BREEDING BIRDS OF RESEARCH NATURAL AREAS IN SOUTHEASTERN ALASKA

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ABSTRACT—The Tongass National Forest encompasses a large expanse of temperate rainforest in southeastern Alaska and contains 12 designated Research Natural Areas (RNAs). Existing in as near a natural condition as possible, RNAs receive minimal commercial and recreational use. Because few bird studies have been conducted on RNAs, we used point counts and area searches to determine the occurrence and abundance of breeding landbirds present in vegetation communities of RNAs. Of 49 species of small landbirds detected during area searches, the most widely distributed birds among RNAs were rufous hummingbird (*Selasphorus rufa*), chestnut-backed chickadee (*Poecile rufescens*), winter wren (*Troglodytes troglodytes*), golden-crowned kinglet (*Regulus satrapa*), Swainson's thrush (*Catharus ustulatus*), hermit thrush (*C. guttatus*), varied thrush (*Ixoreus naevius*), and Townsend's warbler (*Dendroica townsendi*). The 8 most abundant species recorded on 187 point counts (>0.5 birds/point) were Pacific-slope flycatcher (*Empidonax difficilis*), hermit thrush, varied thrush, winter wren, golden-crowned kinglet, Townsend's warbler, and chestnut-backed chickadee. Several species had significant differences in abundance between low- elevation hemlock-spruce forest and their abundance in either high- elevation fir-spruce forest or mixed conifer-shore pine muskeg. Because RNAs provide forests that are not disturbed by human activities, these sites could provide a standard to evaluate changes in bird abundance and richness that may occur on developed land in southeastern Alaska.

Key words: birds, forest, breeding, surveys, abundance, occurrence, Research Natural Areas, southeastern Alaska, Tongass National Forest

Encompassing more than half of southeastern Alaska, the Tongass National Forest (Tongass), the largest National Forest in the United States, is a 70,000 km^2 expanse of temperate rainforest. The Tongass possesses many human commercial and recreational values and provides habitat for numerous wildlife species (Schoen and others 1988). The current forest management plan contains a variety of developed and undeveloped land prescriptions for multiple uses (USFS 1997). Twelve Research Natural Areas (RNAs), totaling 24,097 ha, were established to represent the diversity of vegetation communities on the Tongass and to provide sites for research and monitoring of relatively undisturbed ecosystems (USFS 1997).

Although some studies of landbirds and their use of old-growth and successional forests in southeastern Alaska have been completed (Noble 1977; Kessler 1979; Hughes 1985; Kessler and Kogut 1985; DellaSala and others 1996; Cotter and Andres 2000), quantitative information on bird abundances in natural forest communities across the Tongass is incomplete. Only cursory bird checklists have been compiled for some RNAs, and no quantitative data on breeding bird abundances have been collected in any RNA. A general knowledge of bird abundance and species composition in natural forests is necessary to develop effective programs that monitor how human uses of the forest affect bird populations. Therefore, we undertook a study to determine occurrence and abundance of forest birds breeding in Tongass RNAs.

METHODS

We conducted bird surveys on 11 of 12 designated RNAs within the Tongass (Fig. 1).

