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Breeding Bird Communities of Major Mainland Rivers of Southeastern Alaska

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BREEDING BIRD COMMUNITIES OF MAJOR MAINLAND RIVERS OF SOUTHEASTERN ALASKA

by

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ABSTRACT

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of Southeastern Alaska

by

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Utah State University, 2003

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Because of the scarcity of information for bird communities at the major mainland rivers of southeastern Alaska, the main objective of this study was to provide baseline information including distribution, status, and habitat associations of breeding birds.

I conducted a meta-analysis of all known reports (including the current study) conducted at major mainland rivers during the breeding season. I described bird species composition, distribution, abundance estimates, status, habitat associations, and guild membership for all birds recorded at 11 major mainland rivers. Based on incidental observations, 170 species were recorded by all studies. Of these, 134 species were known or suspected to breed, accounting for 50% of all birds known from Alaska and 80% of all birds known from southeastern Alaska. In addition, I provided information on species of management concern as well as management implications and recommendations.

I used point counts to survey birds within deciduous riparian vegetation at 6 major mainland rivers during 2000-2002. I compared bird species composition, abundance,

richness, and diversity among four main vegetation types of deciduous riparian vegetation: shrubland, young deciduous forest, mature deciduous forest, and mixed deciduous-coniferous forest. Species richness was similar among all habitat types; however, relative abundance and diversity of birds was highest in mixed forest stands. Mature forests had the greatest number of species associated with the Canadian interior.

I also used point counts to compare bird species composition, abundance, richness, and diversity among 6 major mainland rivers consisting of three trans-mountain and three coastal rivers. Latitude, connectivity, and availability of mature and mixed forests were the major factors thought to cause differences in bird communities among rivers. Contrary to our predictions, coastal rivers had higher bird species richness, diversity, point abundance, and point richness than trans-mountain rivers. Of the 10 species associated with the Canadian interior recorded during point counts, 8 occurred at both trans-mountain and coastal rivers.

(244 pages)

DEDICATION

This thesis is dedicated to the memory of Tim Schantz, a gifted birder and friend of the major mainland rivers, and also, of course, my parents, who have always encouraged and supported all my endeavors.

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Jim Johnson

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CHAPTER 1

INTRODUCTION

Riparian Ecosystems and Their Importance to Birds

Riparian areas are zones along water bodies that act as interfaces between terrestrial and aquatic ecosystems (Malanson 1993). Although riparian ecosystems are limited in areal extent, they supply food, cover, and water for a disproportionately large diversity of animals, especially birds (see Brinson et al. 1981 for overview). The importance of riparian systems has been linked to a variety of factors including: spatial heterogeneity, complexity of habitats characterized by close proximity and overlap of diverse habitat elements, localized abundance of resources, a predominance of woody plant communities, presence of surface water, and high soil moisture (Brinson et al. 1981, Knopf 1985). Other important spatial aspects of riparian zones are corridor width, shape, connectivity of habitats, and origin of the river (Malanson 1993).

Riparian zones are dynamic systems affected by a wide range of disturbances of varying frequency and intensity. Physical processes such as channel dynamics, e.g., flooding and sedimentation, act to alter the riparian zone over time and space (Malanson 1993). In addition, biological processes, e.g., the activity of beavers (*Castor canadensis*), greatly influence the availability and diversity of certain habitat conditions (Gill 1972). Allred (1980) documented increases in habitat types as a result of beaver activity in Idaho. This dynmaic state of flux occurring within riparian zones creates new and qualitatively different environmental attributes that may increase the availability of

resources important to birds (Brinson et al. 1981). For example, cutbanks create new potential nest sites for a variety of bird species including the Belted Kingfisher (*Ceryle alcyon*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), and Bank Swallow (*Riparia riparia*). Also, the scouring of vegetation during periodic flood events can drastically alter the structure and composition of woody vegetation communities creating new or different habitat conditions, which in turn may increase regional bird and plant diversity (Brinson et al. 1981). In addition, dead woody vegetation (e.g., standing dead trees or "snags" created as a result of flooding) provides nest sites for cavity-nesting birds, and feeding, resting, and hunting sites for a variety of birds including woodpeckers, flycatchers, and raptors. Although information is limited for the use of herbaceous and non-vegetated riparian habitats by birds, these habitats also provide unique nesting and foraging sites (Brinson et al. 1981). For example, herbaceous meadows provide nesting and foraging environments for ground-nesting birds including Savannah Sparrows (*Passerculus sandwichensis*) and Lincoln's Sparrows (*Melospiza lincolnii*). Unvegetated shorelines, sandbars, and gravelbars provide foraging and nesting substrates for shorebirds such as Killdeer (*Charadrius vociferous*) and Spotted Sandpipers (*Actitis macularia*).

The presence of surface water is required by many birds for foraging (e.g., piscivorous birds), nesting (e.g., loons), and resting (e.g., gulls, molting waterfowl). Similarly, a variety of birds require high soil moisture levels for foraging (e.g., snipe) and nesting (e.g., blackbirds). Soil moisture has dramatic effects on bird species diversity and abundance (Johnson and Jones 1977). Indirect effects of the presence of both surface water and high soil moisture include the abundance of food resources and the formation

of vegetation structure and composition preferred by a large number of species (Odum 1950, Gaines 1974).

The width and shape of the riparian area determines the size and shape of habitat patches, which in turn affects edge-to-area ratios within the riparian zone. As the width of a riparian zone decreases, the effect of adjacent upland habitats on riparian bird communities may become more pronounced (Brinson et al. 1981, Malanson 1993). In addition, the linear spatial configuration of a riparian landscape creates a corridor for the diffusion and dispersal of plants and animals (Malanson 1993). The origin and connectivity of the riparian zone is an important aspect of floral and faunal mixing on a regional basis (Malanson 1993).

The importance of deciduous riparian vegetation to birds during the breeding season, migration, and winter has been well documented throughout North America (see Knopf et al. 1988 for overview). Although riparian vegetation accounts for less than 1% of the area of the western United States, it has greater bird species diversity and density values than any other habitat (Knopf et al. 1988). For example, 82% of all breeding species in northern Colorado occurred in riparian vegetation (Knopf 1985), and 51% of species in the southwestern United States occurred in this habitat (Johnson and Jones 1977). In addition, bird densities were higher in riparian vegetation than in adjacent habitats in California (Gaines 1974), Arizona (Stevens et al. 1977), and Louisiana and east Texas (Dickson 1978).

