	0.48 ±0.12	0.04 ±0.03	0 ± 0	0.13 ±0.05
YRWa	Yellow-rumped Warbler	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0.04 ±0.03	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0.02 ±0.02	0.52 ±0.11	1.65 ±0.25	0.27 ±0.07	0.04 ±0.03
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.73 ±0.22	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0.02 ±0.02	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.29 ±0.08	0.48 ±0.09	0.63 ± 0.1	0.21 ±0.08	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0.06 ±0.03	0.15 ±0.08	0.04 ±0.03	0.02 ±0.02	0.04 ±0.04
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.38 ± 0.1	0.42 ±0.09	0.04 ±0.03	0 ± 0	0 ± 0	0.02 ±0.02
SoSp	Song Sparrow	0.83 ±0.13	0.75 ±0.16	0.19 ±0.08	0 ± 0	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.96 ±0.17	0.73 ±0.12	0.06 ±0.04	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.06 ±0.04	0.04 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	1.15 ±0.18	0.81 ±0.17	0.15 ±0.07	0 ± 0	0 ± 0	0.13 ±0.06
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0.04 ±0.04	0.04 ±0.04
PiSi	Pine Siskin	0.04 ±0.04	0.08 ±0.03	0.13 ±0.12	0.02 ±0.02	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.56 ±0.32	0.25 ±0.14
PuFi	Purple Finch	0 ± 0	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02

APPENDIX IX: Median-singing-males bird data.

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *median* count of *singing male* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- These data rely exclusively upon singing males and all detections for the difficult species listed in Appendix V.

Summary Sheet: Average and Standard Errors of MEDIAN number of SINGING MALES/sample station.

TRANSECT LOCATION:		FR1	FR2	FR3	FR4	FR5	FR6
Franklin River		avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.29 ±0.09	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.42 ±0.12	0.67 ±0.16	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0.63 ±0.13	0.04 ±0.04	1 ±0.17	0.75 ±0.13
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.17 ±0.09	0 ± 0	0.29 ±0.14	0.38 ±0.15
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.09	0.33 ±0.09
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0.08 ±0.05	0.79 ±0.17	0.83 ±0.25	1.79 ±0.12	1.5 ±0.12
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.25 ±0.17	0.17 ±0.09	0.25 ±0.07	0.54 ±0.16
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0 ± 0	0.29 ±0.09	0.25 ±0.09	0.25 ±0.11	0 ± 0	0.08 ±0.05
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.38 ±0.15	0 ± 0	1.04 ±0.19	0.67 ±0.14
AmRo	American Robin	0.46 ±0.12	0.33 ±0.16	0.58 ±0.13	0.67 ±0.17	0.04 ±0.04	0.5 ±0.13
CeWa	Cedar Waxwing	0.08 ±0.08	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.58 ±0.13	0.17 ±0.09	0 ± 0	0.25 ±0.07
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.71 ±0.14	1.21 ±0.21	0.08 ±0.08	0.13 ±0.06	0 ± 0	0 ± 0
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.38 ± 0.1	0.21 ±0.11	0 ± 0	0.08 ±0.05	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0.29 ±0.12	0.71 ±0.17	0.38 ±0.13	0 ± 0	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.08 ±0.08	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1 ± 0.1	0.42 ±0.16	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.04 ±0.04	0.33 ±0.12	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0.13 ±0.06	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.38 ±0.13	0.04 ±0.04	0 ± 0	0 ± 0	0.04 ±0.04	0.08 ±0.08
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0
PuFi	Purple Finch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MEDIAN number of SINGING MALES/sample station.