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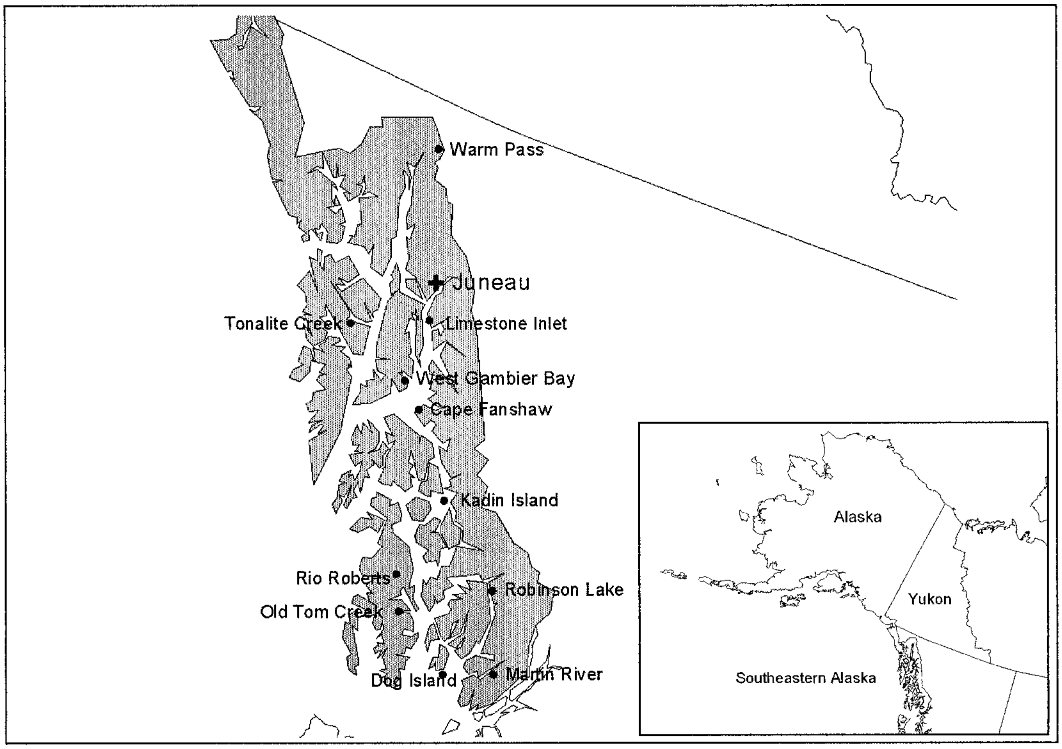

FIGURE 1. Location of Research Natural Areas in the Tongass National Forest, southeastern Alaska, surveyed for breeding birds during 1997 and 1998.

These RNAs represent a cross-section of natural plant communities found in southeastern Alaska; RNAs range in size from 243 to 4676 ha and span elevations from sea level to 1348 m (Table 1). Surveys proceeded from south to north and were conducted between 29 May and 30 June in 1997 and 1998. Following scientific nomenclature as well as plant community definitions of the United States Forest Service (USFS 1995) and Viereck and others (1992), we characterized general plant communities found in RNAs by 4 major overstory types: coniferous forest, mixed coniferous-broadleaf forest, shore pine muskeg, and mixed coniferous scrub. Coniferous forest is dominated by Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), mountain hemlock (*T. mertensiana*), western redcedar (*Thuja plicata*), and Alaska yellow cedar (*Chamaecyparis nootkatensis*); at higher elevations, subalpine fir (*Abies lasiocarpa*) are present in lesser amounts. In low elevations and along rivers and streams, black cottonwood (*Populus trichocarpa*) and red alder (*Alnus rubra*) are mixed with Sitka spruce. Open muskegs of shrubs, sedges, grasses, and scattered shore pines (*Pinus contorta* var. *contorta*) form on low-elevation, poorly drained sites. Patches of shrubby or dwarf (<3 m tall) mixed conifer species, usually dominated by mountain hemlock, occur in muskegs and also at higher elevations. Common understory plants of these forest types include blueberry (*Vaccinium* spp.), rusty mensiezia (*Mensiezia ferruginea*), devil's club (*Oplopanax horridus*), skunk cabbage (*Lysichiton americanum*), salmonberry (*Rubus spectabilis*), and elderberry (*Sambucus callicarpa*). More complete descriptions of plant communities found in some of the Tongass RNAs are provided by Smith and others (2001).

At each RNA, we chose an initial starting point for bird surveys that allowed relatively easy access to the shoreline. Although these starting points could not be randomly selected, we had no prior knowledge about any of the sites. From the starting point, a compass bearing was selected that was approximately perpendicular to the shoreline; starting 250 m inland from the shoreline, a series of points were

TABLE 1. Description of Research Natural Areas (RNAs) of the Tongass National Forest surveyed for breeding birds, and the survey effort expended in each area, 1997 to 1998. RNAs are ordered from south to north, and definitions of overstory vegetation types are provided in the text.