Studies conducted in Alaska also have shown the importance of riparian vegetation to bird communities. For example, the highest breeding bird density and species richness values in southcentral Alaska occurred in cottonwood-willow forests

(Kessel 1998). Similarly, the bird community studies of Willson and Comet (1996a,b) in deciduous and coniferous forest understories in southeastern Alaska and adjacent Canada showed that relative abundance and species richness were higher in deciduous forest understories than coniferous forest understories, with the highest values occurring in the understory of cottonwood forests.

Riparian Ecosystems of Southeastern Alaska

Because of their importance to wildlife, the conservation and management of riparian ecosystems, especially in the arid west, have received special emphasis in recent years (Knopf et al. 1988). However, few studies have investigated the importance of riparian ecosystems to bird communities in regions where moisture is not a limiting factor. The few studies conducted in the Pacific Northwest (Bruce 1985, McGarigal and McComb 1992) concluded that riparian forests might not be as important to avifauna as in arid regions since these habitats supported fewer species and individuals than the adjacent upland. However, these studies were conducted on small, first and second order streams and did not examine the bird communities of large rivers. Lock and Naiman (1998) showed that there was a significant relationship between bird communities and stream size in Washington - bird species richness and abundance were significantly higher on large rivers than small rivers.

Information is even scarcer for riparian bird communities in north-temperate rainforests, particularly in southeastern Alaska, where results from previous studies have been geographically limited and not broadly available to the scientific community. As a

result, one of the largest remaining gaps in our understanding of the southeastern Alaskan avifauna is the use of riparian habitats (Boreal Partners In Flight 1999).

The largest riparian systems of southeastern Alaska occur on the narrow mountainous mainland. These major mainland rivers can be classified as two types: 1) those that transect the coastal mountains to connect the ecologically distinct regions of southeastern Alaska with the Canadian interior (trans-mountain), and 2) those rivers with watersheds limited to the seaward side of the coastal mountains (coastal). Both types contain a heterogeneous mixture of highly diverse and productive avian habitats, including the most structurally and floristically complex deciduous riparian plant communities in Alaska. Indeed, most deciduous riparian vegetation, including the majority of the region's cottonwood (*Populus trichocarpa*) forest and willow (*Salix* spp.) shrublands occurs in the major mainland river systems.

Southeastern Alaska's mainland river corridors are known to support a unique and diverse avifauna (Gibson and MacDonald 1975), including many species more common in the Canadian interior and occurring in small numbers elsewhere. Most published studies conducted at the mainland rivers were descriptive, and sampling area and effort varied considerably among studies (Swarth 1911 and 1922, Bailey 1927, Jewett 1942, Webster 1950, Gibson and MacDonald 1975, MacDonald and MacDonald 1975, Gibson 1986). In addition, the last study to describe the breeding bird communities of mainland rivers was conducted >15 years ago (Gibson 1986), and much of the information has not been widely available.

Management Concerns of Major Mainland Rivers of Southeastern Alaska

Major mainland rivers support a diverse and unique avifauna including several species of priority concern as listed by Boreal Partners in Flight (1999). All 19 priority species of concern listed for the southeastern Alaska biogeographic region regularly occur at the major mainland rivers (Boreal Partners in Flight 1999). In addition, information on the abundances and distributions is lacking for 13 species that are primarily associated with major mainland rivers (see Boreal Partners in Flight 1999 and chapter 2 of this thesis). Information is necessary for managers to implement specific objectives for these species. Making these needs more pressing are the increased threats of present and future anthropogenic disturbances, e.g., road-building, mining, hydroelectric projects, and timber harvest at several major mainland rivers (Boreal Partners in Flight 1999, Transboundary Watershed Alliance 2001). Despite the bioregional importance of major mainland rivers to wildlife, including birds, few have protected land-use status (Boreal Partners in Flight 1999). As a consequence, Boreal Partners in Flight (1999) has listed the study of avian use of deciduous riparian habitats in southeastern Alaska as a top priority.

Objectives

A common and important goal of bird-habitat studies is to identify environmental conditions that may control or affect bird species distribution and abundance. An understanding of important environmental variables would help managers make more

informed, data-based management decisions. In this thesis, I examined some of the factors that contribute to determining community composition, diversity, richness, and abundance of breeding birds at two spatial extents: 1) geographic and 2) local. The geographic level includes regional biogeography and landscape configuration while the local level includes ecological characteristics such as vegetation structure and composition (Willson and Comet 1996b). Chapter 2 provides a meta-analysis of all known published studies conducted at 11 major mainland rivers during the breeding season (Swarth 1911 and 1922, Bailey 1927, Jewett 1942, Webster 1950, Gibson and MacDonald 1975, MacDonald and MacDonald 1975, Gibson 1986). Information included in this summary consists of species composition, distribution, status, estimates of abundance, and broad bird-habitat associations. Bird species of management concern and management considerations are also discussed. In chapter 3, I used point counts to compare bird species composition, abundance, richness, and diversity among 6 major mainland rivers consisting of three trans-mountain and three coastal rivers. In chapter 4, I used point counts to examine habitat relationships of birds using deciduous riparian vegetation at 6 major mainland rivers. My specific objectives were: 1) to determine species composition and relative abundance of breeding birds that use deciduous riparian vegetation; 2) if and how bird species composition and abundances differed significantly among rivers; and 3) whether species composition and abundances differed among trans-mountain and coastal rivers. I also provided information on bird species of special management concern. Chapter 5 provides concluding remarks.

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CHAPTER 2

BREEDING BIRD COMMUNITIES OF MAJOR MAINLAND RIVERS IN SOUTHEASTERN ALASKA

Introduction

Riparian zones have long been recognized for their importance to birds. Dynamic physical and biological processes in riparian zones produce floristically diverse, structurally complex, and biologically productive habitats that support large assemblages of breeding birds (Brinson et al. 1981; Malanson 1993). The importance of riparian zones to breeding birds has been well documented throughout North America. Avian diversity and abundance are commonly much greater in riparian vegetation than in nearby upland habitats (Gaines 1974; Hubbard 1971; Johnson and Jones 1977; Knopf 1985), especially in arid regions where sharp contrasts exist between riparian zones and their adjacent dry uplands (e.g., Brinson et al. 1981; Johnson and Jones 1977; Knopf et al. 1988). Some have even suggested that riparian plant communities support the greatest diversity of breeding birds of any vegetation type in North America (Johnson and Jones 1977; Knopf et al. 1988). Accordingly, landbird conservation initiatives in western North America have focused on protection and restoration of riparian habitats (e.g., California's Riparian Habitat Joint Venture). Information is scarce, however, for riparian bird communities in north-temperate rainforests, particularly in southeastern Alaska, where results from previous studies have been geographically limited and not broadly available to the scientific community.