TRANSECT LOCATION: Kennedy Lake		KY1 avg ±s.e.	KY2 avg ±s.e	KY3 avg ±s.e.	KY4 avg ± s.e	KY5 avg ±s.e.	KY6 avg ±s.e.
BlGr	Blue Grouse	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux s Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.25 ±0.11	0.17 ±0.07	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0.04 ±0.04	0 ± 0	0.13 ±0.09	0.18 ± 0.1	0.83 ±0.17
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.05 ±0.04	0.25 ±0.11
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0.14 ±0.07	0.13 ±0.06
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.75 ± 0.2	0.08 ±0.05	0.42 ±0.15	0.71 ±0.12	0.59 ±0.13	1.38 ±0.13
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.38 ±0.17	0.25 ±0.07	0.14 ±0.09	0.17 ±0.07
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.54 ±0.12	0.75 ±0.18	0.71 ±0.14	0.71 ±0.11	0.14 ±0.09	0.21 ±0.11
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	0.54 ±0.12	0.23 ± 0.1	0.67 ±0.16
AmRo	American Robin	0.46 ±0.19	0.13 ±0.06	0.58 ±0.13	1 ±0.21	0.64 ±0.16	0.42 ±0.18
CeWa	Cedar Waxwing	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.71 ±0.23	1.33 ±0.23	0.46 ±0.15	0.17 ±0.07	0.36 ±0.13	0 ± 0
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0.08 ±0.08	1.42 ±0.35	0.88 ±0.26	0 ± 0	0.25 ±0.11
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.13 ±0.09	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.08 ±0.05	0.5 ±0.13	0.21 ±0.11	0 ± 0	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0.04 ±0.04	0.17 ±0.11	0.38 ± 0.1	0.08 ±0.08	0.09 ±0.09	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.29 ±0.07	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1 ±0.19	0.75 ±0.15	0.33 ±0.15	0.04 ±0.04	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.17 ±0.09	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.04 ±0.04	0.08 ±0.05	0 ± 0	0 ± 0	0.32 ±0.12	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.05 ±0.04	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.13 ±0.09
PuFi	Purple Finch	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MEDIAN number of SINGING MALES/sample station.

TRANSECT LOCATION: Sproat Lake		SP1 avg ±s.e.	SP2 avg ±s.e	SP3 avg ±s.e.	SP4 avg ± s.e	SP5 avg ±s.e.	SP6 avg ±s.e.
BlGr	Blue Grouse	0 ± 0	0.17 ±0.07	0.17 ±0.09	0.04 ±0.04	0 ± 0	0.04 ±0.04
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0 ± 0	0.08 ±0.08	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.05	0.21 ±0.11
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04
OSFl	Olive-sided Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.04 ±0.04
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.05	0.58 ±0.14	0.63 ±0.16
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.07	0.67 ±0.15	1.13 ±0.12
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.29 ±0.12	1.17 ±0.17
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.17 ±0.07	0 ± 0	0 ± 0	0 ± 0
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.21 ±0.11	0.17 ±0.09
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	0.42 ±0.12	0.42 ± 0.1	1.29 ±0.14	0.54 ±0.09
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.58 ±0.14	0.17 ±0.09	0.46 ±0.18	0.46 ±0.18
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0 ± 0	0 ± 0	0.42 ± 0.1	0.38 ± 0.1	0.29 ±0.11	0.25 ±0.11
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.46 ±0.17	0.42 ±0.13	0.88 ±0.18	0.25 ±0.17
AmRo	American Robin	0.04 ±0.04	0.21 ±0.11	0.46 ±0.15	1.17 ±0.16	0.25 ±0.11	0 ± 0
CeWa	Cedar Waxwing	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.42 ±0.12
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.13 ±0.09	0.13 ±0.06	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.08 ±0.05	0.83 ±0.15	0.29 ±0.11	0 ± 0	0 ± 0	0 ± 0
YRWa	Yellow-rumped Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0.58 ±0.14	1.54 ±0.27	0.13 ±0.09	0 ± 0
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.42 ±0.18	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.21 ±0.09	0.42 ±0.12	0.71 ±0.12	0.17 ±0.09	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0 ± 0	0.08 ±0.05	0 ± 0	0 ± 0	0.04 ±0.04
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.21 ±0.09	0.21 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	0.63 ±0.16	0.71 ±0.16	0.08 ±0.05	0 ± 0	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.63 ±0.17	0.67 ±0.12	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.67 ±0.18	0.42 ± 0.1	0.04 ±0.04	0 ± 0	0 ± 0	0.08 ±0.05
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.04 ±0.04
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PuFi	Purple Finch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

APPENDIX X: Maximum-singing-males bird data.

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *maximum* count of *singing male* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- These data rely exclusively upon singing males and all detections for the difficult species listed in Appendix V.

Summary Sheet: Average and Standard Errors of MAXIMUM number of SINGING MALES/sample station.