RNA	Size (ha)	Dominant overstory vegetation	Elevation (m)		Bird survey effort		
			Range	Surveyed	No. of days	Person-h	No. of points
Dog Island	313	shore pine muskeg; mixed conifer scrub	<15	<15	4	32.0	10
Marten River	2514	mixed Sitka spruce-black cottonwood-red alder forest	0–781	0–305	4	23.5	24
Old Tom Creek	1914	western hemlock-western red cedar-Sitka spruce forest	0–457	0–107	6	55.0	19
Rio Roberts	662	shore pine-western hemlock-western red cedar muskeg	18–76	18–76	2	15.0	11
Robinson Lake	1738	western hemlock-western red cedar-Sitka spruce forest	0–1348	0–200	2	18.0	16
Kadin Island	657	western hemlock-Sitka spruce forest; mountain hemlock muskeg	0–530	0–442	3	16.0	9
Cape Fanshaw	243	western hemlock-Alaska yellow cedar forest; mixed conifer	0–682	0–640	2	13.5	8
West Gambier	4676	shore pine muskeg; mixed conifer; western hemlock-western red cedar-Alaska yellow cedar-Sitka spruce forest	0–945	0–122	3	44.0	42
Tonalite Creek	3851	western hemlock-Sitka spruce forest	0–610	0–46	3	16.5	18
Limestone Inlet	3685	western hemlock-Sitka spruce forest; mixed spruce-red alder forest	0–1111	0–61	2	13.5	8
Warm Pass	3634	subalpine fir-Sitka spruce forest	549–1219	549–686	4	22.0	22

systematically surveyed at 250-m intervals along this bearing. All points were located at sites dominated by coniferous trees. Because points were not located along trails, terrain and understory plant density determined how many points could be surveyed between sunrise and 5 h thereafter. With this time constraint, we were able to survey between 6 and 13 points/d.

At each point, a single observer recorded all birds heard or seen during a 10-min period. Individual birds detected ≤50 m, >50 m, and as flyovers were recorded separately at intervals of 0 to 3, 3 to 5, and 5 to 10 min. Locations of observed or heard birds were plotted to minimize double counting individuals. The same observer surveyed all points in both years. We also determined the plant community present (described above) and used topographic maps to determine the elevation at each point.

We used total number of birds encountered at a point, excluding flyovers, to estimate a mean abundance (birds/point) of each species for all RNAs combined. Using information collected during point counts, we combined overstory plant communities and elevation into 4 types: 1) low-elevation (≤75 m) hemlock-spruce forest, 2) mid-elevation (77 to 579 m) hemlock-spruce forest, 3) high-elevation (>640 m) fir-spruce forest, and 4) low-elevation (<100 m) mixed conifer-shore pine muskeg. Points from all RNAs were assigned to 1 of these elevation-vegetation types, and we used a Poisson estimator to determine mean abundance and its variance. The dispersion coefficient was estimated and used to adjust variance estimates. Because the low-elevation hemlock-spruce forest is most vulnerable to timber harvest, we used a z-test to compare bird abundance between low-elevation hemlock-spruce points and abundance in the other 3 elevation-vegetation types. We restricted these comparisons to birds observed ≤50 m from the point and only included species for which >30 individuals were encountered. To control for multiple comparisons, we set the nominal significance level at $P \leq 0.025$. Restricting analysis to encounters made within 50 m of the observer should minimize bias due to differences in detectability among elevation-vegetation types. Because of the constraints on our spatial sampling, we realize that general inferences from our analysis are limited.

TABLE 2. Encounter rates used to construct categorical abundances of birds breeding in Research Natural Areas of the Tongass National Forest, Alaska, 1997 to 1998.

Encounter rate	Categorical abundance
<1 individual/d[1]	occasional
1 individual/d	rare
2 to 4 individuals/d, <1 individual/h	uncommon
5 to 9 individuals/d, 1 individual/h	fairly common
10 to 49 individuals/d, 2 to 5 individuals/h	common
≥50 individuals/d, ≥6 individuals/h	abundant

[1] Day = 8 person-h.

Supplemental information on relative bird abundance was opportunistically collected in each RNA by tallying all birds encountered during a specific time interval (hereafter, area search). Survey effort spent in each area-day was recorded as the number of person-hours (sum of the number of hours each observer surveyed). For safety reasons, 2 observers often surveyed together and we calculated the person-h as 1.5 × the time they surveyed. We assumed that 2 observers working in a single party increased the numbers and species encountered but not to the same magnitude as would 2 independent observers. The total effort spent surveying each RNA was summed across all days. Surveyed areas were delineated on 7.5-min topographic maps and included areas traveled between points and usually a different return path to the starting point. Although we endeavored to survey representative plant communities in each RNA with these opportunistic area searches, we did not obtain complete coverage of most RNAs.