Two primary types of mainland rivers occur in southeastern Alaska – trans-mountain and coastal. Originating in the Canadian interior, trans-mountain rivers, the largest riverine systems in southeastern Alaska, bisect the Coast Range or St. Elias Mountains to drain immense areas of southeastern Alaska and the Canadian interior. These rivers are unique because they form a continuous corridor between ecologically distinct regions of southeastern Alaska coast and the Canadian interior. Coastal rivers are mainland rivers that do not bisect the Coast Range or St. Elias Mountains; their watersheds are primarily confined to the seaward slopes of the coastal mountains. Although coastal rivers do not provide direct connectivity between southeastern Alaska and the Canadian interior, they may be indirectly connected to the interior by major tributaries, their proximity to trans-mountain rivers, or their location at the end of long, often narrow inlets that penetrate the mainland. This connectivity by the rivers provides a relatively unencumbered route for dispersal or movement of flora and fauna between coastal and interior regions. Accordingly, these mainland rivers contain extensive and structurally-complex riparian plant communities, especially cottonwood (*Populus trichocarpa)* forest and willow (*Salix* spp.) shrublands, that are relatively scarce elsewhere in southeastern Alaska, and therefore potentially important in supporting unique avifaunas in the region.

Southeastern Alaska's mainland river corridors are known to support a unique and diverse avifauna (Gibson and MacDonald 1975; O'Clair et al. 1997), including many species more common in the Canadian interior and occurring in small numbers elsewhere in southeastern Alaska. Most studies conducted at the mainland rivers were descriptive and sampling area and effort varied considerably among studies. In addition, the last

study to describe the breeding bird communities of a mainland river was conducted >15 years ago (Gibson 1986), and much of the information has not been widely available.

Although riparian zones of southeastern Alaska's mainland rivers are relatively intact, several anthropogenic disturbances threaten their integrity. Road development projects proposed for southeastern Alaska could negatively affect several mainland rivers. Timber harvest, although declining in recent years, still poses a major threat to bird communities primarily associated with coniferous forests. Urbanization and mining activities could also potentially alter bird habitats within the mainland river corridors in the near future. Plans on the use of public lands in the region have generally not addressed the conservation and management of bird communities inhabiting the mainland rivers in the region.

To remedy the overall scarcity and unavailability of information, I conducted intensive bird surveys of 10 mainland rivers in southeastern Alaska from 2000 to 2002. In conjunction with this field study, I reviewed all published and unpublished reports (Bailey 1927; Gibson 1986; Gibson and MacDonald 1975; Jewett 1942; MacDonald and MacDonald 1975; Schantz unpubl. notes; Swarth 1911; Webster 1950) on riverine breeding bird communities in the region and provide information for 11 major mainland rivers. These datasets were used to describe the abundance and distribution of and habitat use by birds in these riparian corridors. I also describe some of the differences in bird species presence among rivers as well as discuss some of the factors that may influence the distribution of breeding birds at the major mainland rivers. The main purpose of our effort is to provide land managers and conservationists with a

comprehensive review of the importance of southeastern Alaska's riparian habitats to breeding birds.

Study Area and Methods

Study Area

I defined southeastern Alaska (Fig. 2-1) as extending from Dixon Entrance (54°43′N 131°11′W) to Icy Bay (59°54′N 141°26′W). Approximately 850 km in length and 210 km in width, this region is bounded in the east by the crest of the Coast Range and St. Elias Mountains and in the west by the Pacific Ocean and Gulf of Alaska. The narrow mainland and more than 1,000 islands of the Alexander Archipelago encompass approximately 9 million ha; the majority of the area lies within the Tongass National Forest. Rising to approximately 5,000 m, the mainland is dominated by steep mountains, which contain numerous glaciers, expansive icefields, and barren rock. Mean annual precipitation varies considerably in the region, and ranges from 384 cm near Ketchikan to 123 cm at Haines.

I include information on bird communities from 11 of the largest mainland rivers in southeastern Alaska; three are trans-mountain rivers and eight are coastal rivers (Table 2-1). Both types of mainland river systems are characterized by steep-sided, glacially carved valleys, relatively narrow flood plains (rarely >3.5 km in width), and a diverse mosaic of habitats that include broad deltas, extensive wetlands, lakes, and deciduous and coniferous forests (Table 2-1). These mainland rivers are glacial in origin and are characterized by variable glacial processes that influence the distribution and successional stage of vegetation communities both within and among rivers. For

example, several glaciers reach their termini within the river valleys, and their melt-water runoff discharges large amounts of fine sediments deposited at the mouths of the rivers to form extensive tidal flats. Coarser sediments are deposited to form gravel bars throughout the river valleys that support deciduous plant communities that vary from shrublands to cottonwood gallery forests depending on the frequency of flooding. Furthermore glaciers also influence the development of biotic communities by influencing the local climate within river valleys. The Katzehin River valley, for example, is 5° to 8° C colder than surrounding areas in Lynn Canal (pers. obs.).

Several of the rivers, (especially trans-mountain) flow through southeastern Alaska for only a small portion (average = 50 km) of their overall length. The Stikine River, for example, flows only 40 km in southeastern Alaska but is >700 km in length, and has an approximate 50,000 km² watershed, from its headwaters in British Columbia to the Pacific Ocean. In contrast, the Taiya, Katzehin, and Antler rivers are relatively short in total length. Each of these coastal rivers flows for an average of 19 km, occurs entirely within southeastern Alaska, and supports less extensive deciduous riparian vegetation and freshwater marsh than the other rivers (Table 2-1).