TRANSECT LOCATION: FRANKLIN RIVER		FR1 avg ±s.e.	FR2 avg ±s.e	FR3 avg ±s.e.	FR4 avg ± s.e	FR5 avg ±s.e.	FR6 avg ±s.e.
BlGr	Blue Grouse	1 ±0.17	0.5 ±0.19	0.17 ±0.11	0 ± 0	0.08 ±0.08	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.5 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	1 ± 0	1.17 ± 0.2	0.08 ±0.08	0 ± 0	0.08 ±0.08	0.08 ±0.08
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.33 ±0.14
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.42 ±0.14	0.08 ±0.08	0 ± 0	0.17 ±0.11	0.08 ±0.08	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0.25 ±0.13	0 ± 0	0.17 ±0.11	0.33 ±0.14
WiFl	Willow Flycatcher	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.17 ±0.11	0 ± 0	1.08 ±0.14	0.25 ±0.13	2.08 ±0.18	1.67 ±0.32
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.42 ±0.18	0.58 ±0.22	1.33 ±0.38	1.17 ±0.23
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.92 ±0.14	1 ± 0.2
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0.17 ±0.11	1.25 ±0.21	1.75 ±0.36	2.67 ±0.14	2.5 ±0.28
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	1 ±0.39	0.5 ±0.19	1 ±0.17	1.42 ±0.14
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.33 ±0.14	0.58 ±0.14	0.5 ±0.19	1.25 ±0.29	0.5 ±0.19	0.83 ±0.26
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0.42 ±0.14
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.92 ±0.22	0.08 ±0.08	2.25 ±0.21	1.75 ±0.27
AmRo	American Robin	0.92 ±0.18	0.75 ±0.24	2.08 ±0.14	1.25 ±0.34	1.08 ±0.18	1.33 ±0.22
CeWa	Cedar Waxwing	0.33 ±0.18	0.58 ±0.28	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	1.25 ±0.13	1 ±0.17	0.25 ±0.17	1.25 ±0.24
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	1.5 ±0.22	1.75 ±0.29	0.67 ±0.14	0.67 ±0.22	0 ± 0	0 ± 0
YRWa	Yellow-rumped Warbler	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0.5 ±0.19	0.33 ±0.18	0.33 ±0.14	0.08 ±0.08
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	1.17 ±0.16	0.83 ±0.11	0.08 ±0.08	0.42 ±0.18	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0.33 ±0.14	0.58 ±0.18	1.33 ±0.22	1 ± 0.2	0.17 ±0.11	0.33 ±0.14
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.42 ±0.14	0.58 ±0.18	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	1.25 ±0.13	1.08 ±0.18	0 ± 0	0.42 ±0.14	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.17 ±0.11	0.42 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.08 ±0.08	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.08 ±0.08	0 ± 0	0.42 ±0.14	0.08 ±0.08	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	1.33 ±0.25	0.67 ±0.18	0.33 ±0.14	0 ± 0	0.42 ±0.25	0.75 ±0.21
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0
AmGo	American Goldfinch	0.17 ±0.16	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.33 ±0.22	0.92 ±0.28
PuFi	Purple Finch	0.17 ±0.11	0 ± 0	0.17 ±0.11	0.25 ±0.13	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of MAXIMUM number of SINGING MALES/sample station.

TRANSECT LOCATION: Kennedy Lake		KY1 avg ±s.e.	KY2 avg ±s.e	KY3 avg ±s.e.	KY4 avg ± s.e	KY5 avg ±s.e.	KY6 avg ±s.e.
BlGr	Blue Grouse	0.17 ±0.11	0.33 ±0.14	0.08 ±0.08	0.08 ±0.08	0.09 ±0.09	0.08 ±0.08
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	1 ±0.17	0.83 ±0.11	0.33 ±0.14	0.08 ±0.08	0.27 ±0.13	0.33 ±0.14
NoFl	Northern Flicker	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0.18 ±0.17	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0.25 ±0.13
HaWo	Hairy Woodpecker	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0	0.27 ±0.13	0.17 ±0.11
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.17 ±0.11	0 ± 0	0.08 ±0.08	0 ± 0	0.18 ±0.12	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
HaFl	Hammond's Flycatcher	0.17 ±0.11	0 ± 0	0.17 ±0.11	0.08 ±0.08	0.09 ±0.09	0.08 ±0.08
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0.33 ±0.18	0 ± 0	0.25 ±0.13	0.73 ±0.19	1.42 ±0.25
TrSw	Tree Swallow	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
NRWS	Northern Rough-winged Swall	0.25 ±0.24	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.5 ±0.19	0.55 ±0.15	1.25 ±0.27
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.17 ±0.16	0.25 ±0.13	0.36 ±0.15	0.58 ±0.14
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13	0 ± 0	0.33 ±0.22
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.92 ±0.22	0.33 ±0.14	1.08 ±0.25	1.42 ±0.22	1.73 ±0.19	1.92 ±0.22
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	1.08 ±0.32	1.17 ± 0.2	0.73 ±0.23	1 ±0.29
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	1.42 ±0.28	2.25 ±0.29	1.83 ±0.23	1.75 ±0.21	0.55 ± 0.2	0.5 ±0.22
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	1.67 ±0.25	1.09 ±0.33	1.42 ±0.14
AmRo	American Robin	1.33 ± 0.3	0.83 ± 0.2	1.67 ±0.25	1.75 ±0.21	1.36 ±0.19	1.17 ± 0.2
CeWa	Cedar Waxwing	0 ± 0	0.17 ±0.11	0.42 ±0.22	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0.08 ±0.08	0.08 ±0.08	0.25 ±0.13	0.33 ±0.18	0.09 ±0.09	0.25 ±0.13
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	2 ±0.24	2.17 ±0.23	2.08 ± 0.3	0.83 ±0.16	1.18 ±0.22	0.25 ±0.13
YRWa	Yellow-rumped Warbler	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0.08 ±0.08	0.25 ±0.17	3.17 ±0.44	1.92 ±0.38	0.64 ± 0.3	0.83 ± 0.2
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.17 ±0.11	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.25 ±0.13	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.33 ±0.14	1.08 ±0.18	0.83 ±0.28	0.08 ±0.08	0.18 ±0.12	0 ± 0
WiWa	Wilson's Warbler	0.25 ±0.13	0.58 ±0.18	0.92 ±0.18	0.5 ±0.14	0.55 ± 0.2	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.75 ±0.13	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0 ± 0
SoSp	Song Sparrow	1.33 ±0.18	1.83 ± 0.2	1.17 ±0.33	0.17 ±0.11	0.18 ±0.12	0 ± 0
WCSp	White-crowned Sparrow	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.33 ±0.14	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.33 ±0.14	2.08 ± 0.3	0.17 ±0.11	0.08 ±0.08	1.18 ±0.28	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.09 ±0.09	0.08 ±0.08
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0.33 ±0.14	0.17 ±0.16	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.45 ± 0.2	0.75 ±0.27
PuFi	Purple Finch	0.17 ±0.11	0.17 ±0.11	0.5 ±0.19	0.08 ±0.08	0.09 ±0.09	0 ± 0