Encounter rates (birds/person-h) were used to determine the categorical abundance of each species recorded during area searches (Table 2). Abundance categories generally follow suggestions made by Allen (1993) and have been used for breeding bird inventories in other areas of Alaska (Andres and others 1999). We calculated a categorical abundance for each species recorded in each RNA and used the median of these abundance estimates to describe overall abundance for all RNAs combined.

We used behavioral cues to determine the evidence of breeding for all species encountered as observed, possible, probable, or confirmed. Breeding evidence definitions followed recommendations of the NAOAC (1990) and have been used in numerous breeding bird atlases (for example, Robbins and Blom 1996). We strove to confirm breeding by as many species as possible in each RNA. To summarize information for all RNAs, we used the most convincing breeding evidence obtained for the species across all sites. Although we recorded all species, our analyses are restricted to small landbirds (orders Apodiformes, Piciformes, and Passeriformes).

Results

We conducted surveys on 35 d and accumulated 269 person-h of survey effort (Table 1). We recorded a total of 49 species of small landbirds on all RNAs, which represents about 64% of the small landbird species regularly breeding in southeastern Alaska. Of the 28 breeding species not recorded on RNAs, most are restricted to alpine (12 species) or riparian (11 species) areas. Despite differences in survey effort among RNAs, species richness was only weakly correlated with person-h of effort (Pearson's r = 0.17). Although all species we recorded in RNAs are known to breed in southeastern Alaska, we were only able to obtain confirmed or probable breeding evidence for 69% of the taxa. The most widely distributed birds that occurred on all RNAs were rufous hummingbird, chestnut-backed chickadee, winter wren, golden-crowned kinglet, Swainson's thrush, hermit thrush, varied thrush, and Townsend's warbler (Table 3). Brown creeper, orange-crowned warbler, and red crossbill occurred on all but 1 RNA, and the Pacific-slope flycatcher was common on all but the high-elevation Warm Pass RNA. Bird abundance information specific to individual RNAs is provided in Stotts and others (1999).

We surveyed a total of 187 points and recorded 38 species. The 8 most abundant species, constituting >76% of all observations, were, in order of abundance, Pacific-slope flycatcher, hermit thrush, varied thrush, winter wren, golden-crowned kinglet, Townsend's warbler, chestnut-backed chickadee, and brown creeper. Species not recorded during point counts, but observed during area searches, were generally found in only 1 RNA.

Elevation and overstory vegetation type generally influenced abundance of breeding birds (Table 4). Compared to low-elevation hemlock-spruce forest, the abundance of chestnut-backed chickadees was significantly lower ($P \leq 0.025$) in high-elevation fir-spruce forest. Winter wrens, golden-crowned kinglets, and Townsend's warblers were equally abundant in mid- and high-elevation spruce forest as in low-elevation hemlock-spruce forest, but fewer were encountered in low-elevation mixed conifer-shore pine muskeg (Table 4). Varied thrushes were most abundant in high-elevation fir-spruce forest. Hairy woodpeckers were only recorded in low- and mid-elevation hemlock-spruce forest, and abundance of Pacific-slope flycatchers was greatest at low elevations, regardless of overstory forest type (Table 4). All red crossbills were observed in low-elevation hemlock-spruce forest. Only the hermit thrush was significantly ($P \leq 0.005$) more abundant in low-elevation mixed conifer-shore pine muskeg than in low-elevation hemlock-spruce forest.

DISCUSSION

Bird assemblages in RNAs are typical of those found in coniferous forests of southeastern Alaska. As a consequence of the natural state of RNAs, species that respond positively to human alteration of forests were rare or absent (for example, American robin, chipping sparrow [*Spizella passernia*]). Of the breeding species not recorded on RNAs, most are restricted to alpine or mainland riparian areas, and many of the species only rarely observed on RNAs breed in these communities. Although additional area searches might increase the number of rare species encountered, we endeavored to survey representative vegetation types in each RNA.

Although our sampling at an individual site was constrained by topography and vegetation density, few studies, except Cotter and Andres (2000), have addressed relationships between breeding birds and vegetation types over a wide geographic scale in southeastern Alaska. Detectability of most species is likely similar among spruce-dominated forest types, but probably differs from open muskeg habitats and may have artificially increased abundance estimates. Restricting analysis to species observed ≤50 m of the point center should minimize this potential bias. Random sampling constraints in our study limit inferences, but comparison of our results with other studies can provide a general view of forest use by breeding birds.

