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Bird, Mammal, and Vegetation Community Surveys of Research Natural Areas in the Tongass National Forest

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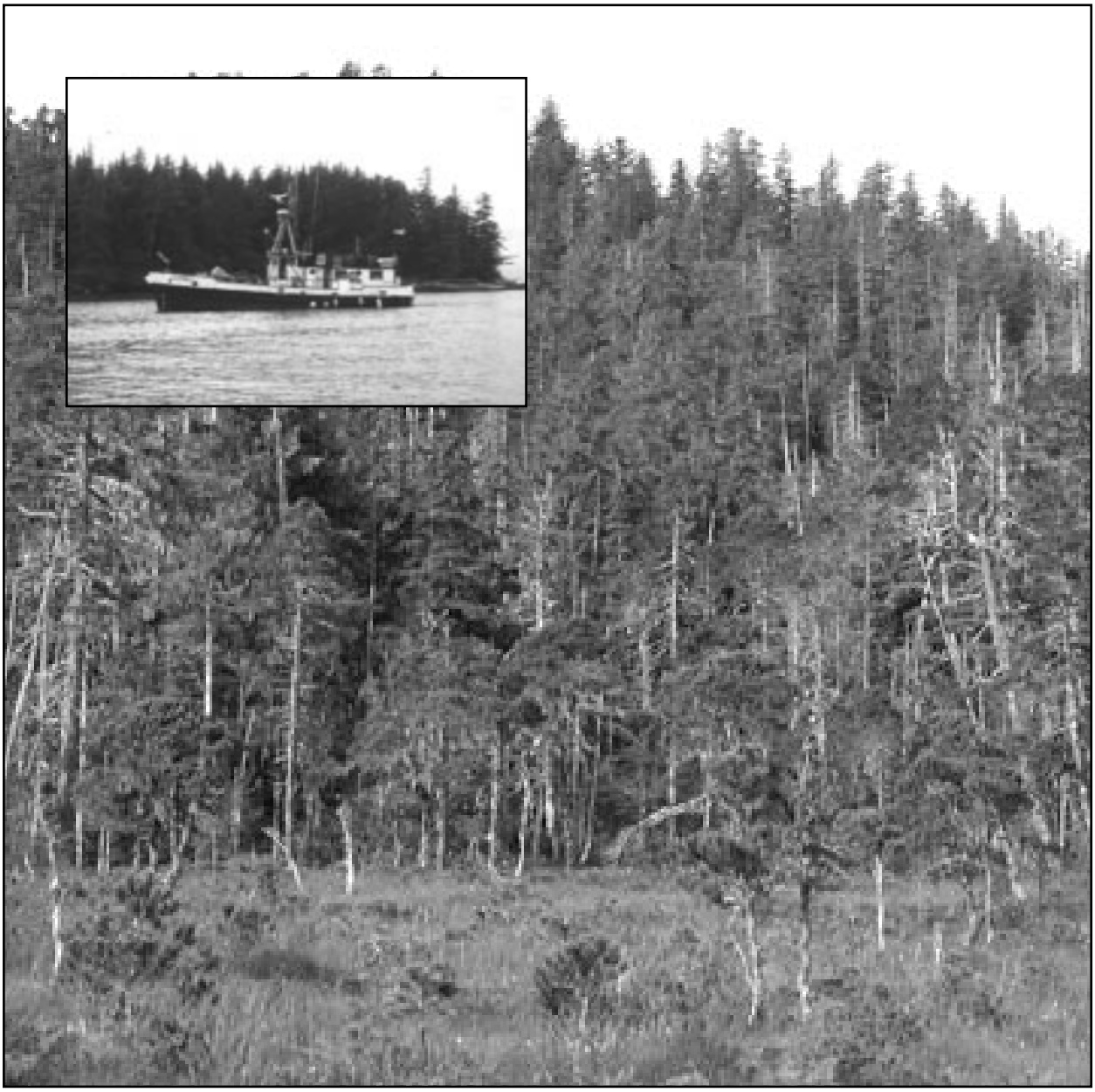

Erratum added 12/27/02

Erratum

This erratum revises text on page 24, paragraph1, line 5 from Noble's 1997 to Noble's 1977.

Authors

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Abstract

Smith, W.P.; Stotts, M.J.; Andres, B.A.; Melton, J.M.; Garibaldi, A.; Boggs K. 2001. Bird, mammal, and vegetation community surveys of research natural areas in the Tongass National Forest. Res. Pap. PNW-RP-535. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 44 p.

In June 1977, we surveyed seven research natural areas (RNAs) in the Tongass National Forest (Tongass). We documented the composition of biotic communities using rare plant and tidal community surveys, targeted searches for rare animals, and samples of permanent vegetation plots. Birds were sampled once along each transect with 10-minute point counts at stations 8 through 11 spaced at 250-m intervals. A total of 84 point-count stations was classified according to plant association. Mammals were sampled for two nights along the initial 1.25-km segment of each transect by establishing trap stations at 10-m intervals. Each trap station had two traps, totaling 250 traps (500 trap/nights of effort) per transect: two snap traps, a snap trap and a folding live-trap, or a snap-trap and a cone pitfall trap. We documented 31 vascular plant species previously unconfirmed for RNAs on the Tongass. Breeding status and relative abundance of 65 bird species were recorded; 331 small mammals representing six species were captured with an additional five species documented from visual observations or physical evidence. Coordinated, community surveys are efficient in documenting elements of biological diversity and should receive consideration as an inventory protocol or for monitoring ecosystem integrity. Community surveys of RNAs provide an important benchmark.

Keywords: Biodiversity, birds, mammals, plant associations, research natural area, southeast Alaska, Tongass National Forest.

Summary

We surveyed the following seven research natural areas (RNAs) on the Tongass National Forest in June 1997: Dog Island, Old Tom Creek, Rio Roberts, Kadin Island, West Gambier Bay, Cape Fanshaw, and Limestone Inlet. We added 31 vascular plant species to the list of plants recorded within RNAs of the Tongass National Forest. Breeding status and abundance of 65 bird species were recorded. Number of bird species among RNAs ranged from 22 to 41 with a median of 37. Percentage of confirmed breeders ranged from 36 to 51 percent with a median of 39 percent. The largest number of bird species was recorded in Dog Island RNA, whereas Old Tom Creek RNA had the largest proportion of confirmed breeders. Checklist surveys were more effective than point counts in generating a comprehensive list of birds for each RNA. Variation in bird species composition among RNAs was related to habitat features, latitude, or geographical location, especially juxtaposition to a marine environment. A total of 331 small mammals representing six species was captured with an additional five species documented from visual observations or physical evidence. Both relative abundance and species richness of captures were highest in Limestone Inlet RNA and lowest in Kadin Island RNA. The Keen's mouse was the numerical dominant species, comprising 66 percent of total captures.

Contents

Introduction

The idea of preserving natural areas for the purpose of conducting research or for education dates back to the early 1900s. The Ecological Society of America, and later, the Society of American Foresters, Society for Range Management, and Soil Conservation Society of America established areas that were representative of natural forest, range, and soil conditions (Juday 1988). Research Natural Areas (RNAs) are (U.S. Department of Agriculture, Forest Service 1994.) sites on federal lands set aside for their unique ecological features. An important function of RNAs is to "preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geological, and similar natural situations that have special or unique characteristics of scientific interest and importance, that in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity."

Thus, at the most fundamental level, RNAs are intended to preserve a sample of the natural heritage of the Nation for future generations while providing unique opportunities to conduct nonmanipulative ecological research (U.S. Department of Agriculture, Forest Service 1992). More recently, RNAs are identified as essential "benchmarks" for comparing the results of a new land management paradigm; i.e., "management experiments," on National Forest System lands (Ryan and others 1994). Without natural areas, and their entire complement of components and processes to serve as standards, or "experimental controls," the outcomes of ecosystem management would remain unknown (Smith and Hamel 1991). Research natural areas are ideal land management "controls" because commercial and most recreational uses are excluded.

The Tongass National Forest (Tongass) is the largest land parcel under public stewardship in the United States and the largest remaining relatively pristine coastal temperate rain forest in the world, incorporating 68 826 km^2 of the temperate coniferous rain forest of southeast Alaska (U.S. Department of Agriculture, Forest Service 1978). Comprised of the Alexander Archipelago and a narrow strip of North American mainland, the >2,000 named islands, mountains, fjords, glaciers, and ice fields create a heterogeneous environment rarely encountered elsewhere. Because of these features and a dynamic geological history, the Tongass supports many unique organisms and habitats for many indigenous vertebrates: 53 mammals, 231 birds, and 5 amphibians and reptiles. Mammals alone are represented by 24 endemic taxa (MacDonald and Cook 1996a, 1996b). Moreover, the lakes, streams, and surrounding marine waters support one of the most diverse and productive fisheries for wild anadromous salmonids in the world (Everest and others 1997). Although there are expanding tourism and recreational interests that complement a commercial fishery, mining, and timber-based economy, subsistence remains a significant component of the lifestyle of many residents.

Recently, 12 RNAs comprising 10 806 ha of temperate coniferous rain forest were authorized under the new Tongass land management plan (U.S. Department of Agriculture, Forest Service 1997). These areas were selected to reflect a broad latitudinal extent and include various physical or geological qualities (Juday 1987) as well as ecological phenomena (U.S. Department of Agriculture, Forest Service 1992). The diversity of natural features represented within the Tongass RNAs provides a rare opportunity to establish baselines of biological diversity across various undisturbed biotic communities on National Forest System lands. Intensive studies of biological communities in the Tongass are few (U.S. Department of Agriculture, Forest Service 1997); notable exceptions include surveys to identify unique or rare

plants, studies of land-bird communities (DellaSala and others 1996, Gibson 1976, Kessler and Kogut 1985, Noble 1977), and efforts to characterize phylogeographic patterns of the mammal fauna (Conroy and others 1999; Demboski and others 1998; MacDonald and Cook 1996a, 1996b). Rather, most of the previous research in southeast Alaska has focused on the biology of one or a few species including birds of prey (Gende and others 1998, Iverson and others 1996), small mammals (Hanley 1996; Hanley and Barnard 1999a, 1999b; Parker and others 1996, Reese and others 1997; Van Horne 1981, 1982), carnivores (Ben-David and others 1997, Giannico and Nagorsen 1989, Hickey and others 1999, Kohira and Rexstad 1997, Szepanski and others 1999), and ungulates (Chang and others 1995; Hanley and others 1989; Kirchhoff and Larsen 1998; Lewis 1994; Parker and others 1996, 1999; Schoen and Kirchhoff 1985, 1990; Yeo and Peek 1992). General broad-scale information on composition, habitat distribution, and relative abundance of plants and animals is limited for much of southeast Alaska.

Documenting the biological diversity of undisturbed communities in the Tongass is important for determining a baseline from which to evaluate long-term, cumulative impacts of continued commercial and recreational land uses. In particular, there is a need to characterize plant and animal communities of low-elevation, old-growth forests where a disproportionate amount of human-caused disturbance has occurred since the onset of commercial logging (U.S. Department of Agriculture, Forest Service 1997). The purpose of this study was to contribute additional baseline information about the natural history of largely pristine, natural communities below 300 m elevation. Specific objectives were to document (1) plants and animals, especially rare or unique species, within RNAs and to supplement existing baseline databases with representative plant associations across the Tongass; (2) plant composition and diversity of intertidal communities, and (3) habitat distribution and relative abundances of breeding birds and small mammals.

Methods

Study Sites

We selected seven RNAs to conduct bird, mammal, and vegetation surveys: Dog Island, Old Tom Creek, Rio Roberts, Kadin Island, Cape Fanshaw, West Gambier Bay, and Limestone Inlet (fig. 1). These RNAs were selected according to distribution within the Tongass, representation along a latitudinal gradient, paucity of ecological information, and logistic constraints. Below is a brief description of each RNA; information was obtained from the corresponding Research Natural Area Establishment Record.