Summary Sheet: Average and Standard Errors of MAXIMUM number of SINGING MALES/sample station.

	TRANSECT LOCATION:	SP1	SP2	SP3	SP4	SP5	SP6
	SPROAT LAKE	avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.5 ±0.14	0.92 ±0.22	0.75 ±0.21	0.33 ±0.14	0.33 ±0.14	0.33 ±0.14
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux s Swift	0 ± 0	0.17 ±0.16	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.25 ±0.13	0.42 ±0.22	0.08 ±0.08	0.17 ±0.11	0 ± 0	0 ± 0
NoFl	Northern Flicker	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.33 ±0.14	0.33 ±0.14
HaWo	Hairy Woodpecker	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.25 ±0.13	0.17 ±0.11
OSFl	Olive-sided Flycatcher	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08	0 ± 0	0.08 ±0.08	0.17 ±0.11
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.92 ±0.28	1.5 ±0.28	1.33 ± 0.3
WiFl	Willow Flycatcher	0.08 ±0.08	0.5 ±0.22	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0.75 ±0.21	1.33 ±0.18	1.5 ±0.14	1.83 ± 0.2
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.33 ±0.18	0.75 ±0.21	1.17 ±0.26	2.17 ±0.28
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.58 ±0.18	0.17 ±0.11	0.17 ±0.11	0.42 ±0.14
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.58 ±0.22	0.5 ±0.22
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	1 ± 0.2	1.33 ±0.14	2.42 ±0.22	1.33 ±0.22
GCKi	Golden-crowned Kinglet	0 ± 0	0.08 ±0.08	1.25 ±0.24	1 ± 0.2	2 ±0.58	1.08 ±0.22
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.08 ±0.08	0.67 ±0.22	1.58 ±0.25	1.75 ±0.21	0.75 ±0.17	0.58 ±0.18
HeTh	Hermit Thrush	0 ± 0	0.08 ±0.08	0.42 ±0.28	0.08 ±0.08	0 ± 0	0.08 ±0.08
VaTh	Varied Thrush	0 ± 0	0.08 ±0.08	1.42 ± 0.4	1.17 ±0.23	2 ±0.29	1.25 ±0.29
AmRo	American Robin	0.58 ±0.14	1.08 ±0.22	1.5 ± 0.3	1.83 ±0.28	1.58 ±0.28	0.67 ±0.18
CeWa	Cedar Waxwing	0 ± 0	0.33 ±0.22	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.42 ±0.18	0.42 ±0.32	0.17 ±0.16	1 ± 0
SoVi	Solitary Vireo	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.5 ±0.19	0.58 ±0.18	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.25 ±0.13	1.42 ±0.22	1.08 ±0.25	0.25 ±0.13	0 ± 0	0.17 ±0.11
YRWa	Yellow-rumped Warbler	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0
ToWa	Townsend's Warbler	0 ± 0	0.08 ±0.08	1.08 ±0.18	3.08 ± 0.4	0.83 ±0.23	0.17 ±0.11
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	1.25 ±0.31	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0.08 ±0.08	0.25 ±0.13	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.75 ±0.17	0.92 ±0.14	1.25 ±0.21	0.5 ±0.19	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0 ± 0	0.25 ±0.13	0.42 ±0.22	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.92 ±0.18	1.17 ±0.16	0.17 ±0.11	0 ± 0	0 ± 0	0.08 ±0.08
SoSp	Song Sparrow	1.5 ±0.22	1.33 ±0.27	0.5 ±0.22	0.08 ±0.08	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	1.33 ±0.27	1.08 ±0.22	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.08 ±0.08	0.17 ±0.11	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	1.42 ±0.22	1.58 ±0.34	0.17 ±0.11	0 ± 0	0 ± 0	0.33 ±0.18
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08
PiSi	Pine Siskin	0 ± 0	0.17 ±0.11	0.08 ±0.08	0.08 ±0.08	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0 ± 0	0.08 ±0.08	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.08	0.25 ±0.17	0.08 ±0.08
PuFi	Purple Finch	0 ± 0	0 ± 0	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08	0.08 ±0.08