From our point count data, the association of hairy woodpeckers, brown creepers, golden-crowned kinglets, varied thrushes, and red crossbills with closed canopy, spruce-dominated forest is consistent with other studies conducted in southeastern Alaska (Noble 1977; Kessler and Kogut 1985; DellaSala and others 1996). Although we, along with Noble (1977), found winter wrens to be rare in mixed conifer-shore pine muskegs, other researchers (Kessler and Kogut 1985; DellaSala and others 1996; Cotter and Andres 2000) found winter wrens to be abundant and widely distributed across a variety of vegetation types, many of which were early successional. Winter wrens likely require some developed understory, especially large root wads, stumps, or downfall, for nesting or foraging. Townsend's warblers in our study were more abundant in spruce-associated vegetation types, but moderate numbers of birds were detected in open forest types and forest edges along Breeding Bird Survey routes in southeastern Alaska (Cotter and Andres 2000). Vertical structure diversity (for example, gaps or canopy unevenness) is an important feature of Townsend's warbler habitat (DellaSala and others 1996).

DellaSala and others (1996) found that golden-crowned kinglets were more abundant in old-growth, versus young-growth, spruce-hemlock forests, and their abundance related positively to density of large trees (>55 cm dbh). Noble (1977) also found that golden-crowned kinglets nested exclusively in old-growth, closed canopy forest, but in our study kinglets were equally abundant among all spruce-dominated forest types. Noble (1977), Kessler and Kogut (1985), and DellaSala and others (1996) found that brown creepers were mainly associated with hemlock-spruce forest, but creepers were equally distributed among spruce forest types in our study. In all studies, brown creepers were rarely encountered in successional or muskeg vegetation types. Because brown creepers commonly nest in natural tree crevices, behind loose bark, or (rarely) in cavities made by other species, they require mature trees.

The hermit thrush was the only species in our study that was most abundant in open

TABLE 3. The most convincing breeding evidence, overall categorical abundance, and distribution (number of RNAs) recorded of small landbirds in 11 RNAs of the Tongass National Forest, Alaska, surveyed in 1997 and 1998. Abundance categories are defined in Table 2. Overall abundance (birds/point) and percentage of points for each species recorded during point counts in combined RNAs.

	Area searches			Point counts (n = 187)	
Common name (*scientific name*)	Breeding status	Abundance	No. of RNAs	No. birds per point	Percent of points
Vaux's swift (*Chaetura vauxi*)	possible[1]	occasional	1	0	0
Rufous hummingbird (*Selasphorus rufus*)	probable[2]	fairy common	11	0.15	11.8
Red-breasted sapsucker (*Sphyrapicus ruber*)	confirmed[3]	uncommon	8	0.10	9.6
Downy woodpecker (*Picoides pubescens*)	possible	occasional	1	0	0
Hairy woodpecker (*P. villosus*)	confirmed	uncommon	8	0.07	7.0
American three-toed woodpecker (*P. dorsalis*)	possible	occasional	1	0.01	0.5
Northern flicker (*Colaptes auratus*)	possible	rare	3	0.01	1.1
Olive-sided flycatcher (*Contopus cooperi*)	possible	occasional	1	0	0
Alder flycatcher (*Empidonax alnorum*)	possible	occasional	1	0	0
Hammond's flycatcher (*E. hammondii*)	possible	occasional	1	0.01	0.5
Pacific-slope flycatcher (*E. difficilis*)	probable	common	10	1.71	80.7
Warbling vireo (*Vireo gilvus*)	probable	occasional	1	0.03	2.7
Steller's jay (*Cyanocitta stelleri*)	probable	uncommon	9	0.13	10.7
Northwestern crow (*Corvus caurinus*)	possible	uncommon	7	0.18	6.4
Common raven (*C. corax*)	probable	uncommon	8	0.11	7.5
Tree swallow (*Tachycineta bicolor*)	probable	uncommon	5	0.01	0.5
Bank swallow (*Riparia riparia*)	probable	occasional	1	0	0
Barn swallow (*Hirundo rustica*)	observed[4]	occasional	1	0	0
Chestnut-backed chickadee (*Poecile rufescens*)	confirmed	common	11	0.69	37.4
Red-breasted nuthatch (*Sita canadensis*)	possible	rare	8	0.01	1.1
Brown creeper (*Certhia americana*)	confirmed	fairly common	10	0.32	19.3
Winter wren (*Troglodytes troglodytes*)	confirmed	common	11	0.97	66.3
American dipper (*Cinclus mexicanus*)	probable	occasional	1	0	0
Golden-crowned kinglet (*Regulus satrapa*)	confirmed	common	11	0.94	47.6
Ruby-crowned kinglet (*R. calendula*)	confirmed	uncommon	8	0.17	14.4
Swainson's thrush (*Catharus ustulatus*)	probable	fairly common	11	0.22	16.0
Hermit thrush (*C. guttatus*)	confirmed	common	11	1.15	65.8
American robin (*Turdus migratorius*)	confirmed	uncommon	7	0.10	8.6
Varied thrush (*Ixoreus naevius*)	confirmed	common	11	1.07	62.0
Tennessee warbler (*Vermivora peregrina*)	probable	occasional	1	0	0