Dog Island[1]—Dog Island is located at the southern end of the Tongass (54˚ 59’ N, 131˚ 19’ W), situated between Felice Strait and Duke Island near Dixon Entrance. The RNA includes the entire island, 3.06 km long and 2.25 km wide, encompassing 313 ha. Dog Island is a low-lying island with little topography, rarely exceeding 15 m elevation. It was selected as an RNA because it supports an ecological complex containing Pacific yew (*Taxus brevifolia*), and it is typical of small island ecosystems in the southern extremity of southeast Alaska. There are only intermittent streams, none of which are used for spawning by anadromous salmonids. The center of the island is mostly a raised bog-type sphagnum muskeg. Annual precipitation in the vicinity (Annette Island, 21 km west) is mostly rain, totaling about 244 cm. Mean air

[1] Harris, A.S. 1969. Establishment report for Dog Island. Unpublished report. 12 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

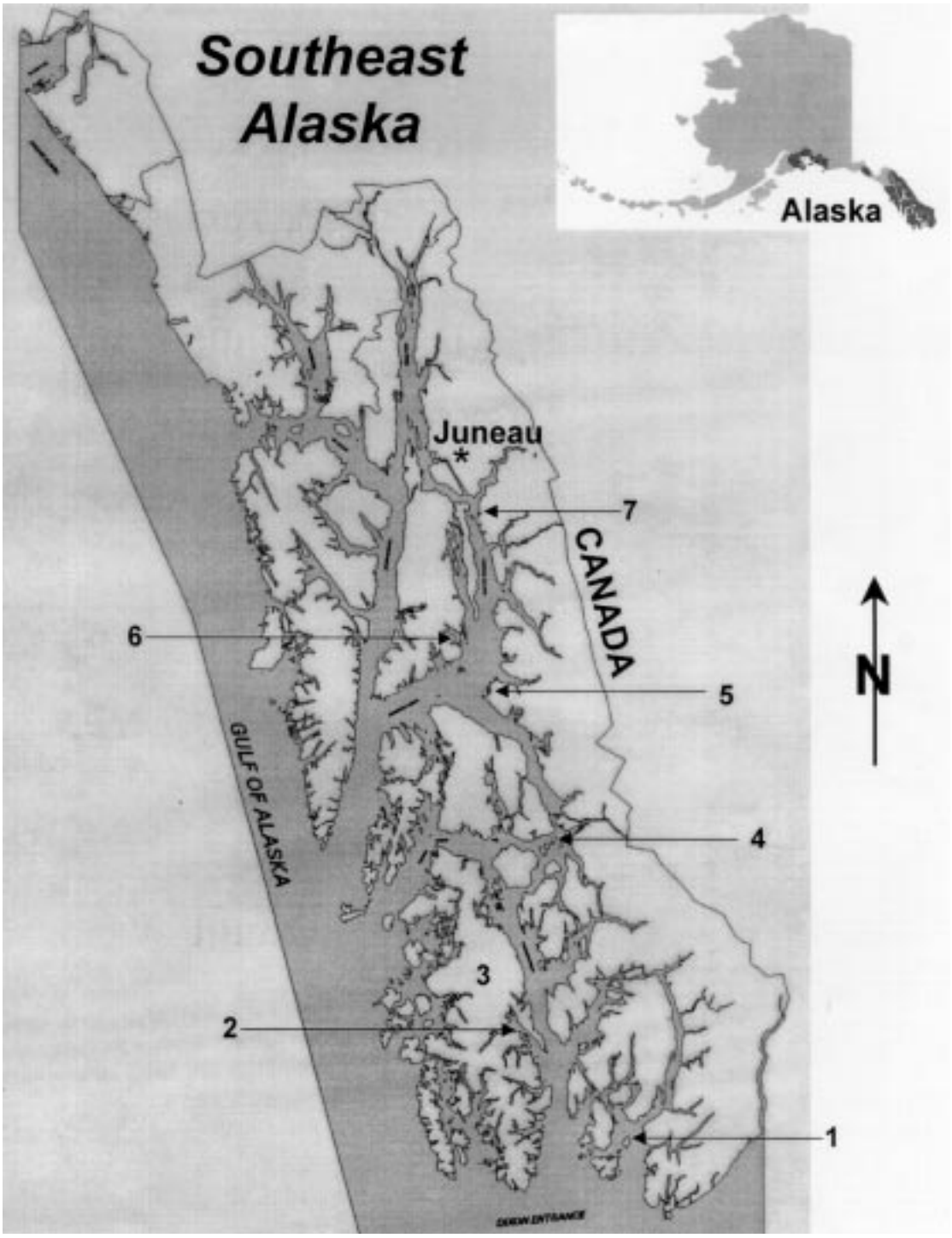

Figure 1—Location of research natural areas within the Tongass National Forest, southeast Alaska: (1) Dog Island, (2) Old Tom Creek, (3) Rio Roberts, (4) Kadin Island, (5) Cape Fanshaw, (6) West Gambier Bay, and (7) Limestone Inlet.

temperature ranges from 2 ˚C during December through February to 12 ˚C during May through October. Temperatures rarely fall below -18 ˚C or exceed 29 ˚C. The growing season is about 160 days.

Old Tom Creek[2]—Old Tom Creek RNA includes 1914 ha between McKenzie Inlet and Polk Inlet on southern Prince of Wales Island (55˚ 23' N. 132˚ 25' W); it empties into Skowl Arm near McKenzie Inlet. Old Tom Creek was selected as an RNA because it is representative of eastern portions of Prince of Wales Island; it has vegetative types common to the islands of southern southeast Alaska; it is reasonably accessible to scientists, but too remote to receive much public use; and it serves as an essential experimental control site of natural condition for ongoing salmonid habitat studies. The RNA is limited by natural watershed boundaries at the ridgeline with elevation ranging from sea level to about 450 m along a northern and eastern ridge and about 180 m along the western boundary. Annual precipitation averages 280 cm. Mean air temperatures at Hollis (20 km northwest of Old Tom Creek RNA) range from 1 ˚C during December through February to 11 ˚C during May through October. The frost-free period is typically between May 15 and September 1.

Rio Roberts[3]—Rio Roberts RNA is located in north-central Prince of Wales Island (55˚ 42' N and 132˚ 43' W) about 24 km west of Thorne Bay. The RNA includes 662 ha in the North Central Prince of Wales Ecological Province where overall forest productivity is high. The RNA is characterized by relatively gentle topography with elevations that range between 18 and 76 m. This site was selected as an RNA primarily because of its representative riparian flood-plain Sitka spruce (*Picea sitchensis*) stands, upland old-growth and natural second-growth stands, and upland hemlock (*Tsuga heterophylla*) on drumlin fields (U.S. Department of Agriculture, Forest Service 1991). Mean annual rainfall is 406 cm; snowfall averages 94 cm. Average air temperatures at Klawock (30 km southwest of Rio Roberts RNA) range from 2 ˚C during December through February to 11 ˚C during May through October.

Kadin Island[4]—Kadin Island (56˚ 31. N and 132˚ 27' W) is in the Wrangell Ranger District, about 6.4 km northwest of Wrangell. The RNA includes the entire island, which is 3.22 km long and 2.41 km wide. It ranges in elevation from sea level to 530 m encompassing 657 ha. The principal unique feature of the RNA is loess soils, which occur over most of the island. Well-drained and fertile, the loess soils lack a well-developed organic layer because of rapid decomposition of litter fall. Plant species uncommon to upland sites are well represented on Kadin Island; all but 8 ha are in forest cover. Annual precipitation in Wrangell averages 208 cm; mean air

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[2] Zach, L. 1950. Establishment report for Old Tom Creek. Unpublished report. 8 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

[3] U.S. Department of Agriculture, Forest Service, 1995. Establishment report for Rio Roberts. Unpublished report. 58 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

[4] U.S. Department of Agriculture, Forest Service. 1994. Establishment report for Kadin Island. Unpublished report. 22 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

temperatures range from -1 ˚C during December through February to 11 ˚C during May through October. The frost-free period for Wrangell averages 169 days.

West Gambier Bay[5]—West Gambier Bay, located in the southern portion of Admiralty Island National Monument (57˚ 25' N and 133˚ 56' W), totals 4676 ha and includes an entire watershed, several streams, karst terrain, a freshwater lake, and many forested and nonforested vegetation communities typical of islands of northern southeast Alaska. By authorization, West Gambier Bay replaced Pack Creek RNA on north Admiralty Island and thus has many of the features associated with that site such as a diverse estuary, anadromous fish-bearing streams, alpine and shrubland plant communities, mixed-conifer low-productivity forest, peatlands, and productive upland and riparian old-growth forests. Elevation ranges from sea level to 863 m at the west end of the RNA where high-elevation plant communities are prominent. Annual precipitation in Angoon (29 km) on the west side of Admiralty Island averages 99 cm. Mean air temperatures range from 1 ˚C during December through February to 10 ˚C during May through October; mean frost-free period at Angoon is 165 days.

Cape Fanshaw[6]—Cape Fanshaw RNA is on the Alaska mainland near the south end of Stephen's Passage, almost centrally located in southeast Alaska (57˚ 13' N and 133˚ 29' W). The 243-ha RNA was selected primarily because of a natural ecological complex with a high proportion of Alaska-cedar (a.k.a. yellowcedar, *Chamaecyparis nootkatensis*). Although Alaska-cedar occurs throughout coastal Alaska, this is the only site set aside for research or education. Elevation ranges from 30 m above sea level along the western boundary to 682 m on the eastern boundary. Mean air temperature varies from 2 ˚C during December through February to 10 ˚C during May through October. The growing season is about 140 days. Annual sea-level precipitation (mainly rain) is about 250 cm. Mean annual rainfall in Petersburg, 56 km to the southeast, is 269 cm; snowfall averages 259 cm.

Limestone Inlet[7]—Limestone Inlet (58˚ 2' N and 133˚ 57' W) is along the eastern shore of Stephen's Passage about 40 km southeast of Juneau. It extends from shoreline to 975 m above sea level, totaling 3685 ha. This site was selected as typical of the vegetation type on the northern mainland portion of the Tongass. About 1336 ha is forested; 1215 ha is classified as barren with the remaining 31 percent largely estuary or stream channel and alluvial flood plain. Annual precipitation (rain and snow) at the Snettisham power facility 10 km northeast of Limestone Inlet averages

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[5] Trull, S.J. 1996. Establishment report for West Gambier Bay. Unpublished report. 26 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

[6] Helmers, A. 1964. Establishment report for Cape Fanshaw. Unpublished report. 8 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

[7] Briegleb, P.A. 1971. Establishment report for Limestone Inlet. [Revised]. Unpublished report. 8 p. On file with: USDA Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

450 cm; snowfall averages 590 cm. Annual precipitation in Juneau averages 225 cm rainfall and 170 cm snowfall; mean air temperature ranges from –1 ˚C during December through February to 11˚C during May through October. The frost-free period at sea level is probably May 5 through September 15.

Logistics

Because of the broad latitudinal extent of the Tongass, investigations began June 1, 1997, on the southern end of the Forest near Dixon Entrance (fig. 1), and continued northward until surveys were completed June 30, 1997. This schedule accommodated latitudinal differences in important phenological events that generally advance northward as spring progresses. Nonetheless, we assumed that RNAs were sampled during comparable seasonal periods in relation to the organisms studied. We traveled among RNAs aboard the U.S. Fish and Wildlife Service vessel *Surfbird*. A 5.8-m Boston Whaler was used to ferry the field crew to shore daily. At each RNA, ≥1 transect was established with compass and pacing. Transects were documented with a global positioning system (GPS).

Documenting Biological Communities

Plant associations—We characterized sites according to regional plant association guides[8 9 10] and by conducting plant surveys to establish or expand comprehensive species lists. On Dog Island, we established a permanent plot in old-growth *Thuja plicata-Tsuga heterophylla* in the northeast corner of the RNA; sampling methods followed Alaback and Juday (1989). In addition, we surveyed RNAs for presence of rare animals including freshwater worms, mollusks, and *Batrachoseps caudatus*, the Alaskan worm salamander. Methods were adapted to local conditions to increase sampling efficiency. Typically, animal searches were concentrated on moist duff and humus soil layers, under boulders, or under logs within forested sites. Specimens were preserved in an alcohol solution. Vegetation sampling was directed at abating specific information deficiencies for southeast Alaska: distribution and composition of intertidal plant communities; and distribution of rare, endangered, or sensitive plant species.

Tidal community survey—A two-person team surveyed tidal areas; a 0.6- by 3.0-m temporary plot was sampled in each recognized community type. A community was defined as “an area that is homogenous in vegetation structure and species composition.” Percentage of cover of each species, bare ground, litter, and rock was recorded according to the categories in the following tabulation:

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[8] DeMeo, T.; Martin, J.; West, R.A. 1992. Forest plant association management guide: Ketchikan Area, Tongass National Forest. Unpublished report. [Pages unknown]. On file with: U.S. Department of Agriculture, Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

[9] Pawuk, W.H.; Kissinger, E.J. 1989. Preliminary forest plant associations of the Sitkine Area, Tongass National Forest. Unpublished report. [Pages unknown]. On file with: U.S. Department of Agriculture, Forest Service. Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628

[10] Martin, J.R.; Trull, S.J.; Brady, W.W. [and others]. 1995. Forest plant association management guide, Chatham Area, Tongass National Forest. Unpublished report. [Pages unknown]. On file with: U.S. Department of Agriculture, Forest Service, Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

Category		Percent	Category		Percent	Category		Percent
TR	=	< 0.5	30%	=	26-35	80%	=	76-85
1%	=	0.5-1	40%	=	36-45	90%	=	86-94
5%	=	2-7	50%	=	46-55	95%	=	95-98
10%	=	7-15	60%	=	56-65	99%	=	99
20%	=	16-25	70%	=	66-75	100%	=	100

Voucher specimens were collected for unique species, for species with questionable taxonomy, and for mosses and lichens with >10 percent cover. The voucher specimens are housed with Alaska Natural Heritage in Anchorage.