APPENDIX XI: Average-singing-males bird data.

Note:

- The following 3 pages contain the $\bar{x} \pm$ s.e. values of birds found per sampling station using the *average* count of *singing male* individuals recorded over 4 surveys. Multiplication by 12 will yield per-transect values, except for the Kennedy Lake (KY5) hypermaritime cedar forest, where n=11 sampling stations.

- Transect descriptions (e.g., "FR3" are as given in Appendix I).

- These data rely exclusively upon singing males and all detections for the difficult species listed in Appendix V.

Summary Sheet: Average and Standard Errors of AVERAGE number of SINGING MALES/sample station.

TRANSECT LOCATION: Franklin River		FR1 avg ±s.e.	FR2 avg ±s.e	FR3 avg ±s.e.	FR4 avg ± s.e	FR5 avg ±s.e.	FR6 avg ±s.e.
BlGr	Blue Grouse	0.38 ±0.07	0.17 ±0.07	0.04 ±0.03	0 ± 0	0.02 ±0.02	0 ± 0
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.13 ±0.04	0.04 ±0.04	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.42 ±0.05	0.6 ±0.12	0.02 ±0.02	0 ± 0	0.02 ±0.02	0.02 ±0.02
NoFl	Northern Flicker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.03
HaWo	Hairy Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.08 ±0.03
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.1 ±0.04	0.02 ±0.02	0 ± 0	0.04 ±0.03	0.02 ±0.02	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0 ± 0	0.06 ±0.03	0 ± 0	0.04 ±0.03	0.1 ±0.05
WiFl	Willow Flycatcher	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0.04 ±0.03	0 ± 0	0.58 ±0.09	0.08 ±0.05	1.02 ±0.11	0.79 ±0.12
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0.19 ±0.09	0.15 ±0.05	0.5 ±0.16	0.48 ±0.12
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0.35 ±0.07	0.4 ±0.08
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.06 ±0.03
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0.08 ±0.05	0.77 ±0.15	0.9 ±0.22	1.77 ± 0.1	1.54 ±0.17
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.4 ±0.17	0.19 ±0.07	0.38 ±0.06	0.65 ±0.12
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.08 ±0.03	0.19 ±0.06	0.25 ±0.09	0.44 ± 0.1	0.13 ±0.05	0.25 ±0.08
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0.1 ±0.04
VaTh	Varied Thrush	0 ± 0	0 ± 0	0.4 ±0.12	0.02 ±0.02	1.15 ±0.15	0.75 ±0.13
AmRo	American Robin	0.42 ±0.09	0.31 ±0.12	0.88 ± 0.1	0.65 ±0.17	0.29 ±0.06	0.58 ±0.11
CeWa	Cedar Waxwing	0.1 ±0.06	0.17 ±0.07	0 ± 0	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0.65 ±0.09	0.33 ±0.08	0.06 ±0.04	0.44 ±0.09
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0.06 ±0.04	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.73 ±0.11	0.92 ±0.13	0.19 ±0.04	0.23 ±0.07	0 ± 0	0 ± 0
YRWa	Yellow-rumped Warbler	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02
ToWa	Townsend's Warbler	0 ± 0	0 ± 0	0.13 ±0.05	0.1 ±0.06	0.08 ±0.03	0.02 ±0.02
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.46 ±0.08	0.27 ±0.05	0.02 ±0.02	0.15 ±0.06	0 ± 0	0 ± 0
WiWa	Wilson's Warbler	0.08 ±0.03	0.27 ± 0.1	0.73 ±0.12	0.44 ±0.11	0.04 ±0.03	0.08 ±0.03
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.03	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.13 ±0.05	0.17 ±0.05	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoSp	Song Sparrow	0.9 ± 0.1	0.48 ±0.12	0 ± 0	0.13 ±0.05	0 ± 0	0 ± 0
WCSp	White-crowned Sparrow	0.06 ±0.04	0.17 ±0.06	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0.02 ±0.02	0.06 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.02 ±0.02	0 ± 0	0.1 ±0.04	0.02 ±0.02	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.52 ±0.11	0.19 ±0.06	0.08 ±0.03	0 ± 0	0.13 ±0.07	0.21 ±0.06
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
AmGo	American Goldfinch	0.04 ±0.04	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0.13 ±0.09	0.23 ±0.07
PuFi	Purple Finch	0.04 ±0.03	0 ± 0	0.04 ±0.03	0.06 ±0.03	0 ± 0	0 ± 0