Bird Information

The breeding season of birds in northern latitudes is of a relatively short duration and is dictated primarily by day length, weather, vegetation phenology, and food availability. Most birds in southeastern Alaska breed between mid-May and mid-August with a peak in June. However, some birds, primarily permanent residents, begin breeding in early May and may finish breeding as late as September. Because these dates overlap

the migration periods of many species, I defined the breeding season 15 May to 15 August. For the 11 rivers, I present abundance, breeding and migration status, and general habitat use for all bird species recorded during the breeding period. Included are observations from all known studies previously conducted at the major mainland rivers (Bailey 1927; Gibson 1984; Gibson and MacDonald 1975; Jewett 1942; MacDonald and MacDonald 1975; Schantz unpubl. notes; Swarth 1911; Webster 1950). I augmented this information with our own surveys of 10 major mainland rivers (Table 2-2). From 2000 to 2002, I kept daily checklists of species and conducted numerous point counts at each river. Timing and effort varied considerably among these studies, from a few days at a primary location to nearly a year in a variety of habitats (Table 2-2).

I used categories defined by the North American Ornithological Atlas Committee (1990) to describe breeding evidence as: confirmed, probable, possible, and observed (Table 2-3). The breeding evidence I report applies only to species observed at major mainland rivers; species not known to breed in the major mainland rivers may, however, breed elsewhere in southeastern Alaska. Abundance categories are based on Gibson and MacDonald (1975), MacDonald and MacDonald (1975), and Kessel and Gibson (1978) to maintain consistency. The following categories were assigned to species based on observations from the major mainland rivers: abundant, common, fairly common, and rare (see appendix A-2 for descriptions). For abundance classifications at the statewide level refer to Gibson (2001); for regional abundances see Armstrong and Gordon (2001) and Armstrong (1995). I followed Kessel and Gibson (1978) to describe status as breeder, resident, visitant, vagrant/accidental, and migrant. I assigned migration system, as defined by DeGraaf and Rappole (1995), to each migrant bird species encountered at

major mainland rivers as either Nearctic-Neotropical or Nearctic-Nearctic migrant. Bird nomenclature follows the American Ornithologists' Union (1998, 2000); scientific names are provided in appendix A-2. I discuss general patterns for all species detected. I produced accounts that describe abundance, distribution, breeding status, and habitat use for each species (appendix A-2).

River Comparisons

Due to the direct connectivity of trans-mountain rivers with the Canadian interior, I expected that the number of interior associated species (e.g., American Bittern, Warbling Vireo, American Redstart, Western Tanager) would be greater at trans-mountain rivers than coastal rivers. To address this I compared the number of interior associated species among trans-mountain and coastal rivers.

I also assessed the similarity of breeding bird communities among rivers and between trans-mountain and coastal rivers with Sorensen's similarity index (Krebs 1999) using presence-absence information of bird species known or suspected to breed at the major mainland rivers. In order to examine whether there were differences in breeding bird community composition as a result of river length I separated coastal rivers into two classes: rivers <25km in length and rivers >25 in length. In addition, due to the absence of several breeding bird species at the Alsek that regularly occur at the other major mainland rivers comparisons with trans-mountain rivers were made both including and excluding the Alsek.

Habitats and Their Use

I adapted the work of Gibson and MacDonald (1975) and Viereck and others (1992) to identify 10 distinct habitats prevalent at the major mainland rivers of southeastern Alaska: coniferous forest, mixed forest, deciduous forest, deciduous shrubland, estuarine meadow, freshwater marsh, lacustrine waters and shorelines, fluviatile waters and shorelines, alluvial bars and islands, and tidal flats. In addition, buildings and other artificial structures were scattered throughout the study areas and provided unique habitats for some species. I used the total number of bird species encountered to determine richness; species could be assigned to multiple habitats. Descriptions of habitats follow.

Coniferous forests are late-seral communities that occur on well-drained and well-developed soils that are rarely flooded. The dominant tree species of coniferous forests are Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*). Trees, reaching heights of >50 m, are widely spaced and form a patchy canopy layer. The shrub understory is most often dominated by devil's club (*Oplopanax horridus*), salmonberry (*Rubus spectabilis*), and blueberry (*Vaccinium* spp.).

Deciduous forests are mid-seral communities intermediate between early successional shrub communities and late-successional conifer forests. Deciduous forest sites may be composed entirely of black cottonwood, red alder (*Alnus rubra*), or a mixture of both species. At the Taiya and Chilkat rivers, paper birch (*Betula papyrifera*) is also present. Young deciduous forests consist of closely spaced, small- to medium-diameter black cottonwood and red alder. Except for gaps resulting from fallen trees, the tree canopy is mostly closed. The forest understory is sparse and composed of scattered

salmonberry, nootka rose (*Rosa nutkana*), red-osier dogwood (*Cornus stolonifera*), and Douglas maple (*Acer glabrum*). As these forests mature, trees may reach heights of 40 m, with cottonwood often becoming the dominant tree species - openings in the tree canopy increase light penetration to the forest floor and allow development of a dense shrub understory. Common shrubs in mature cottonwood forest include Sitka alder (*Alnus sinuata*), salmonberry, red-osier dogwood, highbush cranberry (*Viburnum edule*), red elderberry (*Sambucus racemosa*), and devil's club.

Mixed forests are mid- to late-seral communities that occur on well-drained and well-developed soils and that are rarely flooded. These forests are composed of widely spaced mature Sitka spruce, black cottonwood, and red alder; often, no species is clearly dominant. The Taiya and Chilkat rivers also contain scattered, paper birch. The canopy is patchy, and trees reach heights of 50 m. The dense shrub understory is predominately Sitka alder, red-osier dogwood, highbush cranberry, nootka rose, red elderberry, salmonberry, and devil's club.

Deciduous shrublands are early-seral communities and consist of either tall or low shrublands. Tall shrubland occurs on frequently flooded sites, is composed primarily of Sitka alder and willow (*Salix* spp.) >1.5 m in height, and may contain a few scattered tall deciduous trees. Other understory shrubs include red elderberry, devil's club, red-osier dogwood, and highbush cranberry. Low shrubland occurs on recently disturbed sites. Although small (<1.5 m in height) willow and Sitka alder predominate, patches of young cottonwoods (≤10 m in height) may also be present. Soils are generally rocky and lack a well-developed organic layer.