Rare plant surveys—Surveys for rare and endangered plants were performed coincidental with other activities. Also, communities with a greater likelihood of supporting rare species were identified and intensive searches performed. Several rare plants (Lipkin and Murray 1997) were targeted during intensive searches: *Poa macrantha, Poa laxiflora, Botrychium lunaria, Cochlearia sessifolia, Platanthera gracilis, Lobelia dortmanna, Salix reticulata glabellicarpa, Mecodium wrightii, and Ligusticum calderi.*

Classification of vascular plants followed Hultèn (1968) and Kartesz (1992). Taxonomy and nomenclature of mosses, lichens, and ferns followed Vitt and others (1988). Nomenclature and species codes of taxa recorded during this study are presented in appendix 1.

Bird Checklist Procedures

Abundance and breeding status of birds were recorded during systematic searches of different habitats on a time-available basis. Survey effort in each area-day (plot) was recorded as number of person-hours computed as the sum of hours surveyed by each individual, or 1.5 times the hours surveyed by a two-person team assuming that the added sampling efficiency of a second person was 50 percent that of a single individual. Person-hours was summed across days to compute total effort; >13.5 person-hours of effort occurred in each RNA. Plots were delineated on 7.5-minute U.S. Geological Survey topographic maps.

Birds recorded during checklist surveys were assigned to one of four breeding categories (table 1): observed, possible, probable, or confirmed (North American Ornithological Atlas Committee 1990). In each RNA, the highest recorded rank established the breeding status of a species. Abundance was summarized according to categories that generally followed Allen (1993) but were modified to reflect the abundance of birds in RNAs (table 2). We added a category (occasional) for species whose average abundance ranged from 0 to 0.33 birds per day (Andres 1995).

Point Counts

Point stations were established with a compass and pacing along each transect. Transect locations were selected to maximize variation in aspect, elevation, and major vegetation cover types. Point stations were spaced along transects at 250-m intervals and ranged from 8 to 11 points. Terrain often limited points surveyed during the 5-hour period following sunrise. All points were located >250 m from shoreline to reduce edge effects.

A standardized point count protocol was used to sample all RNAs (Hamel and others 1996). At each point, a single observer recorded all bird species, heard or seen, during a 10-minute period. Individuals detected ≤50 m, >50 m, and overhead (i.e.,

Table 1—Description of breeding status of birds recorded on research natural areas in the Tongass National Forest, June 1997[a]

Status	Description
Observed	Male or female observed, but did not show evidence of breeding; was not in suitable nesting habitat or was an obvious migrant.
Possible	Species (male or female) heard or seen in suitable nesting habitat but no further evidence of breeding was noted; included soaring birds (raptors) over suitable habitat.
Probable	Any of the following behaviors:
	Pair observation—Male and female simultaneously observed in suitable habitat.
	Permanent territory—Permanent territory presumed by observation of multiple, well spaced, singing males (indicated territory holders), also, if classes of individuals of the same species were seen.
	Courtship behavior—Male-female behavior observed that was indicative of breeding or observed copulation; included aerial displays of pipits, longspurs, and shorebirds.
	Agitated behavior—Adults seen exhibiting anxiety behavior including distress calls.
Confirmed	Any of the following behaviors:
	Carrying nesting material—Adult observed transporting nest building items such as sticks.
	Nest building—Adults seen constructing nest at singular nest site.
	Distraction display—Adults observed feigning injury (used by ground-nesting species to deter predators from detecting nest or young).
	Nest with eggs—Nest found that contained eggs.
	Nest with young—Live young seen or heard; dead, identifiable hatchlings found in a nest.
	Precocial young—Flightless young observed in the immediate nest area and were dependent on adults or had limited development.
	Carrying food—Adults seen delivering food to young.
	Recently fledged young—Young birds (either precocial or altricial) observed that were incapable of sustained flight and were restricted to the natal area by dependence on adults or by limited mobility.
	Feeding recently fledged young—Adult observed feeding recently fledged young (those incapable of sustained flight) away from nest site.

[a]Adapted from North American Ornithological Atlas Committee 1990.

Table 2—Descriptions, codes, categories and ranges of mean codes used for analysis of abundance categories of breeding birds observed on research natural areas in the Tongass National Forest, June 1–30, 1997

Category	Field description (per plot)	Range of mean codes (birds/day)
Occasional	<1 individual per day[a]	0.00-0.33
Rare	1 individual per day	0.34-0.67
Uncommon	2-4 individuals per day, <1 individual per hour	0.68-1.42
Fairly common	5-9 individuals per day, 1 individual per hour	1.43-2.42
Common	10-49 individuals per day, 2-5 individuals per hour	2.43-3.67
Abundant	≥50 individuals per day, ≥6 individuals per hour	3.68-5.00

[a] Day = eight person-hours.

flyovers) were recorded separately at intervals of 0 to 3, 3 to 5, and 5 to 10 minutes. The same observer surveyed all points. Point stations were assumed to represent independent units in estimating parameters. Number of detections at each point was used to estimate mean density (birds per point) and standard error of each species.

Vegetation Measurement

Habitat features were measured at a subset of point-count stations. Quadrat plots encompassing 288 m^2 were established around selected points. Points along each cardinal direction defined the perimeter of each plot 12 m from the center. Plots were marked with flagging, an aluminum tree tag, and GPS coordinates. Elevation (from topographic maps), slope, and aspect were recorded. Each plot was assigned to a plant community type (table 3) according to association guides for corresponding portions of the Tongass National Forest: Ketchikan (Demeo and others 1992), Stikine (Pawuk and Kissinger 1989), and Chatham Area (Martin and others 1995). We used Viereck and others (1992) and Pojar and MacKinnon (1994) as additional references for vegetation classification and distribution in the Pacific Northwest and Alaska. Plant associations were combined into two overstory cover types to facilitate summarizing the habitat distribution of birds (table 3).

Vegetation measurements generally followed Hamel and others (1996) or those recorded by DellaSala and others (1996). We measured tree and shrub species composition, living tree density, dead tree density (≥10 cm diameter at breast height [d.b.h.]), downed tree density (≥10 cm d.b.h.), shrub density (0.1 - 6 cm d.b.h.), percentage of canopy cover, and presence of water within 50 m of plot center. Living tree density was recorded as number of trees in each of three size classes: 6 to 35 cm, 36 to 55 cm, and >55 cm d.b.h. Dead trees were recorded as follows: snags (>5 m tall, lateral limbs, without bark), standing dead (≥5 m tall, ≥75 percent dead with limbs and bark), or stumps (<5 m tall). Water was recorded as ephemeral, stream or river, pond or lake, or absent. Relative shrub cover was estimated as number of contacts with shrubs of an observer's outstretched arm while walking 24 m along a north-south line (James and Shugart 1970).

Mammal Surveys

The small mammal sampling protocol was adapted from the procedures of MacDonald and Cook (1996b). In our study, a trap line was established along each avian transect. Trap lines began at point station 1 with two museum special snap traps and continued for about 1.25 km to point station 6 with two traps per station at about 10-m spacing. Large (7.6 by 8.9 by 22.9 cm) folding live traps and galvanized, cone pitfall traps (15 by 27.5 cm) were alternated systematically to replace museum special snap traps as the second trap at every other trap station. Thus, each trap line was comprised of 125 trap stations with 31 folding live traps, 31 cone pitfall traps, and 188 museum special snap traps. Trap stations were assigned a plant community type according to association guides for corresponding portions of the Tongass National Forest: Ketchikan (Demeo and others 1992), Stikine (Pawuk and Kissinger 1989), and Chatham Area (Martin and others 1995).

Snap traps were baited with a mixture of oatmeal and peanut butter; folding live traps were baited with dry oatmeal. Typically, trap lines were established and baited during the morning of the first day and maintained over 2 nights, totaling 500 trap nights of effort per transect. We followed the guidelines of acceptable field methods in Mammalogy (American Society of Mammalogists Animal Care and Use Committee 1998). Some animals were sacrificed by thoracic compression for genetic studies. All collected specimens were deposited with the University of Alaska Museum. Nomenclature followed MacDonald and Cook (1996a).

Table 3—Plant community and overstory types for plant associations found on avian point-count plots (*n* = 84) among research natural areas in the Tongass National Forest, June 1–30, 1997

Plant community type	Overstory cover type	Number of plots sampled
Western hemlock/blueberry	Hemlock/spruce	5
Western hemlock/menziesia	Hemlock/spruce	2
Western hemlock/blueberry-shield fern	Hemlock/spruce	3
Western hemlock/blueberry-skunk cabbage	Hemlock/spruce	5
Western hemlock/blueberry-devil's club	Hemlock/spruce	4
Western hemlock/devil's club-shallow soils	Hemlock/spruce	1
Western hemlock/yellowcedar/blueberry-skunk cabbage	Hemlock/spruce	2
Western hemlock/yellowcedar/menziesia	Hemlock/spruce	1
Western hemlock/yellowcedar/blueberry-devil's club	Hemlock/spruce	1
Sitka spruce/blueberry	Hemlock/spruce	2
Sitka spruce/blueberry-devil's club	Hemlock/spruce	1
Sitka spruce/devil's club	Hemlock/spruce	2
Sitka spruce/devil's club-salmonberry	Hemlock/spruce	1
Sitka spruce/devil's club-skunk cabbage	Hemlock/spruce	2
Sitka spruce/red alder/salmonberry	Hemlock/spruce	2
Sitka spruce/blueberry-skunk cabbage	Hemlock/spruce	2
Sitka spruce/mountain hemlock/blueberry	Hemlock/spruce	1
Mixed conifer/blueberry	Mixed conifer/shore pine	2
Mixed conifer/blueberry-skunk cabbage	Mixed conifer/shore pine	6
Mixed conifer/blueberry-deer cabbage	Mixed conifer/shore pine	1
Mixed conifer/skunk cabbage-lady fern	Mixed conifer/shore pine	1
Mixed conifer/blueberry-salal-deer cabbage	Mixed conifer/shore pine	2
Mountain hemlock/blueberry	Mixed conifer/shore pine	1
Shore pine/crowberry	Mixed conifer/shore pine	4
Shore pine/Sitka sedge	Mixed conifer/shore pine	5
Shore pine/tufted club rush	Mixed conifer/shore pine	3
Shore pine/salal	Mixed conifer/shore pine	3
Western hemlock/western redcedar/blueberry	Hemlock/spruce	5
Western hemlock/western redcedar/blueberry-skunk cabbage	Hemlock/spruce	5
Western hemlock/western redcedar/blueberry, well-drained variant	Hemlock/spruce	3
Western hemlock/western redcedar/blueberry-salal	Hemlock/spruce	1
Western hemlock/western redcedar/blueberry-salal-skunk cabbage	Hemlock/spruce	3
Western hemlock/western redcedar-salal	Hemlock/spruce	2

Results and Discussion

Rare Plants and Animals

Surveys to determine the current status of the Alaskan worm salamander in southeast Alaska yielded little additional information. Our searches occurred primarily in moist rocky areas with limestone substrate, the typical habitat of congeners (*Batrachoseps* spp.). *Batrachoseps caudatus* has not been recorded since it was initially collected in 1881 at Hassler Harbor, Annette Island. There are several reasons why this species was overlooked in previous surveys. The evasive nature of *B. caudatus* likely contributes to challenges associated with documenting its presence. Also, there is considerable uncertainty about the range of *Batrachoseps caudatus* and a general lack of knowledge about its natural history and seasonal phenology. Its official status is the category "Global Historical" (*sensu* Alaska Natural Heritage Program[11]).

We recorded 31 vascular plant species that were previously unconfirmed for Tongass National Forest RNAs. (table 4). Results are summarized according to RNA.

Dog Island—A crew led by Paul Alaback surveyed Dog Island in 1992 and established a permanent plot for long-term monitoring of *Taxus brevifolia* populations. We used the methods of Alaback and Juday (1989), but because of time constraints, only one 25- by 25-m plot and six subplots were sampled (table 5). Eight tidal marsh communities were sampled about 0.5 km west of the permanent plot (table 6). Invertebrate surveys failed to locate any specimens. No rare plants were recorded, and no new plant species were added to the comprehensive list.

Old Tom Creek—Eight tidal community plots were sampled along the north-northeast perimeter of the RNA (table 6). An inland lake, tidal area and several mesic forest sites were sampled for rare plants. No rare plants were found; eight common species were recorded (app. 2). No salamanders or uncommon invertebrates were recorded.