Summary Sheet: Average and Standard Errors of AVERAGE number of SINGING MALES/sample station.

TRANSECT LOCATION:		KY1	KY2	KY3	KY4	KY5	KY6
Kennedy Lake		avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.04 ±0.03	0.15 ±0.07	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux's Swift	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RuHu	Rufous Hummingbird	0.35 ±0.07	0.29 ±0.05	0.08 ±0.03	0.02 ±0.02	0.06 ±0.03	0.1 ±0.05
NoFl	Northern Flicker	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0.04 ±0.04	0 ± 0
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0.06 ±0.03
HaWo	Hairy Woodpecker	0.06 ±0.03	0 ± 0	0 ± 0	0 ± 0	0.06 ±0.03	0.04 ±0.03
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.04 ±0.03	0 ± 0	0.02 ±0.02	0 ± 0	0.04 ±0.03	0 ± 0
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
HaFl	Hammond's Flycatcher	0.04 ±0.03	0 ± 0	0.04 ±0.03	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
WiFl	Willow Flycatcher	0 ± 0	0 ± 0	0.08 ±0.06	0 ± 0	0 ± 0	0 ± 0
PSFl	Pacific Slope Flycatcher	0 ± 0	0.1 ±0.06	0 ± 0	0.13 ±0.07	0.25 ±0.08	0.77 ±0.14
TrSw	Tree Swallow	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
NRWS	Northern Rough-winged Swall	0.06 ±0.06	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0.04 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0.06 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.15 ±0.06	0.15 ±0.05	0.44 ±0.09
BrCr	Brown Creeper	0 ± 0	0 ± 0	0.06 ±0.06	0.06 ±0.03	0.15 ±0.06	0.21 ±0.06
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0.06 ±0.03	0 ± 0	0.08 ±0.05
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0.63 ±0.17	0.13 ±0.06	0.48 ±0.12	0.77 ±0.14	0.69 ±0.11	1.27 ±0.13
GCKi	Golden-crowned Kinglet	0 ± 0	0 ± 0	0.46 ±0.16	0.42 ±0.07	0.23 ±0.09	0.33 ±0.09
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.6 ±0.12	0.94 ±0.15	0.81 ±0.12	0.79 ±0.08	0.19 ±0.08	0.23 ± 0.1
HeTh	Hermit Thrush	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
VaTh	Varied Thrush	0 ± 0	0 ± 0	0 ± 0	0.69 ±0.11	0.35 ±0.12	0.73 ±0.12
AmRo	American Robin	0.52 ±0.14	0.27 ±0.07	0.71 ±0.11	0.96 ±0.16	0.6 ±0.12	0.5 ±0.13
CeWa	Cedar Waxwing	0 ± 0	0.04 ±0.03	0.1 ±0.05	0 ± 0	0 ± 0	0 ± 0
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0.02 ±0.02	0.02 ±0.02	0.06 ±0.03	0.08 ±0.05	0.02 ±0.02	0.06 ±0.03
SoVi	Solitary Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.83 ±0.15	1.25 ±0.19	0.77 ±0.12	0.29 ±0.06	0.44 ±0.11	0.06 ±0.03
YRWa	Yellow-rumped Warbler	0 ± 0	0.04 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ToWa	Townsend's Warbler	0.02 ±0.02	0.1 ±0.08	1.54 ±0.28	0.96 ±0.22	0.15 ±0.07	0.38 ± 0.1
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0.1 ±0.07	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0.08 ±0.05	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0	0 ± 0
MGWa	MacGillivray's Warbler	0.13 ±0.06	0.52 ± 0.1	0.33 ±0.12	0.02 ±0.02	0.04 ±0.03	0 ± 0
WiWa	Wilson's Warbler	0.08 ±0.05	0.23 ±0.09	0.38 ±0.08	0.19 ±0.08	0.17 ±0.08	0 ± 0
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.33 ±0.06	0 ± 0	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0
SoSp	Song Sparrow	0.92 ±0.15	0.9 ±0.13	0.52 ±0.15	0.06 ±0.04	0.04 ±0.03	0 ± 0
WCSp	White-crowned Sparrow	0.04 ±0.03	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCSp	Golden-crowned Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
FoSp	Fox Sparrow	0.17 ±0.07	0 ± 0	0 ± 0	0.02 ±0.02	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.1 ±0.05	0.56 ±0.07	0.04 ±0.03	0.02 ±0.02	0.42 ±0.11	0 ± 0
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0.04 ±0.04	0.02 ±0.02
PiSi	Pine Siskin	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
AmGo	American Goldfinch	0 ± 0	0.1 ±0.05	0.04 ±0.04	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.1 ±0.05	0.25 ± 0.1
PuFi	Purple Finch	0.04 ±0.03	0.04 ±0.03	0.17 ±0.08	0.02 ±0.02	0.02 ±0.02	0 ± 0