TABLE 3. Continued.

Common name (*scientific name*)	Area searches			Point counts (*n* = 187)	
	Breeding status	Abundance	No. of RNAs	No. birds per point	Percent of points
Orange-crowned warbler (*V. celata*)	confirmed	fairly common	10	0.20	16.6
Yellow warbler (*Dendroica petechia*)	probable	rare	3	0.05	4.3
Yellow-rumped warbler (*D. coronata*)	confirmed	rare	3	0.06	4.8
Townsend's warbler (*D. townsendi*)	confirmed	common	11	0.90	61.0
Northern waterthrush (*Sieurus noveboracensis*)	probable	rare	2	0.06	5.3
Common yellowthroat (*Geothlypis trichas*)	confirmed	rare	2	0.02	1.6
Wilson's warbler (*Wilsonia pusilla*)	confirmed	uncommon	5	0.08	7.0
Western tanager (*Piranga ludoviciana*)	possible	occasional	1	0.01	1.1
Savannah sparrow (*Passerculus sandwichensis*)	possible	occasional	1	0	0
Fox sparrow (*Passerella iliaca*)	confirmed	rare	2	0.04	3.2
Song sparrow (*Melospiza melodia*)	confirmed	uncommon	6	0.01	0.5
Lincoln's sparrow (*M. lincolnii*)	confirmed	rare	4	0.07	4.3
Golden-crowned sparrow (*Zonotrichia atricapilla*)	possible	occasional	1	0	0
Dark-eyed junco (*Junco hyemalis*)	confirmed	fairly common	6	0.20	14.4
Red-winged blackbird (*Agelaius phoeniceus*)	possible	occasional	1	0.01	0.5
Pine grosbeak (*Pinicola enucleator*)	possible	occasional	2	0	0
Red crossbill (*Loxia curvirostra*)	probable	common	10	0.19	4.8
White-winged crossbill (*L. leucoptera*)	possible	occasional	2	0.02	1.1
Pine siskin (*Carduelis pinus*)	confirmed	uncommon	9	0.13	3.7

[1] Heard or seen in suitable nesting habitat but no further evidence of breeding.
[2] Pair observation, permanent territory, chases, courtship behavior, observed copulation, or agitated behavior.
[3] Carrying nesting material, nest building, distraction display, nest with eggs or young, precocial young, carrying food, recently fledged young.
[4] Observed but did not show evidence of breeding, was not in suitable nesting habitat, or was an obvious migrant.

TABLE 4. Mean abundance (birds/point observed ≤50 m from point center) of small landbirds species (for which >30 individuals were observed), by elevation and overstory forest types, in Research Natural Areas of the Tongass National Forest, 1997 to 1998. Statistical significance of comparison ($P < 0.05$), using dispersion-adjusted Poisson variances, between low-elevation hemlock-spruce and other forest types is denoted as a superscript.