Rio Roberts—A species list was available from the establishment record and was derived from an understory vegetation summary. Rocky mesic sites, peatlands, and river corridors were surveyed for rare plants or plant additions to the species list. Nineteen previously undocumented species were added to the Rio Roberts species list (app. 2). One rare plant, *Platanthera hyperborea* var. *gracilis*, was found along the streambank and awaits taxonomic verification. Rio Roberts RNA does not contain a tidal area.

Kadin Island—An extensive species list was available for Kadin Island.[12] Four previously unreported species were recorded from the rocky tidal areas and forest fringe (app. 2). In the RNA report for Kadin Island, it was noted that two small bogs found "in a small valley that drains to the north" were not surveyed. We surveyed those bogs and found no new species (app. 2). Salamander and worm searches were conducted along rocky outcrops without success. Rare plant surveys were conducted on an opportunistic basis at all locations visited within the RNA. No rare plants were found. Kadin Island RNA does not contain a tidal marsh in the survey area on the south side of the island.

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[11] Alaska National Heritage, 707 A Street, Suite 101, Anchorage, AK 99501.

[12] Parker, C. 1994. Vascular plants collected and observed on Kadin Island, Wrangell District, SE Alaska. Unpublished administrative report. [Unpaged] On file with: USDA FS Alaska Region, P.O. Box 21628, Juneau, AK 99802-1628.

Table 4—Vascular plant species previously unconfirmed for research natural areas of the Tongass National Forest, June 1-30, 1997

Species	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay
Caltha leptosepala ssp. *Howellii*	X			
Carex pauciflora	X			
Comarum palustre	X			
Coptis aspleniflolia	X			
Drosera anglica	X			
Drosera rotundifolia	X			
Eleocharis palustris	X			
Empetrum nigrum ssp. *hermaphroditum*	X			
Fauria crista-galli	X			
Gentiana douglasiana	X			
Kalmia polifolia	X			
Ledum groenlandicum	X			
Menyanthes trifoliate	X			
Nuphar lutea ssp. *polysepala*	X			
Pinguicula vulgaris	X			
Platanthera stricta	X			
Scheuchzeria palustris ssp. *americana*	X			
Scirpus cespitosus	X			
Trientalis europaea ssp. *arctica*	X			
Carex macrochoeta		X		
Draba hyperborean		X		
Juncus filiformis		X		
Pleurozium schreberi		X		
Corallorhiza maculata			X	
Corallorhiza trifida			X	
Monotropa hypopithys			X	
Orthilia secunda			X	
Polygonum viviparum				X
Rhynchospora alba				X
Total	21	4	4	2

Table 5—Distribution (relative frequency) among subplots (*n* = 24), mean percentage of cover (TR = trace), height (cm; NA = not applicable) and basal diameter (cm) of plants recorded in a permanent plot established June 2, 1997, Dog Island Research Natural Area, Tongass National Forest[a]

Species code	Life form[b]	Relative frequency	Cover	Height	Basal diameter[c]
		-------- *Percent* --------		------- *Centimeters* ------	
VAC spp.	S	12.5	TR	15.0	0.6
VACOVA	S	54.2	37	145.4	1.2
MENFER	S	79.2	48	191.7	3.6
GYMDRY	P	66.7	12	17.1	
MAIDIL	F	100.0	72	17.5	
STRROS	F	83.3	17	17.2	
PETFRI	F	12.5	2	7.0	
STRAMP	F	45.8	4	28.6	
Unknown fern	F	12.5	TR	3.0	
HYLSPL	M	95.8	31	N A	
RHYTRI	M	100.0	58	N A	
Short moss	M	29.2	3	N A	
Medium moss	M	16.7	3	N A	
Flat moss	M	8.3	TR	N A	
Pancake moss	M	4.2	10	N A	
Black lichen	L	4.2	1	N A	
PICSIT	T	4.2	1	30.0	.6
TSUHET	T	4.2	5	60.0	.6
Litter		100.0	19	N A	

[a] NA = according to the procedures of Alaback and Juday (1989).

[b] T = tree; S = shrub; F = forb; G = graminoid P = pteridophyte; and M = moss.

[c] If basal diameter is not included, tree was not rooted in plot.

Table 6—Relative frequency (freq) in percent and mean percentage of cover (cover) of forbs (F), grasses (G), moss (M), shrubs (S) and trees (T) among tidal marsh community plots in four research natural areas, Tongass National Forest, June 1-30, 1997

Species Code	Life form	Research natural areas[a]							
		Dog Island (*n* = 9)		Old Tom Creek (*n* = 3)		West Gambier Bay (*n* = 7)		Limestone Inlet (*n* = 6)	
		Freq.	Cover	Freq.	Cover	Freq.	Cover	Freq.	Cover
ACHMIL	F	44	38	33	90	43	67	67	29
ANGLUC	F	11	1	0	0	0	0	33	55
ARGEGE	F	56	42	67	58	29	58	83	45
CAROLI	F	0	0	0	0	0	0	17	1
CASMIN	F	22	1	0	0	0	0	17	5
CHERUB	F	44	2	67	18	0	0	0	0
CICDOD	F	0	0	0	0	14	20	0	0
COCGRO	F	33	7	33	30	0	0	17	5
CONCHI	F	11	1	0	0	14	40	83	19
DODPUL	F	22	20	33	30	0	0	50	15
EQUSPP	F	0	0	0	0	14	5	17	70
FRICAM	F	0	0	33	1	0	0	33	TR
GALTRI	F	0	0	0	0	43	9	33	35
GERERI	F	0	0	0	0	0	0	33	45
GLAMAR	F	22	3	0	0	43	33	0	0
LIGSCO	F	11	1	33	TR[b]	0	0	17	50
LYSAME	F	0	0	0	0	14	10	17	20
MAIDIL	F	11	1	33	40	29	12	0	0
OENSAR	F	0	0	33	5	14	10	0	0
PLAMAC	F	33	67	0	0	0	0	17	1
PLAMAR	F	33	21	0	0	71	34	33	3
POLVIV	F	0	0	0	0	0	0	17	5
RANOCC	F	11	5	0	0	14	10	0	0
RANPAC	F	0	0	0	0	0	0	17	50
RANUNC	F	0	0	0	0	0	0	17	30
RUMSPP	F	0	0	0	0	14	1	17	5
SAGMAX	F	0	0	0	0	14	60	33	3
SALVIR	F	11	40	0	0	29	48	0	0
SANCAN	F	0	0	0	0	0	0	17	20
SPECAN	F	0	0	0	0	29	55	0	0
STECAL	F	0	0	0	0	14	5	33	8
STEHUM	F	0	0	0	0	14	5	17	TR[b]
TRIEUR	F	11	5	0	0	0	0	0	0
TRIMAR	F	67	12	67	30	14	5	33	23
TRIPAL	F	11	40	0	0	0	0	0	0
TRISPP	F	11	TR	0	0	14	1	0	0
CALCAN	G	0	0	0	0	14	80	17	90
CALNUT	G	0	0	0	0	0	0	17	40
CARLYN	G	33	TR	33	100	14	99	0	0

Table 6—Relative frequency (freq) in percent and mean percentage of cover (cover) of forbs (F), grasses (G), moss (M), shrubs (S) and trees (T) among tidal marsh community plots in four research natural areas, Tongass National Forest, June 1-30, 1997 (continued)

Species code	Life form	Research natural areas[a]							
		Dog Island (*n* = 9)		Old Tom Creek (*n* = 3)		West Gambier Bay (*n* = 7)		Limestone Inlet (*n* = 6)	
		Freq.	Cover	Freq.	Cover	Freq.	Cover	Freq.	Cover
CARPLU	G	33	47	0	0	14	1	0	0
CARAQU	G	0	0	0	0	14	90	0	0
FESRUB	G	0	0	0	0	29	20	67	54
HORBRA	G	0	0	0	0	0	0	67	16
JUNHAE	G	67	51	0	0	0	0	0	0
JUNFIL	G	22	50	0	0	0	0	0	0
LEYMOL	G	56	68	33	100	29	62	50	40
PUCKUR	G	0	0	0	0	57	61	0	0
PUCNUT	G	11	70	0	0	0	0	0	0
PUCSPP	G	22	5	100	55	0	0	0	0
RHYTRI	M	33	70	0	0	0	0	0	0
MOSS	M	33	8	0	0	0	0	0	0

[a] Not all sites were sampled because dominant plants were not identifiable due to early sample dates.
[b] TR = trace.

Table 7—Total effort, (no. days, no. person-hr), number of species, and percentage of "confirmed" or "probable" breeders observed on research natural areas (RNA) in the Tongass National Forest, June 1-30, 1997

RNA	Days	Person-hr	Species	Confirmed[a] or probable[b]
	----------	*Number*	----------	*Percent*
Dog Island	4	32.0	41	37
Old Tom Creek	6	55.0	37	51
Rio Roberts	2	15.0	22	45
Kadin Island	3	16.0	28	39
Cape Fanshaw	2	13.5	30	43
West Gambier Bay	3	30.0	39	36
Limestone Inlet	2	13.5	38	37

[a] Confirmed = observed activity related to active nesting (such as carrying nesting material).
[b] Probable = observed breeding pair activity related to breeding (such as courtship behavior).

Cape Fanshaw—Surveys mostly were conducted from the shoreline at South Passage along a southeasterly transect to an elevation of 610 m. This provided a diverse cross section of communities for vegetation and invertebrate sampling. Four previously unreported plant species were recorded inland within forested sites (app. 2). A species list was compiled for a bog encountered between transect points one and two (app. 2). Salamander and worm searches were conducted without success. Rare plant surveys were conducted on an opportunistic basis at all locations visited within the RNA. No rare plants were found. There were tidal marshes within the Cape Fanshaw RNA.

Gambier Bay—Eight plots were surveyed along the perimeter of the tidal marsh located on the eastern perimeter of the RNA (table 6). A species list was available from the RNA establishment record derived from species confirmed as occurring within the RNA; species in Hulten (1968) whose range map included the RNA (unconfirmed); and species whose distribution depicted in Argus (1973) included the RNA. Nineteen species included in Hulten (1968) were confirmed for Gambier Bay RNA (app. 2). Additionally, two previously undocumented plant species were recorded. Extensive salamander searches were performed in a rocky limestone outcropping located on the eastern peninsula of the RNA. No salamanders were found.

Limestone Inlet—No species list was previously available for Limestone Inlet. During this study, seven tidal marsh plots where surveyed along the southwestern portion of the RNA. These results provide a preliminary species list for the tidal area of Limestone Inlet (table 6). Additional common species were recorded for a rock-slide zone (app. 2). No rare plants were found. Salamander and worm searches failed to locate any specimens.

Avian Checklists

We conducted checklist surveys for 22 days between June 1 and June 30 and accumulated 175 person-hours of survey time, which varied among RNAs (table 7). We recorded a total of 65 species across seven RNAs; breeding status and categorical abundance are summarized in table 8. Among RNAs, sampling effort varied from 15.5 to 55.0 person-hours, and number of species recorded varied from 22 to 41 species (table 7). Percentage of confirmed or probable breeders varied from 36 to 51 percent among RNAs (table 7). The highest number of species (41) was recorded on Dog Island, the most southern RNA, which received the second-greatest sampling effort. The greatest percentage of confirmed or probable breeders (51 percent) was recorded on Old Tom Creek (n = 37 species), which received the greatest sampling effort (table 7).

Widely distributed (recorded in all RNAs) species were bald eagle, rufous hummingbird, Pacific-slope flycatcher, common raven, chestnut-backed chickadee, winter wren, golden-crowned kinglet, hermit thrush, varied thrush, orange-crowned warbler, Townsend's warbler, red crossbill, and pine siskin (table 8). Notable rare bird observations included a pair of barred owls (Old Tom Creek), a western-screech owl (Gambier Bay), a northern saw-whet owl (Limestone Inlet) and an osprey (Limestone Inlet).

Point Counts

We systematically surveyed a total of nine transects and 84 points during June 1 through 30, 1997, and recorded a total of 37 species on all transects. The most consistently encountered species within and among RNAs was the Pacific-slope flycatcher; it was the only species recorded in all habitats (table 9). Other species

Text continues on page 22.