Estuarine meadows occur at river mouths and may be periodically inundated by tidal waters. Vegetation is composed of sedges, grasses, and scattered forbs; patches of willow and alder may be present in areas seldom flooded by salt water. Freshwater marshes occur on sites with poor drainage, such as flooded areas surrounding beaver dams. Scattered ponds of varying sizes are typically surrounded by sedges, grasses, forbs, and low shrubs such as willow, sweetgale (*Myrica gale*), and Sitka alder.

Lacustrine waters and shorelines include the surface water of lakes and ponds and the sparse vegetation and alluvium at the waters' edge. Fluviatile waters and shorelines include the surface water of rivers, sloughs, and streams and the sparse vegetation and alluvium at the water's edge. Alluvium and islands consist of either unvegetated or sparsely vegetated gravel and sand deposited or scoured by glaciers or recent flood events. Islands, in either lacustrine or fluviatile zones, may be sparsely vegetated and are composed of glacial till, gravel, or boulders. Tidal flats are extensive areas of river-deposited sand and silt that are inundated daily by tidal exchanges. The largest tidal flats occur at the Stikine River mouth.

To provide some description of how birds use mainland river habitats, I used life history information provided by Ehrlich and others (1988) and our own observations to assign each species to categories within three types of guilds: foraging habitat (aquatic, ground, aerial, bark, foliage), foraging behavior (piscivore [including molluscivores], insectivore, herbivore, carnivore, omnivore, granivore), and nest location (ground, shrub, tree, cavity, cliff, bank, building).

Results

Community Composition and Structure

During the breeding season, 170 species, representing 15 orders and 38 families, were recorded by all studies of major mainland river systems of southeastern Alaska (Table 2-4). This total represents 37% of the species known to occur in Alaska (Gibson 2001) and 50% of the species known to occur in southeastern Alaska (Armstrong and Gordon 2001). Of the 170 species recorded, 134 species were known or suspected to breed along the study rivers; representing 50% of the breeding avifauna of Alaska (Gibson 2001) and 80% of southeastern Alaska (Armstrong and Gordon 2001). The 104 landbirds recorded at mainland rivers constituted 40% of state's landbird species and 59% of southeastern Alaska's landbird species. Of these, 95 landbird species were known or suspected to breed, representing 72% of the state's known or suspected breeding landbird species (Gibson 2001) and 92% of southeastern Alaska's landbird species (Armstrong and Gordon 2001).

Bird communities of the major mainland rivers showed a strong pattern of seasonal use (Table 4); i.e., the majority (69%) of the 134 breeding species were migrants. Of these 92 migrant species, 77% were Nearctic-Neotropical migrants and 23% were Nearctic-Nearctic migrants. The remaining species (31%) were considered permanent residents. Landbirds followed a similar pattern. Most (67%) of the 95 breeding species were migratory; 57% of the species were Nearctic-Neotropical migrants, and 10% were Nearctic-Nearctic migrants. Thirty-one landbird species were permanent

residents. Because most studies did not assess wintering populations, a greater percentage of species might be resident than reported here.

Bird species richness and community composition varied among the 11 rivers (Table 2-5, appendix A-1). Although total species richness ranged from 44 to 126 species, the number of breeding species was less variable (Table 2-5). High variation in effort among rivers appeared to result mainly in increased records of visitants or vagrants; numbers of breeding species were much less variable among rivers (Table 2-5). The low breeding species richness at the Katzehin (44 species), relative to the other rivers ($\overline{X}$ = 77 species), might result from low habitat diversity and extent (especially deciduous riparian vegetation and freshwater marsh) and local climate. Due to the close proximity of the Meade Glacier, the Katzehin River valley was approximately 5-8 °C colder than at nearby Lynn Canal, and birds appeared to avoid areas exposed to cold glacial winds.

Twenty-five species were common to all 11 rivers (Table 2-4). The most common waterfowl species were the Mallard and Common Merganser. Only one species of shorebird (Spotted Sandpiper) and two species of seabirds (Mew Gull and Arctic Tern) were recorded at every river. Twenty species of landbirds were recorded at every major mainland river; of these, the most common species were the Bald Eagle, Tree Swallow, Ruby-crowned Kinglet, Hermit Thrush, American Robin, Varied Thrush, Yellow Warbler, Yellow-rumped Warbler, and Lincoln's Sparrow (appendix A-1).

The composition of bird communities was noticeably different between the Alsek and other rivers. Breeding species, such as Aleutian Tern, Northern Hawk Owl, and Common Redpoll, and several non-breeding species of waterfowl and shorebirds were

only observed at the Alsek River (appendix A-1). Species common in mature forests in more southern rivers, such as Pacific-slope Flycatcher, Chestnut-backed Chickadee, Winter Wren, and Townsend's Warbler, were rarely encountered at the Alsek River. Interior associated species, such as the Warbling Vireo, American Redstart, and Western Tanager, were absent. In general, early successional habitats at the Alsek River may have limited the diversity of forest-dwelling taxa such as flycatchers, vireos, and warblers.

Similarity of breeding bird communities was lowest between the Alsek and other rivers (Table 6). Similarity between coastal rivers <25km and trans-mountain rivers both including and excluding the Alsek were 84.5% and 86.6%, respectively. Relative to coastal rivers >25 km in length, the similarity of both trans-mountain including and excluding the Alsek were 91.4% and 89.4%. When comparing all coastal rivers combined to trans-mountain rivers both including and excluding the Alsek, the similarity of breeding bird communities were 91.9% and 89.9% (Table 2-6).

Of the 16 species of interior associated species recorded at the major mainland rivers, 16 were detected at coastal rivers and 13 were detected at the trans-mountain rivers (Table 2-7). The number of interior associated species detected at coastal rivers <25 km was lower (11 species) than at coastal rivers >25 km (14 species). The only interior associated species detected at the Alsek was the Black-capped Chickadee. The number of interior associated species did not differ between trans-mountain rivers when the Alsek was excluded.

During our fieldwork, I obtained new information on the breeding status of several species for the state and southeastern Alaska. I observed several pairs of

Common Nighthawks at the Chilkat and Klehini river valleys, of which several were observed performing distraction displays. The discovery of two flightless nighthawk young confirmed breeding of this species in Alaska (appendix A-2). A Magnolia Warbler nest containing young on the Stikine River provided the first confirmed breeding record of this species in Alaska (appendix A-2). New breeding records for southeastern Alaska included a breeding colony of Caspian Terns on the Taku River, a nesting pair of American Kestrels on the Chilkat River, and a recently used Black-billed Magpie nest on the Chilkat River (appendix A-2). Other notable species included a single calling Virginia Rail on the Chilkat River, a singing Least Flycatcher on the Chickamin River, pairs of territorial Red-eyed Vireos on the Stikine and Chickamin rivers, pairs of territorial Cassin's Vireos on the Taku, Whiting, and Chickamin rivers, and a pair of Black-and-White Warblers on the Chickamin River (appendix A-2).