	Low-elevation hemlock-spruce	Mid-elevation hemlock-spruce	High-elevation fir-spruce	Low-elevation mixed conifer-shore pine
Number of surveyed points	83	39	22	37
Number of RNAs	9	7	1	6
Mean elevation (m)	30	174	663	30
Pacific-slope flycatcher	1.12	$0.67^{0.001}$	$0.00^{0.001}$	0.89
Chestnut-backed chickadee	0.58	0.67	$0.09^{0.025}$	0.95
Brown creeper	0.36	0.18	0.32	0.08
Winter wren	0.55	0.49	0.50	$0.16^{0.004}$
Golden-crowned kinglet	1.21	0.92	0.77	$0.11^{0.001}$
Hermit thrush	0.22	0.28	0.32	$0.54^{0.05}$
Varied thrush	0.22	0.15	$0.55^{0.009}$	$0.05^{0.049}$
Townsend's warbler	0.53	0.44	0.73	$0.16^{0.004}$

mixed conifer-shore pine muskegs. Noble (1977) also had greater detections of hermit thrushes in shore pine, versus closed canopy forests, and DellaSala and others (1996) found similar abundances of thrushes in young- and old-aged stands. Numbers of hermit thrushes are thought to increase after recent disturbance in southeastern Alaska (Noble 1977; Kessler 1979). Although only small numbers were encountered in our study, rufous hummingbirds tended to be equally abundant among all low- and mid-elevation forest types but were associated with forest edges on Breeding Bird Survey routes in southeastern Alaska (Cotter and Andres 2000).

Although the Swainson's thrush was suggested to be less abundant in old-growth than young forests in 1 study (DellaSala and others 1996), our observations of Swainson's thrushes were too infrequent to determine vegetation associations for this species. High occurrence of thrushes in shrubs on Breeding Bird Survey routes (Cotter and Andres 2000) and other incidental observations (Noble 1977) suggest primary use of early successional stage forests by Swainson's thrushes.

The Pacific-slope flycatcher and chestnut-backed chickadee occurred in high abundances in all forest types except high-elevation spruce-fir. Other work supported their use of a wide range of forest types, but encounters of Pacific-slope flycatchers and chestnut-backed chickadees in young forest stands (<10 y) were rare (Noble 1977; Kessler and Kogut 1985). DellaSala and others (1996) found that Pacific-slope flycatchers were 6 to 14x more abundant in old-growth than in young coniferous stands, whereas Noble (1977) found that densities were 5x and 2x higher in shore pine muskegs and 23-y-old successional forests than in tall, old-growth forests. Kessler and Kogut (1985) recorded the flycatcher as abundant in riparian old-growth forests, common in shore pine muskegs and conifer stands to 30 y old, but absent in stands <5 y old. Chickadees and flycatchers were positively related to increasing coniferous forest cover on Breeding Bird Survey routes in southeastern Alaska (Cotter and Andres 2000). Although common among many forest types, Pacific-slope flycatchers are likely most abundant in riparian and low-elevation coniferous forests.

Although species diversity in old-growth, coniferous forests is often lower than in successional forests (DellaSala and others 1996), several breeding species reach their highest abundances in low-elevation hemlock-spruce forest. Additionally, old-growth hemlock-spruce forests provide important wintering habitat for resident birds (for example, winter wrens, golden-crowned kinglets, and chestnut-backed chickadees), and structural attributes of old-growth forests may positively influence survival of these species during harsh winters (Hughes 1985; Schoen and others 1988; DellaSala and others 1996). Development and maintenance of a system of RNAs, and other non-development land units, across the Tongass will ensure that needs of several forest birds are met. Because RNAs provide non-anthropogenically disturbed forest for breeding birds, a rigorous sampling program could be designed that incorporates RNAs as a benchmark to evaluate changes in bird abundance and richness that may occur in developed lands within southeastern Alaska.

ACKNOWLEDGMENTS

A Garibaldi and K Boggs, Alaska Natural Heritage Program, assisted with plant community surveys. P Schempf and J McClung, US Fish and Wildlife Service, provided on-water logistical support. Funding for this study was obtained by WP Smith, US Forest Service, Forestry Sciences Laboratory, and KD Wohl, US Fish and Wildlife Service, Nongame Migratory Bird Management. Thanks to numerous Forest Service staff in several districts who assisted us in locating RNAs on the ground. BC McComb and JC Hagar provided helpful comments on drafts of this manuscript.

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Submitted 5 December 2002, accepted 4 May 2004. Corresponding Editor: KA Engel.

* Unpublished.