Table 8—Abundance (no.) and breeding status (status) of birds observed during checklist surveys of research natural areas in the Tongass National Forest, June 1–30, 1997

Species	Dog Island		Old Tom Creek		Rio Roberts		Kadin Island		Cape Fanshaw		Gambier Bay		Limestone Inlet	
	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]
Red-throated loon											OC	O		
Pacific loon	C	O							UC	O	OC	O		
Common loon	FC	O	R	PR							OC	O		
Great blue heron	UC	PO												
Canada goose	A	PR	FC	C	FC	PO	FC	O			R	PO		
Mallard			OC	PR										
Harlequin duck											FC	O	FC	PO
Black scoter	FC	O							UC	O				
Surf scoter	C	O	UC	O					UC	O				
White-winged scoter	FC	O												
Common merganser	FC	PR	OC	C					UC	O			R	PO
Osprey													R	PO
Bald eagle	C	PO	A	PO	FC	PO	C	PO	C	C	C	PR	C	PO
Sharp-shinned hawk			OC	PR										
Red-tailed hawk											OC	PO	UC	PO
Blue grouse							UC	PR	UC	PR	R	PR	FC	PR
Sandhill crane	FC	PR	OC	PO	UC	PO								
Black oystercatcher											OC	PO		
Greater yellowleg	FC	PO							UC	O	UC	PR	R	PO
Least sandpiper													FC	O
Bonaparte's gull											UC	O		
Mew gull	R	O	UC	PO			FC	O	C	O	UC	O		
Ring-billed gull							R	O						
Glaucous-winged gull	A	O	R	O										
Pigeon guillemot	FC	O	R	O					FC	PO	UC	O		
Marbled murrelet	A	O	UC	PO			C	PO	C	O	UC	O		
Western screech-owl											OC	PO		
Barred owl			OC	PR										
Northern saw-whet owl													R	PO
Rufous hummingbird	FC	PR	UC	PO	UC	PO	FC	PO	C	PR	R	PO	C	PO
Belted kingfisher											OC	PO	UC	PR
Red-breasted sapsucker	R	PR	OC	C					UC	PR	UC	C	UC	PO
Downy woodpecker	R	PO												
Hairy woodpecker			UC	C	UC	PR	FC	C	C	PR	OC	PO	UC	PO

[a] Empty cell indicates that the species was not recorded.

[b] A = abundant, C = common, FC = fairly common, UC = uncommon, R = rare; and OC = occasional.

[c] C = confirmed, O = observed, PR = probable, and PO = possible.

Table 8—Abundance (no.) and breeding status (status) of birds observed during checklist surveys of research natural areas in the Tongass National Forest, June 1–30, 1997

Species	Dog Island		Old Tom Creek		Rio Roberts		Kadin Island		Cape Fanshaw		Gambier Bay		Limestone Inlet	
	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]	No.[b]	Status[c]
Northern flicker	FC	PO	R	PO	UC	PO								
Alder flycatcher													R	PO
Pacific-slope flycatcher	A	PR	A	PR	A	PR	A	PR	A	PR	A	PR	A	PR
Tree swallow	R	PO	UC	PO										
Steller's jay	UC	PO	R	PO	FC	PR	FC	PO			FC	PO	FC	PO
Northwestern crow	FC	PO	FC	PO			C	PO	FC	PO	FC	PO	FC	PO
Common raven	FC	PR	R	PO	UC	PO	C	PO	C	PO	UC	PO	UC	PO
Chestnut-backed chickadee	C	C	C	C	FC	PO	C	PO	C	C	A	C	C	PO
Red-breasted nuthatch	R	PO	OC	PO			UC	PO	UC	PO	OC	PO		
Brown creeper	R	PO	FC	PR			C	C	C	PO	FC	PO	UC	PO
Winter wren	C	PR	FC	C	A	PR	A	C	A	PR	C	PR	A	C
Golden-crowned kinglet	UC	PR	C	C	A	PO	A	C	A	PR	C	PR	C	C
Ruby-crowned kinglet					UC	PR	FC	PO	UC	PO	OC	PO	FC	C
Swainson's thrush	UC	PO	FC	PR	FC	PR	UC	PO	FC	PR			FC	PO
Hermit thrush	C	PR	C	C	A	C	C	C	A	C	A	PR	C	PO
American robin	UC	PO	UC	PO							R	PR	C	C
Varied thrush	FC	PR	C	C	FC	PO	A	C	A	C	FC	PR	A	C
Orange-crowned warbler	C	PR	R	PO	UC	PO	C	PR	FC	PO	UC	PR	R	PO
Townsend's warbler	C	PR	FC	PR	A	PR	C	C	R	PO	R	PO	A	PR
Northern waterthrush													UC	PR
Common yellowthroat													C	C
Wilson's warbler	R	PO					R	PO					FC	C
Savannah sparrow													R	PO
Fox sparrow							C	C						
Song sparrow	C	C	OC	PO			R	PO			OC	PO	R	PO
Lincoln's sparrow			FC	C	UC	PR					UC	PR	A	C
Golden-crowned sparrow	R	PO												
Dark-eyed junco	FC	PO			A	C			C	C	C	C		
Red crossbill	C	PO	C	PO	C	PO	A	PO	C	PO	A	PO	FC	PR
White-winged crossbill													UC	PO
Pine siskin	R	PO	FC	C	UC	PO	UC	PO	FC	PO	OC	PO	UC	PO

[a] Empty cell indicates that the species was not recorded.

[b] A = abundant, C = common, FC = fairly common, UC = uncommon, R = rare; and OC = occasional.

[c] C = confirmed, O = observed, PR = probable, and PO = possible.

Table 9—Relative abundance, variability, and relative frequency (percentage) of species observed among point counts among research natural areas (*n* = 84) in the Tongass National Forest, June 1–30, 1997

Species	Mean	SE	Percentage of point count stations
Common loon	0.04	0.03	2.4
Canada goose	.33	.14	9.5
Common merganser	.01	.01	1.2
Bald eagle	.13	.04	10.7
Blue grouse	.05	.02	4.8
Black oystercatcher	.02	.02	1.2
Greater yellowlegs	.04	.02	3.6
Marbled murrelet	.01	.01	1.2
Rufous hummingbird	.04	.02	3.6
Belted kingfisher	.01	.01	1.2
Red-breasted sapsucker	.02	.02	2.4
Hairy woodpecker	.07	.03	7.1
Northern flicker	.02	.02	2.4
Pacific-slope flycatcher	1.95	.12	91.7
Steller's jay	.11	.04	9.5
Northwestern crow	.37	.16	11.9
Common raven	.20	.06	15.5
Chestnut-backed chickadee	.83	.11	46.4
Brown creeper	.32	.09	19.0
Winter wren	1.04	.11	65.5
Golden-crowned kinglet	1.05	.14	48.8
Ruby-crowned kinglet	.06	.03	4.8
Swainson's thrush	.17	.06	11.9
Hermit thrush	1.32	.13	70.2
American robin	.07	.03	6.0
Varied thrush	.96	.12	59.5
Orange-crowned warbler	.23	.06	17.9
Townsend's warbler	.63	.09	48.8
Northern waterthrush	.05	.02	4.8
Common yellowthroat	.02	.02	2.4
Wilson's warbler	.01	.01	1.2
Fox sparrow	.02	.02	2.4
Lincoln's sparrow	.14	.06	7.1
Dark-eyed junco	.31	.08	20.2
Red crossbill	1.74	.35	35.7
White-winged crossbill	.02	.02	1.2
Pine siskin	.37	.13	14.3

detected at >50 percent of the point stations were the hermit thrush, winter wren, and varied thrush (table 9). Pacific-slope flycatcher, chestnut-backed chickadee, winter wren, hermit thrush, varied thrush, and red crossbill were detected during point counts in all RNAs (table 10). The eight most abundant species (in order of abundance) were Pacific-slope flycatcher, red crossbill, hermit thrush, golden-crowned kinglet, winter wren, varied thrush, chestnut-backed chickadee, and Townsend's warbler (table 10). Most detections of red crossbills, however, were fly-overs. Among RNAs, density of Pacific-slope flycatchers ranged from 0.89 to 2.57. In contrast, winter wren abundance varied from 0.20 on the southern end of the Tongass (Dog Island) to 1.88 at Limestone Inlet (table 10). Brown creepers showed relatively consistent, but lower, densities among RNAs. Variability across point stations within RNAs was generally greater for less abundant species like the rufous hummingbird as compared to Pacific-slope flycatchers or hermit thrushes. A notable exception was the red crossbill, which was detected in flocks or not at all.

Checklist surveys were more effective than point counts in generating a comprehensive list of birds. Invariably, more species were detected by using checklist procedures than during point counts. In particular, seabirds and other species associated with beach fringe or other nonforested habitats were included in the checklist survey but were not recorded during point counts. At the same time, an emphasis on surveying as many habitats as possible during checklist surveys reduced the efficacy of fulfilling other study objectives. We documented that Pacific-slope flycatchers were abundant across all RNAs, yet were unable to confirm its status as a breeder in any RNA. Flycatchers were relatively easy to detect, but their nesting habits were more reclusive. This also was true for other species and influenced the efficacy of documenting breeding status.

Variation in species composition among RNAs was apparently related to sampling effort, habitat features, latitude, or geographical location, especially juxtaposition to a marine environment. Dog Island, which is a relatively small island, was surveyed almost entirely, including the shoreline. Consequently, the species list included many marine bird species as well as the many inhabitants of forest and scrub habitats. In contrast, Rio Roberts RNA is situated inland on Prince of Wales Island where marine birds are seldom encountered. Also, the habitat of inland sites may differ substantially from comparable beach-fringe forest or other exposed sites where recurring severe windstorms cause catastrophic blowdown at somewhat regular intervals (Nowacki and Kramer 1998). At wind prone sites, trees rarely become very large (>100 cm) or very old (>200 years old), and stands seldom progress beyond the stem-exclusion or early-understory initiation phase of succession (Nowacki and Kramer 1998). Protected or moderately exposed sites are characterized by older, uneven-aged stands with large trees (>125 cm), open canopies, and a well-developed understory. Additional features such as tidal inlets or perennial streams also influenced the avifaunal composition of RNAs. At Limestone Inlet, for example, alder flycatcher, northern waterthrush, and common yellowthroat were likely encountered because Limestone Inlet and its associated riparian habitats was a prominent feature of this RNA.

Results of point count surveys suggested that brown creepers, golden-crowned kinglets, chestnut-backed chickadees, winter wrens, and varied thrushes prefer closed-canopy hemlock-spruce forest (table 11). These results are consistent with the findings of previous investigations in southeast Alaska (DellaSala and others 1996,

Table 10—Mean abundance and standard errors (SE) of birds detected on point counts located in research natural areas (*n* = no. of points) the Tongass National Forest, June 1-30, 1997

	Dog Island (*n* = 10)		Old Tom Creek (*n* = 19)		Rio Roberts (*n* = 11)		Kadin Island (*n* = 9)		Cape Fanshaw (*n* = 8)		Gambier Bay (*n* = 19)		Limestone Inlet (*n* = 8)	
Species	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Common loon			0.16	0.12										
Canada goose	1.40	0.84	.21	.14	0.64	0.64					0.16	0.12		
Common merganser	.10	.10												
Bald eagle					18	.12			0.38	0.26	.21	.10	0.25	0.26
Blue grouse							0.11	0.11	.25	.16	.05	.05		
Black oystercatcher											.11	.11		
Greater yellowlegs											.16	.08		
Marbled murrelet							.11	.11						
Rufous hummingbird	.10	.10	.05	.05					.13	.13				
Belted kingfisher													.13	.13
Red-breasted sapsucker									.13	.13	.05	.05		
Hairy woodpecker			.05	.05			.11	.11	.25	.16	.05	.05	.13	.13
Northern flicker			.05	.05	.09	.09								
Pacific-slope flycatcher	2.00	.21	2.58	.29	1.27	.24	.89	.35	1.38	.26	2.47	.21	1.88	.30
Steller's jay	.20	.13	.05	.05	.09	.09					.21	.12	.13	.13
Northwestern crow	.60	.50					.22	.22			.26	.13	2.25	1.45
Common raven	.10	.10	.05	.05			.67	.37	.25	.16	.37	.14		
Chestnut-backed chickadee	.50	.22	.42	.16	.36	.20	.78	.32	1.38	.32			.88	.35
Brown creeper	.20	.13	.53	.25			.22	.22	.88	.51	.21	.12	.25	.16
Winter wren	.20	.13	1.00	.25	1.27	.27	1.22	.32	1.00	.42	.95	.19	1.88	.23
Golden-crowned kinglet			1.32	.25	1.27	.51	2.22	.62	.50	.50	.79	.20	1.25	.41
Ruby-crowned kinglet							.11	.11	.25	.25	.05	.05	.13	.13
Swainson's thrush			.32	.19	.18	.12	.22	.15					.50	.27
Hermit thrush	.80	.25	.84	.23	1.64	.49	1.00	.29	1.38	.38	2.05	.26	1.25	.36
American robin											.05	.05	.63	.26
Varied thrush	.20	.13	1.00	.15	.27	.14	1.11	.26	1.50	.42	.79	.22	2.50	.60
Orange-crowned warbler	1.10	.28			.09	.09	.33	.23			.21	.10		
Townsend's warbler	.50	.22	.84	.16	1.27	.24	.56	.18			.11	.07	1.38	.53
Northern waterthrush													.50	.19
Common yellowthroat													.25	.16
Wilson's warbler													.13	.13
Fox sparrow							.22	.15						
Lincoln's sparrow											.58	.26	.13	.13
Dark-eyed junco			.21	.12	.82	.33			.13	.13	.63	.22		
Red crossbill	1.10	.82	2.11	1.06	.91	.49	1.56	1.14	.75	.53	1.79	.57	3.88	1.49
White-winged crossbill													.25	.25
Pine siskin			.63	.29			1.56	.91	.50	.38	.05	.05		