Summary Sheet: Average and Standard Errors of AVERAGE number of SINGING MALES/sample station.

	TRANSECT LOCATION:	SP1	SP2	SP3	SP4	SP5	SP6
	Sproat Lake	avg ±s.e.	avg ±s.e	avg ±s.e.	avg ± s.e	avg ±s.e.	avg ±s.e.
BlGr	Blue Grouse	0.13 ±0.04	0.31 ±0.08	0.31 ±0.08	0.31 ±0.08	0.31 ±0.08	0.31 ±0.08
RuGr	Ruffed Grouse	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VaSw	Vaux s Swift	0 ± 0	0.04 ±0.04	0.04 ±0.04	0.04 ±0.04	0.04 ±0.04	0.04 ±0.04
RuHu	Rufous Hummingbird	0.06 ±0.03	0.15 ±0.07	0.15 ±0.07	0.15 ±0.07	0.15 ±0.07	0.15 ±0.07
NoFl	Northern Flicker	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
RBSa	Red-breasted Sapsucker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaWo	Hairy Woodpecker	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
PiWo	Pileated Woodpecker	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OSFl	Olive-sided Flycatcher	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
WWPe	Western Wood Pewee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HaFl	Hammond's Flycatcher	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
WiFl	Willow Flycatcher	0.02 ±0.02	0.13 ±0.06	0.13 ±0.06	0.13 ±0.06	0.13 ±0.06	0.13 ±0.06
PSFl	Pacific Slope Flycatcher	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
TrSw	Tree Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
VGSw	Violet-green Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BaSw	Barn Swallow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NRWS	Northern Rough-winged Swall	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
StJa	Steller's Jay	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
NoCr	Northwestern Crow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CoRa	Common Raven	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
CBCh	Chestnut-backed Chickadee	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
BrCr	Brown Creeper	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RBNu	Red-breasted Nuthatch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HoWr	House Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
WiWr	Winter Wren	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
GCKi	Golden-crowned Kinglet	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
ToSo	Townsend's Solitaire	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SwTh	Swainson's Thrush	0.02 ±0.02	0.17 ±0.05	0.17 ±0.05	0.17 ±0.05	0.17 ±0.05	0.17 ±0.05
HeTh	Hermit Thrush	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
VaTh	Varied Thrush	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
AmRo	American Robin	0.17 ±0.05	0.38 ± 0.1	0.38 ± 0.1	0.38 ± 0.1	0.38 ± 0.1	0.38 ± 0.1
CeWa	Cedar Waxwing	0 ± 0	0.08 ±0.05	0.08 ±0.05	0.08 ±0.05	0.08 ±0.05	0.08 ±0.05
EuSt	European Starling	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
HuVi	Hutton's Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
SoVi	Solitary Vireo	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
WaVi	Warbling Vireo	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
OCWa	Orange-crowned Warbler	0.1 ±0.05	0.81 ±0.13	0.81 ±0.13	0.81 ±0.13	0.81 ±0.13	0.81 ±0.13
YRWa	Yellow-rumped Warbler	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
ToWa	Townsend's Warbler	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
BTGW	Black-throated Grey Warbler	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
YeWa	Yellow Warbler	0 ± 0	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02	0.02 ±0.02
MGWa	MacGillivray's Warbler	0.29 ±0.08	0.46 ±0.09	0.46 ±0.09	0.46 ±0.09	0.46 ±0.09	0.46 ±0.09
WiWa	Wilson's Warbler	0 ± 0	0.06 ±0.03	0.06 ±0.03	0.06 ±0.03	0.06 ±0.03	0.06 ±0.03
CoYe	Common Yellowthroat	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
RSTo	Rufous-sided Towhee	0.35 ± 0.1	0.4 ±0.07	0.4 ±0.07	0.4 ±0.07	0.4 ±0.07	0.4 ±0.07
SoSp	Song Sparrow	0.75 ±0.14	0.75 ±0.16	0.75 ±0.16	0.75 ±0.16	0.75 ±0.16	0.75 ±0.16
WCSp	White-crowned Sparrow	0.69 ±0.15	0.65 ±0.12	0.65 ±0.12	0.65 ±0.12	0.65 ±0.12	0.65 ±0.12
GCSp	Golden-crowned Sparrow	0.02 ±0.02	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03
FoSp	Fox Sparrow	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
DEJu	Dark-eyed Junco	0.73 ±0.15	0.6 ±0.12	0.6 ±0.12	0.6 ±0.12	0.6 ±0.12	0.6 ±0.12
WeTa	Western Tanager	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PiSi	Pine Siskin	0 ± 0	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03	0.04 ±0.03
AmGo	American Goldfinch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
ReCr	Red Crossbill	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
PuFi	Purple Finch	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