General Habitat Use

For terrestrial habitats, the number of species that were known or suspected to breed was greatest in mixed forest (46 species), coniferous forest (42), and deciduous forest (35; Table 2-8). Among aquatic habitats, freshwater marsh supported the highest number of species known or suspected to breed (27 species; Table 2-8). Species richness patterns were similar when all species breeding and nonbreeding species were considered. Numbers of migrant birds were highest in habitats that underwent large seasonal alterations (e.g., freshwater marsh, deciduous shrubland; Table 2-8), whereas numbers of resident birds were greatest in more seasonally stable habitats (e.g., coniferous and mixed forest; Table 2-8). Several species were found in a variety of

habitats (e.g., Bald Eagle, Northwestern Crow, Common Raven, and American Robin), and many were regularly observed in both coniferous and deciduous forest (e.g., Sharp-shinned Hawk, Red-breasted Sapsucker, Hairy Woodpecker, Steller's Jay, Hermit Thrush, American Robin, Yellow-rumped Warbler, and Dark-eyed Junco). On several occasions, I observed Winter Wrens defending territories around single or small patches of coniferous trees that were surrounded by deciduous vegetation.

The heterogeneity of aquatic and terrestrial habitats and structural diversity of vegetation at the major mainland rivers offers a variety of nesting opportunities for breeding birds. The majority of breeding species are species that nest primarily on the ground (37%), in trees (32%), and in cavities (16%; Fig. 2-3). Likely due to its early successional state, Alsek River habitats supported fewer tree-nesting species, and a greater percentage of birds nested on the ground relative to the other rivers (57%; Table 2-9). Ground-nesting birds, such as Lincoln's Sparrow, Savannah's Sparrow, and Dark-eyed Junco placed their nests in dense herbaceous vegetation. Dense shrubs (especially willow and alder) provide nesting substrate to a variety of birds, such as Swainson's Thrush, Orange-crowned Warbler, American Redstart, MacGillivray's Warbler, and Song Sparrow. At rivers with moose populations (Chilkat, Katzehin, Antler, Taku, Stikine, and Unuk), I found that moose hair was used as a lining in the nests of several species (e.g., Hermit Thrush, Swainson's Thrush, American Robin, Orange-crowned Warbler, Yellow Warbler, American Redstart, Song Sparrow, and Fox Sparrow). Moose hair may offer increased insulation to eggs and young.

Snags provided an important habitat feature for breeding birds at the major mainland rivers. Snags surrounding wetlands (especially beaver ponds) provided ample

opportunities for cavity-nesting birds, such as American Kestrel, Common Goldeneye, Hooded Merganser, and several swallow species. Snags adjacent to open areas (e.g., wetlands, meadows, alluvial bars) also provided perch sites for singing and displaying territorial passerines, such as Olive-sided Flycatcher, Winter Wren, and Orange-crowned Warbler, and sites for raptors (e.g., Bald Eagle, Red-tailed Hawk, Merlin, and Great-horned Owl) to search for prey. Snags within mature forests were likely used by cavity nesting species, such as Northern Saw-whet Owl, Red-breasted Sapsucker, Hairy Woodpecker, and Chestnut-backed Chickadee.

Most bird species breeding at southeastern Alaska's mainland rivers (78%) fed on animal foods that consisted of insects (57% of the species), fish (11%), or birds and mammals (9%; Fig. 2-4). Insectivores were dominated by ground gleaners (37%), foliage gleaners (25%) and aerial foragers (21%). The Alsek River supported few aerial and foliage foragers relative to other rivers (Table 2-10) and resulted in lower number of insectivores on the Alsek (46% of the species) relative to the other rivers (ave. 59%; Table 2-11). For all breeding birds, the most species foraged on the ground (26%) and few foraged on tree bark (5%; Fig. 2-5). Foliage and aquatic foraging habitats were equally used by breeding species (23%), while aerial habitats were used to a lesser extent (11%; Fig. 2-5). High densities of invertebrates observed at marshes and other aquatic habitats provide food for aerial foraging insectivors such as swifts and swallows. In addition, species not typically associated with wetland habitats (e.g., American Kestrel, Olive-sided Flycatcher, Western Wood-pewee, and American Robin) were observed feeding on aerial and terrestrial invertebrates along edges of freshwater marshes. For example, Merlins were observed foraging for dragonflies on several occasions.

Regurgitated pellets of Merlins from one location consisted almost entirely of dragonfly exoskeletons.

The only evidence of prey for rodent-eating species was the presence of several voles (*Microtus* spp.) in the nest of a Short-eared Owl and rodent hair in the regurgitated pellet of a Merlin. Feathers of a Yellow-rumped Warbler, waxwing (species unknown), and White-winged Crossbill were found at a feeding post of a Merlin. Other terrestrial food resources included conifer cones, which were important to fringillids, and berries (e.g., *Vaccinium* spp., *Rubus* spp.), which were an important fall food for corvids, thrushes, waxwings, and sparrows. Estuarine meadows and freshwater marshes provide nutrient-rich sedges and forbs that are important foods for waterfowl.

Specific Habitat Use

Most species recorded in riparian coniferous forests also commonly occurred in upland coniferous forests, some of which include Blue Grouse, Pacific-slope Flycatcher, Golden-crowned Kinglet, Hermit Thrush, Varied Thrush, Chestnut-backed Chickadee, Winter Wren, and Townsend's Warbler. Coniferous forest supported a fairly high proportion of carnivores (57%) compared to other habitats. Northern Goshawk, Red-tailed Hawk, Northern Pygmy Owl, Barred Owl, and Northern Saw-whet Owl were primarily associated with this habitat type.