Table 11—Common breeding landbirds among mature forest and seral stages, Tongass National Forest[a b c]

Species	Old-growth		Seral stage			
	Tall closed[d]	Medium open[e]	20 years[f]	11-17 years[g]	9 years[h]	<5 years[i]
Rufous hummingbird	x	x	x	x	x	
Red-breasted sapsucker	x	x	x	x		
Hairy woodpecker	x	x	x	x		r
Northern flicker		x	x			
Pacific-slope flycatcher	x	x	x	x		
Tree swallow		x	x	x		x
Steller's jay	x	x	x	x	x	x
Northwestern crow	x					
Common raven	x		x			r
Chestnut-backed chickadee	x	x	x	x	x	
Brown creeper	x	x				
Winter wren	x	x	x	x	x	x
Golden-crowned kinglet	x	x	x	r		
Ruby-crowned kinglet	x	x	x	r		
Swainson's thrush	r	x	x	x		
Hermit thrush	x	x	x	x	x	x
American robin		x	x	x		r
Varied thrush	x	x	x	x	x	
Orange-crowned warbler	x	x	x	x	x	r
Townsend's warbler	x	x	x	r	x	
Wilson's warbler	r		x	r	x	
Fox sparrow		r	x	x	x	r
Song sparrow			x			
Lincoln's sparrow		x				
Dark-eyed junco	x	x	x	x	x	x
Red crossbill	x		x			
White-winged crossbill	x					
Pine siskin	x	x	x	x		

[a] Includes data from DellaSala and others (1996), Kessler (1979), and Noble (1977).

[b] Our results are included in the “tall closed” and “medium open” old-growth canopies.

[c] x = commonly present; r = present only rarely.

[d] Closed-canopy forest dominated by large-diameter hemlock/spruce associations.

[e] Open forest, primarily muskeg habitat, dominated by shorepine and mixed-conifer associations.

[f] Hemlock-spruce associations, trees <55 cm d.b.h.

[g] Hemlock/spruce saplings <13 cm d.b.h., deciduous shrubs.

[h] Similar to above but trees ≤2.5 cm d.b.h.

[i] Dense hemlock/spruce seedlings; deciduous shrubs and forbs.

Kessler and Kogut 1985, Noble 1977). Golden-crowned kinglets were more abundant in old-growth hemlock-spruce forests than in young growth; their abundance was directly related to the density of trees >55 cm d.b.h. (DellaSala and others 1996). Noble (1977) reported that golden-crowned kinglets nest exclusively in old-growth hemlock-associated cover types. Noble's (1977) study associated brown creepers with hemlock/hemlock-cedar cover types and rarely detected them in other habitats. Similar results were reported by Gibson (1976), Noble (1977), Kessler and Kogut (1985), and DellaSala and others (1996). Also, Noble (1977) and Kessler and Kogut (1985) reported that detections of varied thrushes increased with stand age; in our survey, we found that varied thrushes preferred mature hemlock-spruce forests. Conversely, we did not substantiate this same reported pattern for Townsend's warblers (Kessler and Kogut 1985, Noble 1977).

The Pacific-slope flycatcher, chestnut-backed chickadee, and hermit thrush were widely distributed across all cover types, thereby suggesting that these species are forest generalists (table 11). Other studies support this pattern although detections of Pacific-slope flycatchers and chestnut-backed chickadees in young forest stands (<10 years) were rare (Kessler and Kogut 1985, Noble 1977). DellaSala and others (1996) reported that Pacific-slope flycatchers are 6 to 14 times more abundant in old growth than in younger coniferous stands. Noble (1977), however, observed that densities of this species are 5 times and 2 times higher in shore pine/muskeg and 23-year-old seral forests, respectively, as compared to tall, old-growth forests. Kessler and others (1985) recorded flycatchers as abundant in stream-associated old-growth forests, common in muskegs and stands to 30 years, but absent in stands <5 years old. These studies and our data suggest that the Pacific-slope flycatcher is abundant in old-growth stands, regardless of cover type, but ranges from uncommon to rare in young (<20-year-old) stands.

The winter wren is abundant and widely distributed across various habitats in southeast Alaska, including many early-seral habitats (DellaSala and others 1996, Kessler and others 1985). Results from our survey and Noble (1977) suggest that winter wrens are rare in muskeg habitat. This is not a surprising result because habitat use by winter wrens is likely influenced by understory density and composition. Peatlands (muskegs) typically represent some of the least productive habitat in southeast Alaska with the poorer draining sites supporting a relatively sparse understory of herbaceous or woody vegetation (Lawford and others 1996).

Further comparison of our results with other land-bird studies in southeast Alaska reveals that avifaunal distribution and abundance among RNAs of the Tongass National Forest is determined by forest age and cover type (table 11). Previous investigators consistently reported an increase in detections of birds associated with early-seral forests. Total bird abundance in old-growth cover types was lower by a factor of 0.8 as compared to successional forest stands (DellaSala and others 1996). Orange-crowned warblers, Wilson's warblers, fox sparrows, and dark-eyed juncos were negatively associated with old-growth cover types (DellaSala and others 1996, Kessler and Kogut 1985, Noble 1977). In our survey, we recorded relatively few orange-crowned warblers, Wilson's warblers, fox sparrows, and dark-eyed juncos because most point count stations occurred within old-growth habitats. The Swainson's thrush also was identified (DellaSala and others 1996) as a species typically not associated with old-growth habitat; however, detections of Swainson's thrushes in southeast Alaska are limited and insufficient to reliably infer habitat associations.

Mammal Surveys

A total of 4,500 trap nights of effort was applied across nine transects in seven RNAs. A 10th trapline of 30 stations was established and maintained for two nights along the shoreline of Dog Island. We captured 331 small mammals representing six species (table 12). Five additional species were documented from visual observations (e.g., *Mustela vison*) or from fecal deposits or other physical evidence (e.g., *Canis lupus*). Both capture success rate (percent) and "species richness" was highest at Limestone Inlet (11.8 percent; S = 7) and lowest at Kadin Island (1.0 percent; S = 1). Despite few or no captures at three RNAs, the Keen's mouse (*Peromyscus keeni*) was the numerical dominant species, representing 66 percent of total captures among the nine transects (table 12). This is not surprising because Keen's mouse is widely distributed and common across southeast Alaska, known from the mainland, from all of the larger islands, and from most of the smaller islands (MacDonald and Cook 1996b). The dusky shrew (*Sorex monticolus*) was the next most abundant species with captures along eight transects in six RNAs. Like the Keen's mouse, the dusky shrew occurs over most of southeast Alaska (MacDonald and Cook 1996b). In Rio Roberts RNA, the dusky shrew replaced the Keen's mouse as the numerical dominant species.

The observed pattern of habitat distribution from small mammal captures was likely influenced by the appropriation of sampling effort. Because of logistic constraints, all but one transect (Rio Roberts RNA) was located near a shoreline. In addition, the study was designed to emphasize habitats of old-growth forests, and sampling effort was biased toward forested cover types (table 3), with some habitats, subalpine and alpine, completely excluded. Sampling error was probably greater for species with restricted ranges because sample sizes were smaller; for example, only two of nine transects occurred within the known geographic distribution of the red-backed vole (*Clethrionomys rutilus*) in southeast Alaska. Consequently, the conclusions of our survey should be viewed as cursory and limited to sites that were sampled. The results of our survey cannot be used to infer the general habitat distribution or abundance of small mammals.

Detailed information about the ecology of small mammals in southeast Alaska is limited to relatively few case studies. Van Horne (1982) studied food and habitat dimensions of *Peromyscus maniculatus* (= *P. keeni*) within young-growth forests on Prince of Wales Island. She notes considerable demographic variation among study grids, with most attributable to habitat variation (Van Horne 1981, 1982). Similarly, Hanley and Barnard (1999a) report considerable site, habitat, and annual variation in density and demography of the Sitka mouse (*P. k. sitkensis*) among replicates of upland and flood-plain forests. Although spatial and temporal complexity seems to be an important feature of habitat quality in riparian systems, there was little evidence that flood-plain forests provided unique food resources or habitat features as compared to upland forest (Hanley and Barnard 1999a, 1999b). One of the clearest patterns of small mammal habitat relations in southeast Alaska comes from a study in even-aged, second-growth forests. Hanley (1996) reported that voles (*Microtus sp.*) are commonly associated with red alder (*Alnus rubra*) patches within second-growth conifer stands and that there was a significant correspondence between Sitka mouse density and understory biomass, which was greater in second-growth conifer stands where alder patches occurred.

MacDonald and Cook (1996b) presented a general habitat model for forest floor mammals in southeast Alaska. This model portrays Keen's mouse as a habitat

Table 12—Species and abundance (number of individuals observed) of terrestrial mammals recorded among research natural areas of the Tongass National Forest, June 1-30, 1997

Species	Dog Island	Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay[a]	Limestone Inlet	Total animals
Sorex cinereus				5	6		9	20
Sorex monticolus	8	21	11		8	7	3	58
Castor canadensis		***P***[b]						***P***[b]
Peromyscus keeni	55	69	5		2	53	35	219
Clethrionomys rutilus					22		8	30
Microtus longicaudus		1					2	3
Synaptomys borealis							1	1
Canis lupus	***P***[b]							***P***[b]
Ursus americanus		***P***[b]						***P***[b]
Ursus spp.				***P***[b]				***P***[b]
Mustela vison	1						1	2
Lontra canadensis		1				1		2
Odocoileus hemionus	***P***[b]	***P***[b]	***P***[b]		***P***[b]	***P***[b]	***P***[b]	6***P***[b]
Total	66	95	17	6	39	62	60	345

[a] RNA with two transects and 1,000 trap nights of effort; all other RNAs had one transect and 500 trap nights of effort.

[b] ***P*** denotes presence, verification of which was provided by fecal deposits or other physical evidence. Species designated as present were considered as one observation for computing totals.

Table 13—Mammal species distribution and relative abundance (total captures) among plant associations of research natural areas, Tongass National Forest, June 1-30, 1997

Habitat[a]	Species	Number of animals
Mixed conifer/blueberry	*Clethrionomys rutilus*	1
Mixed conifer/blueberry	*Sorex monticolus*	3
Mixed conifer/blueberry	*Sorex cinereus*	2
Mixed conifer/blueberry-salal-deer cabbage	*Peromyscus keeni*	6
Mixed conifer/blueberry-salal-deer cabbage	*Sorex monticolus*	6
Mixed conifer/blueberry-salal-skunk cabbage	*Peromyscus keeni*	2
Mixed conifer/blueberry-salal-skunk cabbage	*Sorex monticolus*	3
PICO/crowberry	*Peromyscus keeni*	6
PICO/crowberry	*Sorex monticolus*	7
PICO/Sitka sedge	*Peromyscus keeni*	28
PICO/Sitka sedge	*Sorex monticolus*	3
PICO/salal	*Peromyscus keeni*[a]	16
PICO/tufted club rush	*Peromyscus keeni*	8
PISI-TSHE/blueberry	*Sorex cinereus*	1
PISI/blueberry	*Sorex cinereus*	2
PISI/blueberry-skunk cabbage	*Peromyscus keeni*	6
PISI/Blueberry-skunk cabbage	*Sorex monticolus*	1
PISI/devil’s club	*Sorex cinereus*	2
PISI/devil’s club-salmonberry	*Clethrionomys rutilus*	1
PISI/devil’s club-salmonberry	*Peromyscus keeni*	8
PISI/devil’s club-salmonberry	*Synaptomys borealis*	1
PISI/devil's club-salmonberry	*Sorex cinereus*	3
PISI/devil's club-salmonberry	*Sorex monticolus*	1
PISI/red alder-salmonberry	*Clethrionomys rutilus*	6
PISI/red alder-salmonberry	*Peromyscus keeni*	6
PISI/red alder-salmonberry	*Sorex cinereus*	3
Shoreline (wildrye grass - *Elymus* spp.)	*Peromyscus keeni*[a]	11
Shoreline (wildrye grass - *Elymus* spp.)	*Sorex monticolus*	3
TSHE-THPL/blueberry	*Peromyscus keeni*	12
TSHE-THPL/blueberry	*Sorex monticolus*	2
TSHE-THPL/blueberry, well-drained variant	*Peromyscus keeni*	5
TSHE-THPL/blueberry, well-drained variant	*Sorex monticolus*	1
TSHE-THPL/blueberry-devil's club	*Clethrionomys rutilus*	4
TSHE-THPL/blueberry-devil's club	*Sorex monticolus*	2
TSHE-THPL/blueberry-devil's club	*Sorex cinereus*	1
TSHE-THPL/blueberry-salal-skunk cabbage	*Peromyscus keeni*	10
TSHE-THPL/blueberry-salal-skunk cabbage	*Sorex monticolus*	10
TSHE-THPL/blueberry-skunk cabbage	*Peromyscus keeni*	18
TSHE-THPL/menziesia	*Peromyscus keeni*	3
TSHE-THPL/salal	*Peromyscus keeni*	11
TSHE-THPL/salal	*Sorex monticolus*	2

[a] Habitat represents plant associations according to guide for corresponding administrative area of the Tongass National Forest; TSHE = *Tsuga heterophylla* (western hemlock), PISI = *Picea sitchensis* (Sitka spruce), THPL = *Thuja plicata* (western redcedar), TSME = *Tsuga mertensiana* (mountain hemlock), CHNO = *Chamaecyparis nootkatensis* (Alaska yellow cedar), and PICO = *Pinus contorta* (shore pine).