APPENDIX XII: Horn's community overlap matrix.

NOTE
Horn's (1966) similarity index ranges from 0 (no overlap) to 1.0 (complete overlap). We calculated this index for each of the *n(n-1)*0.5=153 possible transect comparisons. Transect labels (eg., "FR1", "SP4") are as given in Appendix I.

Overlap values >75% are shown in bold type.

	Clearcuts			15-20 year-old			30-35 year-old			50-60 year-old			Old-growth			Old-growth		
	Fr1	**Ky1**	**Sp1**	**Fr2**	**Ky2**	**Sp2**	**Fr3**	**Ky3**	**Sp3**	**Fr4**	**Ky4**	**Sp4**	**Fr5**	**Ky5**	**Sp5**	**Fr6**	**Ky6**	**Sp6**
Fr1	**1.00**	**0.77**	0.74	**0.83**	**0.78**	**0.85**	0.25	0.53	0.53	0.34	0.31	0.30	0.14	0.51	0.12	0.18	0.20	0.16
Ky1		**1.00**	0.52	**0.82**	**0.84**	0.61	0.53	0.68	0.62	0.63	0.60	0.46	0.34	0.63	0.37	0.41	0.48	0.35
Sp1			**1.00**	0.55	0.49	**0.88**	0.11	0.31	0.33	0.20	0.15	0.16	0.10	0.38	0.06	0.13	0.12	0.11
Fr2				**1.00**	**0.88**	0.72	0.40	0.65	0.58	0.49	0.45	0.33	0.15	0.56	0.18	0.25	0.27	0.24
Ky2					**1.00**	0.65	0.40	0.70	0.68	0.52	0.52	0.38	0.14	0.51	0.22	0.23	0.32	0.30
Sp2						**1.00**	0.17	0.42	0.47	0.24	0.22	0.19	0.09	0.39	0.07	0.11	0.12	0.11
Fr3							**1.00**	0.59	0.64	**0.87**	**0.76**	0.62	0.70	0.68	0.69	**0.77**	0.74	0.70
Ky3								**1.00**	**0.83**	0.74	**0.80**	0.65	0.32	0.55	0.42	0.34	0.53	0.35
Sp3									**1.00**	0.74	**0.82**	0.66	0.46	0.64	0.53	0.54	0.63	0.44
Fr4										**1.00**	**0.81**	0.62	0.58	0.67	0.62	0.69	0.66	0.59
Ky4											**1.00**	**0.78**	0.60	0.67	0.68	0.67	**0.76**	0.54
Sp4												**1.00**	0.51	0.53	0.62	0.55	0.67	0.51
Fr5													**1.00**	0.64	**0.82**	**0.92**	**0.91**	0.69
Ky5														**1.00**	0.62	0.71	0.72	0.52
Sp5															**1.00**	**0.81**	**0.85**	**0.81**
Fr6																**1.00**	**0.87**	**0.75**
Ky6																	**1.00**	0.68
Sp6																		**1.00**