The most frequently observed species in deciduous forest were the Hammond's Flycatcher, Warbling Vireo, American Robin, Swainson's Thrush, Yellow Warbler, and Yellow-rumped Warbler (appendix A-2). Several breeding species that occurred primarily at the major mainland rivers in southeastern Alaska were associated with

deciduous forest. These include Hooded Merganser, Least Flycatcher, Warbling Vireo, Red-eyed Vireo, and American Redstart. Mixed forest supported bird species that frequently occurred in coniferous forest, deciduous forest, and deciduous shrubland. The most frequently recorded species in mixed forests were Red-breasted Sapsucker, Ruby-crowned Kinglet, Townsend's Warbler, and Yellow-rumped Warbler (appendix A-2). Several species recorded in mixed forest, such as Cassin's Vireo, Magnolia Warbler, and Western Tanager, were primarily associated with major mainland rivers. Most cavity nesters were associated with forest habitats.

Along with deciduous forest, deciduous shrubland supported the most unique assemblage of breeding birds in southeastern Alaska. The most frequently observed species in deciduous shrubland were MacGillivray's Warbler, American Redstart, Orange-crowned Warbler, Yellow Warbler, Wilson's Warbler, and Fox Sparrow (appendix A-2). Deciduous shrubland supported several breeding species that were restricted to major mainland rivers in southeastern Alaska: Ruffed Grouse, Black-capped Chickadee, American Redstart, and Chipping Sparrow.

Relatively few species breed in estuarine meadow; the most frequently observed species were Savannah Sparrow and Lincoln's Sparrow. Alder Flycatchers, Orange-crowned Warblers, and Song Sparrows were frequently observed in patches of deciduous shrubs in estuarine meadow (appendix A-2).

Although freshwater marsh has relatively low structural diversity, it supported a diverse breeding bird avifauna. Freshwater marshes of the major mainland rivers were usually created by beaver activity. The presence of snags, deciduous shrubland, herbaceous vegetation, and scattered ponds offered an abundance of nesting and foraging

resources to birds. Accordingly, freshwater marshes had the highest number of nesting species of any aquatic habitat (Table 2-6). The most frequently observed species in freshwater marsh habitats were the Mallard, Common Snipe, Tree Swallow, Common Yellowthroat, Lincoln's Sparrow, Song Sparrow, and Red-winged Blackbird (appendix A-2). Species whose ranges in southeastern Alaska were primarily restricted to freshwater marsh at major mainland rivers include the American Bittern and Sora. Freshwater marsh also provided foraging habitat for raptors, flycatchers, swifts, and swallows.

The most frequently observed species in lacustrine habitats were Canada Goose, Mallard, and Common Merganser (appendix A-2). Seventy-nine species of seabirds, shorebirds, landbirds, and waterfowl associated with surface water were recorded at the mainland rivers (appendix A-2). Several shorebird species, including Semipalmated Plover and Spotted Sandpiper, nested and foraged along lacustrine shorelines. Mew Gulls, Herring Gulls, Arctic Terns, Aleutian Terns, and Caspian Terns were observed foraging in lacustrine habitats. Aerial foragers, including the Black Swift, Vaux's Swift, Tree Swallow, Violet-green Swallow, and Barn Swallow were frequently observed foraging over lacustrine waters (appendix A-2).

Species commonly observed in fluviatile habitats were the Bald Eagle, Mallard, Common Merganser, Spotted Sandpiper, and Belted Kingfisher (appendix A-2). Shorebirds, including the Spotted Sandpiper, Greater Yellowlegs, and Lesser Yellowlegs, were recorded foraging and nesting along fluviatile shorelines. Mew Gulls, Herring Gulls, Arctic Terns, and Aleutian Terns were observed foraging in fluviatile habitats. Colonies of northern Rough-winged Swallows and Bank Swallows nested in steep

cutbanks along several rivers. Belted Kingfishers were also frequently observed nesting in cutbanks along the major mainland rivers. Large cliffs lining many of the river valleys were used by nesting Common Ravens. In addition, Black Swifts were also observed visiting probable nest sites on cliffs with waterfalls. Large flocks of Common Mergansers were observed on fluviatile waters of the rivers, and Bald Eagles congregated at the mouths of rivers and along tributaries when salmon were present.

Alluvial habitats provided foraging and nesting resources primarily for seabirds and shorebirds. Frequent flooding events have created large alluvial plains along the major mainland rivers. Dry Bay at the Alsek River contains the largest amount of alluvial habitat. Nesting Parasitic Jaegers were observed in small numbers on the Dry Bay flats. Shorebirds observed nesting in alluvial habitats included the Semipalmated Plover, Killdeer, and Spotted Sandpiper. In addition, Common Nighthawks bred on sparsely vegetated alluvial bars at the major tributaries of the Chilkat River. Breeding colonies of >1000 Herring Gulls, Glaucous-winged Gulls, and Arctic Terns were recorded on islands at the major mainland rivers. Smaller breeding colonies of Mew Gulls, Arctic Terns, and Caspian Terns were also observed nesting on islands (appendix A-2). Species associated with tidal flats during the breeding season include the Great Blue Heron, Canada Goose, Bald Eagle, Mew Gull, and Bonaparte's Gull (appendix A-2). Although not extensively used during the breeding season, tidal flats are important stopover habitats for numerous species of waterfowl, seabirds, and shorebirds (e.g., Gibson 1984).

Discussion

Clearly, the major mainland rivers of southeastern Alaska support one of the most diverse assemblages of breeding birds in Alaska. Bird species richness appeared to be higher in riparian vegetation communities than upland vegetation. For example, Smith and others (1999) only recorded 63 breeding landbird species at 11 upland sites in southeastern Alaska, whereas I recorded 95 breeding landbirds at mainland rivers. Bird diversity was also higher in riparian cottonwood forests than any other vegetation type surveyed in southeastern Alaska, northern British Columbia (Willson and Comet 1996a), or south-central Alaska (Kessel 1998). The importance of the major mainland rivers to breeding birds may be attributed to several ecological factors including habitat heterogeneity, structural and compositional complexity of vegetation, high primary productivity, presence of surface water (Kessel 1998), and unique connectivity to other regional populations of birds.