Table 13—Mammal species distribution and relative abundance (total captures) among plant associations of research natural areas, Tongass National Forest, June 1-30, 1997 (continued)

Habitat[a]	Species	Number of animals
TSHE/blueberry	*Clethrionomys rutilus*	6
TSHE/blueberry	*Peromyscus keeni*	23
TSHE/blueberry	*Sorex monticolus*	5
TSHE/blueberry	*Sorex cinereus*	1
TSHE/blueberry-devil's club	*Clethrionomys rutilus*	1
TSHE/blueberry-devil's club	*Microtus longicaudus*	2
TSHE/blueberry-devil's club	*Peromyscus keeni*	13
TSHE/blueberry-devil's club	*Sorex monticolus*	3
TSHE/blueberry-devil's club	*Sorex cinereus*	2
TSHE/blueberry-shield fern	*Microtus longicaudus*	1
TSHE/blueberry-shield fern	*Peromyscus keeni*	10
TSHE/blueberry-shield fern	*Sorex monticolus*	3
TSHE/blueberry-skunk cabbage	*Clethrionomys rutilus*	11
TSHE/blueberry-skunk cabbage	*Peromyscus keeni*	2
TSHE/blueberry-skunk cabbage	*Sorex monticolus*	2
TSHE/blueberry-skunk cabbage	*Sorex cinereus*	2
TSHE/devil’s club-Shallow Soils	*Peromyscus keeni*	8
TSHE/devil’s club-Shallow Soils	*Sorex cinereus*	1
TSHE/menziesa	*Peromyscus keeni*	7
TSHE/menziesa	*Sorex monticolus*	1

[a] Habitat represents plant associations according to guide for corresponding administrative area of the Tongass National Forest; TSHE = *Tsuga heterophylla* (western hemlock), PISI = *Picea sitchensis* (Sitka spruce), THPL = *Thuja plicata* (western redcedar), TSME = *Tsuga mertensiana* (mountain hemlock), CHNO = *Chamaecyparis nootkatensis* (Alaska yellow cedar), and PICO = *Pinus contorta* (shore pine).

generalist with an affinity for scrub habitat, which is consistent with the habitat model of Van Horne (1982). They portrayed shrews as more of a habitat generalist than Keen's mouse with some affinity for herbaceous habitats. The patterns observed in our study are generally consistent with these characterizations. Both Keen's mouse and dusky shrews in this study were captured in every vegetative series that we classified (table 13).

Conclusions

Integrated community surveys are a relatively efficient means of documenting various elements of biological diversity and warrant consideration as an inventory protocol, or in efforts to monitor ecosystem integrity. Small mammal and bird sampling protocols used in this study were relatively simple to implement, yielded valuable information, and were relatively cost effective. Checklist surveys, although more effective than point counts in generating a comprehensive list of birds for each RNA, likely yield ambiguous estimates of relative abundance. Rare plant and animal surveys were conducted in a rather unsystematic and opportunistic fashion. Future efforts to survey biological communities likely would yield more reliable and complete information if sampling effort were uniform among community types and across RNAs, rare plant and animal surveys used a list of targeted species and habitats and followed standardized procedures, and study designs emphasized sampling representative portions of the entire RNA including interior and higher elevation communities. Community surveys of RNAs provide important benchmarks for monitoring natural processes and serve as controls for quantifying the effect of land management on biological communities and their habitats.

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English Equivalents

When you know:	Multiply by:	To find:
Meters (m)	3.281	Feet
Hectares (ha)	2.471	Acres
Celsius (˚C)	1.8 and add 32	Fahrenheit
Kilometers (Km)	0.621	Miles
Centimeters (Cm)	0.394	Inches

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Appendix 1

Table 14—Species codes for plant taxa recorded in plots among seven research natural areas in the Tongass National Forest, southeast Alaska, June 1-30, 1997

Code	Life form[a]	Kartesz (1992)	Hultèn (1968)
ACHMIL	F	*Achillea millefolium* var. *borealis*	*Achillea borealis*
ANGLUC	F	*Angelica lucida*	*Angelica lucida*
ARGEGE	F	*Argentina egedii* ssp. *egedii*	*Potentilla egedii* ssp. *grandis*
CAROLI	F	*Cardamine oligosperma* var. *kamtschatica*	*Cardamine umbellata*
CASMIN	F	*Castilleja miniata*	*Castilleja miniata*
CHERUB	F	*Chenopodium rubrum*	*Chenopodium rubrum*
CICDOU	F	*Cicuta douglasii*	*Cicuta douglasii*
COCGRO	F	*Cochlearia groenlandica*	*Cochlearia officinalis* ssp. *oblongifolia*
CONCHI	F	*Conioselinum chinense*	*Conioselinum chinense*
DODPUL	F	*Dodecatheon pulchellum* ssp. *Macrocarpum*	*Dodecatheon pulchellum ssp Superbum*
EQUSPP.	F	*Equisetum (arvense)*	*Equisetum (arvense)*
FRICAM	F	*Fritillaria camschatcensis*	*Fritillaria camschatcensis*
GALSPP.	F	*Galium* spp	*Galium* spp
GALTRI	F	*Galium trifidum* ssp. (either *trifidum* or *columbianum*)	*Galium trifidum* ssp. (either *trifidum* or *columbianum*)
GERERI	F	*Geranium erianthum*	*Geranium erianthum*
GLAMAR	F	*Glaux maritima*	*Glaux maritima*
LIGSCO	F	*Ligusticum scothicum* ssp. *Hultenii*	*Ligusticum scoticum* ssp. *Hultenii*
LYSAME	F	*Lysichiton americanus*	*Lysichiton americanum*
MAIDIL	F	*Maianthemum dilatatum*	*Maianthemum dilatatum*
OENSAR	F	*Oenanthe sarmentosa*	*Oenanthe sarmentosa*
PETFRI	F	*Petasites frigidus*	*Petasites frigidus*
PLAMAC	F	*Plantago macrocarpa*	*Plantago macrocarpa*
PLAMAR	F	*Plantago maritima* var. *Juncoides*	*Plantago maritima* ssp. *Juncoides*
POLVIV	F	*Polygonum viviparum*	*Polygonum viviparum*
RANOCC	F	*Ranunculus occidentalis* var. *brevistylis*	*Ranunculus occidentalis* ssp. *occidentalis* var. *brevistylis*
RANPAC	F	*Ranunculus pacificus*	*Ranunculus pacificus*
RANUNC	F	*Ranunculus uncinatus* var. *parviflorus*	*Ranunculus bongardi*
RANSPP	F	*Ranunculus* ssp.	*Ranunculus* spp.
RUMSPP	F	*Rumex* spp.	*Rumex* spp.
SAGMAX	F	*Sagina maxima* ssp. *Crassicaulis*	*Sagina crassicaulis*
SALVIR	F	*Salicornia virginica*	*Salicornia virginica*
SANCAN	F	*Sanguisorba canadensis*	*Sanguisorba stipulata*
SPECAN	F	*Spergularia canadensis*	*Spergularia canadensis*

[a] F = forbs, G = graminoids, P = pteridophyte, M = moss, S = shrubs, and T = trees.

[b] Taxonomy according to Vitt and others (1988).

Table 14—Species codes for plant taxa recorded in plots among seven research natural areas in the Tongass National Forest, southeast Alaska, June 1-30, 1997 (continued)

Code	Life form[a]	Kartesz (1992)	Hultèn (1968)
STECAL	F	*Stellaria calycantha* ssp. *Calycantha*	*Stellaria calycantha* ssp. *Calycantha*
STEHUM	F	*Stellaria humifusa*	*Stellaria humifusa*
STESPP	F	*Stellaria* spp.	*Stellaria* spp.
STRAMP	F	*Streptopus amplexifolius*	*Streptopus amplexifolius*
STRROS	F	*Streptopus roseus* var. *Curvipes*	*Streptopus roseus* ssp. *Curvipes*
TRIEUR	F	*Trientalis europaea* ssp. *Arctica*	*Trientalis europaea* ssp. *Arctica*
TRIMAR	F	*Triglochin maritimum*	*Triglochin maritimum*
TRIPAL	F	*Triglochin palustre*	*Triglochin palustris*
TRISPP	F	*Trisetum* spp.	*Trisetum* spp.
CALCAN	G	*Calamagrostis canadensis*	*Calamagrostis canadensis*
CALNUT	G	*Calamagrostis nutkaensis*	*Calamagrostis nutkaensis*
CARLYN	G	*Carex lyngbyaei*	*Carex lyngbyaei*
CARPLU	G	*Carex pluriflora*	*Carex pluriflora*
CARAQU	G	*Carex aquatilis* var. *dives*	*Carex sitchensis*
DESCAE	G	*Deschampsia caespitosa* ssp. *caespitosa*	*Deschampsia caespitosa* ssp. *caespitosa* var. *caespitosa*
FESRUB	G	*Festuca rubra*	*Festuca rubra*
HORBRA	G	*Hordeum brachyantherum*	*Hordeum brachyantherum*
JUNHAE	G	*Juncus haenkei*	*Juncus arcticus* ssp. *sitchensis*
JUNBAL	G	*Juncus balticus* var. *montanus*	*Juncus arcticus* ssp. *Ater*
JUNFIL	G	*Juncus filiformis*	*Juncus filiformis*
LEYMOL	G	*Leymus mollis* ssp. *mollis*	*Elymus arenarius* ssp. *mollis* var. *mollis*
PUCKUR	G	*Puccinellia kurilensis*	*Puccinellia pumila*
PUCNUT	G	*Puccinellia nutkaensis*	*Puccinellia nutkaensis*
PUCSPP	G	*Puccinellia* spp.	*Puccinellia* spp.
SCIMIC	G	*Scirpus microcarpus*	*Scirpus microcarpus*
GYMDRY	P	*Gymnocarpium dryopteris*	*Gymnocarpium dryopteris*
HYLSPL	M		*Hylocomium splendens*[b]
RHYTRI	M		*Rhytidiadelphus triqeutrus*[b]
MOSS	M	Refers to unidentified moss	
MENFER	S	*Menziesia ferruginea*	*Menziesia ferruginea*
VACOVA	S	*Vaccinium ovalifolium*	*Vaccinium ovalifolium*
VACSPP	S	*Vaccinium* spp.	*Vaccinium* spp.
PICSIT	T	*Picea sitchensis*	*Picea sitchensis*
TSUHET	T	*Tsuga heterophylla*	*Tsuga heterophylla*

[a] F = forbs, G = graminoids, P = pteridophyte, M = moss, S = shrubs, and T = trees.

[b] Taxonomy according to Vitt and others (1988).

Appendix 2

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997

Species[a]	Habitat	Research natural areas					
		Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Achillea millefolium var. *borealis* (= *A. borealis*)	Rocky tidal[b]		X				
Agrostis scabra	Interior					X	
Alnus rubra	Rockslide						X
Andromeda polifolia	Peatland			X			
Anthyrium filix-femina	Forest floor				X		
Aquilegia formosa	Peatland	X					
Arabis hirsuta or drummondii	Rockslide						X
Arabis lyrata ssp. kamchatica	Rockslide						X
Argentina egedii spp. *egedii* (= *Potentilla egedii* ssp. *grandis*)	Rocky tidal[b]			X			
Blechnum spicant	Upland, Peatland			X			
Blechnum spicant	Forest floor				X		
Boschniakia rossica	Upland			X			
Calamagrostis nutkaensis	Peatland					X	
Caltha leptosepala ssp. *howellii* (= *Caltha biflora*)	Peatland		X		X		
Cardamine oligosperma var. *kamtschatica* (= *Cardamine umbellata*)	Rocky tidal[b]			X			
Carex macrochoeta	Rocky tidal[b]			X			
Carex macrochoeta	Peatland			X			
Carex macrochoeta	Rockslide						X
Carex mertensii	Rocky tidal[b]			X			
Carex mertensii	Rockslide						X
Carex pauciflora	Peatland		X				
Carex pluriflora	Peatland			X			
Carex plurifera	Forest floor				X		

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas					
		Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Cassiope stelleriana	Peatland				X		
Castilleja hyetophila	Tidal					X	
Circaea alpina	Forest floor				X	X	
Circaea alpina	Rockslide						X
Claytonia sibirica	Coastal					X	
Claytonia sibirica	Rockslide						X
Clintonia uniflora	Peatland	X		X			
Clintonia uniflora	Forest floor				X	X	
Cochlearia officinalis	Tidal					X	
Cochlearia sessilifolia[c]	Tidal					X	
Comarum palustre (= *Potentilla palustris*)	Peatland		X				
Conioselinum chinense	Rocky tidal[b]			X			
Coptis aspleniflolia	Peatland		X	X			
Coptis asplenifolia	Upland			X			
Coptis asplenifolia	Forest floor				X		
Corallorhiza maculata spp. *maculata*	Forest floor					X	
Corallorhiza maculata (*Corallorrhiza maculata* ssp. *mertensiana*)	Forest floor				X		
Corallorhiza maculata (*Corallorrhiza maculata* ssp *mertensiana*) + *albino*	Upland			X			
Corallorhiza trifida (wet site)	Forest floor				X		
Cornus canadensis	Upland, Peatland			X	X		
Cornus Canadensis	Forest floor				X		
Cornus canadensis X *suecica*	Upland			X			
Deschampsia caespitosa	Coastal					X	
Deschampsia cespitosa ssp. *beringensis* (= D. c. ssp. *caespitosa* var. *caespitosa*)	Rocky tidal[b]			X			
Dodecatheon jeffreyi	Peatland	X					

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas					
		Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Dodecatheon pulchellum	Tidal					X	
Draba hyperborean	Rocky tidal[b]			X			
Drosera anglica	Peatland		X				
Drosera rotundifolia	Peatland	X	X	X			
Drosera rotundifolia	Forest floor				X		
Eleocharis palustris	Peatland		X				
Empetrum nigrum ssp. *hermaphroditum*	Peatland	X		X			
Epilobium ciliatum	Rockslide						X
Equisetum arvense	Upland			X			
Erigeron peregrinus ssp. *peregrinus*	Peatland					X	
Eriophorum angustifolium	Peatland	X		X	X		
Eriophorum angustifolium	Forest floor				X		
Fauria crista-galli	Peatland		X	X	X		
Festuca rubra	Coastal					X	
Galium trifidum	Coastal					X	
Gentiana douglasiana	Peatland		X	X			
Geum calthifolium							
Glaux maritime	Rocky tidal[b]			X			
Gymnocarpium dryopteris	Forest floor				X	X	
Heuchera glabra	Rockslide						X
Honkenya peploides ssp. major	Rocky tidal[b]			X			
Hordeum brachyantherum	Coastal					X	
Hordeum jub	Coastal					X	
Impatiens noli-tangere	Rockslide						X
Juncus arcticus ssp. *sitchensis*	Rocky tidal[b]			X			
Juncus arcticus ssp. *sitchensis*	Peatland					X	
Juncus filiformis	Rocky tidal[b]			X			
Kalmia polifolia (= *Kalmia polifolia* ssp. *polifolia*)	Peatland		X	X	X		
Lathyrus spp.	Peatland	X					
Ledum groenlandicum (= *Ledum palustre* ssp. *groenlandicum*)	Peatland		X	X	X		

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas: Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Leymus mollis (= *Elymus mollis*)	Rocky tidal[b]			X			
Leymus mollis ssp. *mollis* (= *Elymus arenarius* ssp. *mollis* var. *mollis*)	Rocky tidal[b]			X			
Ligusticum scoticum ssp. *Hultenii*	Rocky tidal[b]			X			
Linnaea borealis	Forest floor					X	
Listera caurina	Peatland	X					
Listera caurina	Upland			X			
Listera cordata	Upland			X			
Listera cordata	Forest floor				X	X	
Luzula parviflora	Rockslide						X
Lycopodium annotinum	Upland			X			
Lycopodium annotinum	Forest floor				X		
Lycopodium clavatum	Upland			X			
Lysichiton americanus (= *L. americanum*)	Peatland		X	X	X		
Lysichiton americanus (= *L americanum*)	Forest floor				X		
Lupinus nootkatensis	Rocky tidal[b]			X			
Maianthemum dilatatum	Rocky tidal,[b] Upland			X			
Maianthemum dilatatum	Forest floor, Peatland				X	X	
Menyanthes trifoliate	Peatland		X				
Menziesia ferruginea	Peatland				X		
Menziesia ferruginea	Forest floor					X	
Mimulus guttatus	Tidal, Rockslide						X
Mitella pentandra	Peatland				X		
Moneses uniflora	Rocky tidal,[b] Upland			X			
Moneses uniflora	Forest floor				X	X	
Monotropa hypopithys (= *Monotropa hypopitys* ssp. *lanuginosa*)	Upland			X			

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas: Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Monotropa hypopithys (= *Monotropa hypopitys* ssp. *lanuginosa*)	Forest floor				X		
Nuphar lutea ssp. *Polysepala* (= *Nuphar polysepalum*)	Peatland		X				
Oenanthe sarmentosa	Coastal					X	
Oplopanax horridus	Forest floor					X	
Osmorhiza chilensis	Forest floor					X	
Osmorhiza purpurea	Upland			X			
Orthilia secunda (= *Pyrola secunda* ssp. *secunda*)	Forest floor				X		
Petasites frigidus var. *nivalis* (= *Petasites frigidus*)	Peatland				X		
Phyllodoce glanduliflora	Peatland				X		
Picea sitchensis	Peatland				X		
Pinguicula vulgaris (= *Pinguicula vulgaris* ssp. *vulgaris*)	Peatland		X	X			
Pinus contorta	Peatland			X			
Plantago macrocarpa	Tidal					X	
Plantago maritime	Peatland					X	
Platanthera dilatata	Forest floor				X		
Platanthera hyperborea var. *gracilis* (= *Platanthera gracilis*)	Upland		X				
Platanthera stricta (= *Platanthera saccata*)	Peatland, Forest floor		X		X	X	
Pleurozium schreberi	Rocky tidal[b]			X			
Polygonum viviparum	Coastal					X	
Potentilla egedii	Coastal					X	
Potentilla villosa	Rocky tidal[b]			X			
Prenanthes alata	Rocky tidal[b]			X			
Pyrola secunda	Forest floor				X		
Ranunculus bongardi	Peatland					X	

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas: Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Rhynchospora alba	Peatland					X	
Rubus arcticus	Peatland			X	X		
Rubus chamaemorus	Forest floor, Peatland				X		
Rubus pedatus	Forest floor				X		
Scheuchzeria palustris ssp. *americana*	Peatland		X				
Scirpus cespitosus (= *Trichophorum cespitosum*)	Peatland		X	X			
Scirpus cespitosus (= *Trichophorum cespitosum*)	Peatland		X	X			
Spergularia canadensis	Tidal					X	
Stellaria calycantha	Rocky tidal[b]			X			
Stellaria calycantha	Coastal					X	
Stellaria humifusa	Rocky tidal[b]			X			
Streptopus amplexifolius	Upland			X			
Streptopus amplexifolius	Forest floor				X		
Streptopus roseus	Forest floor				X	X	
Tellima grandiflora	Rockslide						X
Tiarella trifoliata	Upland, Rockslide			X			X
Tiarella trifoliata	Forest floor				X		
Tiarella trifoliata (moist site)	Forest floor					X	
Tiarella unifoliata (moist site)	Forest floor					X	
Tofieldia glutinosa	Peatland					X	
Tofieldia glutinosa ssp. *brevistyla*	Peatland					X	
Trichophorum cespitosum	Peatland			X	X		
Trientalis europea	Forest floor				X		
Trientalis europaea ssp. *arctica*	Peatland		X	X	X		
Triglocan maritimum	Rocky tidal[b]			X			
Trisetum cernuum	Rocky tidal[b]			X			
Trisetum cernuum (moist site)	Forest floor					X	

Table 15—Summaries of plant species that were observed as present in various terrestrial habitats within research natural areas of the Tongass National Forest, June 1-30, 1997 (continued)

Species[a]	Habitat	Research natural areas: Old Tom Creek	Rio Roberts	Kadin Island	Cape Fanshaw	Gambier Bay	Limestone Inlet
Tsuga mertensiana	Peatland				X		
Urtica dioica	Interior, Rockslide					X	X
Vaccinium oxycoccos (= *Oxycoccos microcarpus*)	Peatland			X			
Vaccinium uliginosum	Peatland				X		
Veratrum viride	Forest floor				X		
Veratrum viride (= *Veraturm viride* ssp. *eschscholtzii*)	Peatland			X			
Veronica americana	Peatland	X					
Vicia gigantea (moist site)	Forest floor					X	
Viola epipsila	Peatland			X			

[a] Taxonomy follows Kartesz (1992); Hultèn (1968) is in parentheses.

[b] Edge between rocky tidal area and shoreline forest.

[c] *Cochlearia sessilifolia* in rocky tidal area; needs taxonomic verification.

Appendix 3

Common and Scientific Names of Avian Species Found in This Survey

Common name	Scientific name	Common name	Scientific name
Red-throated loon	*Gavia stellata*	Downy woodpecker	*Picoides pubescens*
Pacific loon	*Gavia pacifica*	Hairy woodpecker	*Picoides villosus*
Common loon	*Gavia immer*	Northern flicker	*Colaptes auratus*
Great blue heron	*Ardea herodias*	Alder flycatcher	*Empidonax alnorum*
Sandhill crane	*Grus canadensis*	Pacific-slope flycatcher	*Empidonax difficilis*
Canada goose	*Branta canadensis*	Tree swallow	*Tachycineta bicolor*
Mallard	*Anas platyrhynchos*	Steller's jay	*Cyanocitta stelleri*
Harlequin duck	*Histrionicus histrionicus*	Northwestern crow	*Corvus caurinus*
Black scoter	*Melanitta nigra*	Common raven	*Corvus corax*
Surf scoter	*Melanitta perspicillata*	Chestnut-backed chickadee	*Parus rufescens*
White-winged scoter	*Melanitta fusca*	Brown creeper	*Certhia americana*
Common merganser	*Mergus merganser*	Red-breasted nuthatch	*Sitta canadensis*
Black oystercatcher	*Haemotopus bachmani*	Winter wren	*Troglodytes troglodytes*
Greater yellowleg	*Tringa melanoleuca*	Golden-crowned kinglet	*Regulus satrapa*
Least sandpiper	*Calidris minutilla*	Ruby-crowned kinglet	*Regulus calendula*
Bonaparte's gull	*Larus philadelphia*	Swainson's thrush	*Catharus ustulatus*
Mew gull	*Larus canus*	Hermit thrush	*Catharus guttatus*
Ring-billed gull	*Larus delawarensis*	Varied thrush	*Ixoreus naevius*
Glaucous-winged gull	*Larus glaucescens*	American robin	*Turdus migratorius*
Pigeon guillemot	*Cepphus columba*	Orange-crowned warbler	*Vermivora celata*
Marbled murrelet	*Brachyramphus marmoratus*	Townsend's warbler	*Dendroica townsendi*
Bald eagle	*Haliaeetus leucocephalus*	Wilson's warbler	*Wilsonia pusilla*
Sharp-shinned hawk	*Accipiter striatus*	Northern waterthrush	*Seiurus noveboracensis*
Red-tailed hawk	*Buteo jamaicensis*	Common yellowthroat	*Geothlypis trichas*
Osprey	*Pandion haliaetus*	Savannah sparrow	*Passerculus sandwichensis*
Blue grouse	*Dendragapus obscurus*	Fox sparrow	*Passerella iliaca*
Barred owl	*Strix varia*	Song sparrow	*Melospiza melodia*
Western screech-owl	*Otus kennicottii*	Lincoln's sparrow	*Melospiza lincolnii*
Northern saw-whet owl	*Aegolius acadicus*	Golden-crowned sparrow	*Zonotrichia atricapilla*
Rufous hummingbird	*Selasphorus rufus*	Dark-eyed junco	*Junco hyemalis*
Belted kingfisher	*Ceryle alcyon*	Red crossbill	*Loxia curvirostra*
Red-breasted sapsucker	*Sphyrapicus ruber*	White-winged crossbill	*Loxia leucoptera*
		Pine siskin	*Carduelis pinus*

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