Similar to riparian systems in arid environments (Brinson et al. 1981), the diversity and structural complexity of habitats in riparian areas in southeast Alaska contrasted markedly with the relative homogeneity of adjacent upland habitats, which in this study were dominated by spruce-hemlock forest. River processes in the region, in particular created novel habitats, such as deciduous plant communities and freshwater marshes, and a dynamic mosaic of vegetation patches characterized by unique interfaces between stream channel and riparian vegetation and between riparian and upland vegetation. These transition zones were particularly important habitats for birds in these river systems. For example, the ecotone between freshwater marsh and both riparian and

upland vegetation was one of the most diverse avian habitats I surveyed. This habitat edge provided an abundance of nesting and foraging resources for a wide group of birds including aerial foraging and predatory birds, and primary and secondary cavity-nesting species. Furthermore, aquatic habitats on mainland rivers provided water and associated resources for foraging waterfowl and piscivorous birds, moulting waterfowl, and nesting loons and grebes. The presence of surface water and adjacent marshland habitats, often associated with beaver marshes and ponds, was important in providing specialized foraging and nesting resources for Common Snipe, Common Yellowthroat, Northern Waterthrushes, Red-winged Blackbirds, Rusty Blackbirds, and Song Sparrows.

The linearity and connectivity of riparian zones allows for the migration and dispersal of flora and fauna at multiple spatial scales (Malanson 1993). Riparian vegetation may help connect patchy or fragmented habitats at the local scale within a watershed as well as facilitate the transfer of nutrients between aquatic and terrestrial habitats. At larger scales, the major mainland rivers may act as corridors for the movement and dispersal of species across otherwise ecological distinct regions. This is especially evident at the trans-mountain rivers where plant and bird species characteristic of the Canadian interior penetrate into and integrate with sister taxa in the coastal rainforests of southeast Alaska. The extension of interior plant communities into coastally influenced areas along these rivers in particular acts as a mechanism that allows for the invasion of Canadian boreal forest birds, such as Warbling Vireo, American Redstart, and Common Yellowthroat into the coastal zone. The scarcity of appropriate habitats, especially deciduous riparian vegetation, probably limit further dispersal in the region. In southeastern Alaska, the presence of Canadian interior species may be influenced by the

size of the river valley and the frequency of flooding which in turn influences the amount of deciduous riparian vegetation available for breeding (Willson and Comet 1996a,b).

Coastal mountains may act as movement barriers that divide bird communities in southeastern Alaska and Canadian interior into allopatric units. For example, several species that commonly breed in the Pacific rainforest, such as Blue Grouse, Red-breasted Sapsucker, Pacific-slope Flycatcher, Steller's Jay, and Townsend's Warbler, are rare or absent in the interior. Conversely, numerous common interior species are rare or absent along the coast, such as Dusky Flycatcher, Gray Jay, Mountain Chickadee, Tennessee Warbler, Purple Finch. Whether the coastal mountains limit the dispersal of birds from one region to the other directly by acting as a physical barrier, or indirectly by governing climatic differences (temperature and precipitation) that subsequently affect both the timing of breeding and the condition and availability of preferred habitat, is not yet known. Mainland rivers provide an obvious route for migration and dispersal. Species unique to mainland rivers are often more common inland in the Canadian Interior than further north or south along the coast.

The major mainland rivers occur from extreme south to north in southeastern Alaska, a distance covered by more than 800 km. The influence of latitude on the presence of bird species at the major mainland rivers is most apparent between the Alsek River and the other major mainland rivers. Several bird species commonly observed along the more southerly rivers were rare or absent at the Alsek River. Similarly, species recorded at the Alsek River that were more commonly observed north of the Alsek River region were not recorded at the other major mainland rivers suggests that this area may

be a transitional zone for several bird species (Andres and Browne 2003). However, the relatively low species richness and absence of species common to the other rivers may be due to the predominance of early-successional plant communities, resulting from the relatively recent glacial retreat along the Alsek River. Species that commonly occur in the Canadian interior forests, such as Warbling Vireo and Western Tanager, but are currently absent from the Alsek River may colonize the area once plant succession advances and creates more appropriate mature habitat conditions.

In general, riparian systems contain a fairly predictable set of feeding guilds (Brinson et al. 1981). Like riparian systems in other regions (Stevens et al. 1977), insectivores dominated the foraging guilds of birds along the rivers in southeastern Alaska. In a recent southeastern Alaska study, Willson and Comet (1996b) found that deciduous understory foliage and leaf litter supported a higher density of invertebrates in deciduous forests than in coniferous forests. This higher prey availability is thought to contribute to both higher bird species richness and abundance in deciduous compared to coniferous forests in southeastern Alaska and British Columbia (Willson and Comet 1996b).

The presence of large populations of anadromous fish distinguishes riparian areas in the coastal Pacific Northwest from those further inland. The arrival of spawning salmon to the rivers marks an influx of one of the most important food resources for a variety of animals (Willson and Halupka 1995) including numerous birds such as Bald Eagle, Osprey, Great Blue Heron, and several gull species. Eggs and juvenile salmon also provide an important food base for many birds such as loons, mergansers, terns, Belted Kingfishers, and American Dippers (Obermeyer et al. 1999, Obermeyer and Willson *in*

press). In addition to providing a direct food source, salmon introduce a pulse of marine-derived nutrients that enrich both freshwater and terrestrial food webs through the decomposition or the feces of salmon-eating mammals (Ben-David et al. 1998) and birds. This enrichment of these riparian systems results in increases in the abundance of aquatic and terrestrial invertebrates that in turn may result in relatively high densities of breeding birds near salmon streams compared to non-salmon streams in southeastern Alaska (Gende and Willson 2001).

Although much smaller than Pacific salmon, eulachon (*Thaleichthys pacificus*) also provides an important food source for birds at several major mainland rivers. At Berners Bay, for example, more than 46,000 avian predators composed primarily of gulls but also including 34 additional species of seabirds, shorebirds, waterfowl, and landbirds, were observed foraging on both live and dead eulachon (Marston et al. 2002). Eulachon are high in lipid content and provide an abundant, early spring food resource for birds that may be an important factor in determining the reproductive success of Bald Eagles (Phil Schempf, USFWS, pers. comm.) and potentially other species of piscivorous birds in the region.

Management Considerations

Due to high bird species richness, uniqueness of breeding bird communities, and presence of habitat types uncommon in the region, major mainland rivers of southeastern Alaska are regarded as regionally significant to bird populations by biologists, conservationists, land managers alike. Although these rivers are currently governed by natural processes, few have protective status and therefore face increasing threats by

human activities such as road-building, mining, timber harvest, and urban development. Such activities could drastically alter or destroy riparian habitat quality and their value to a unique avifauna. Major road developments in southeastern Alaska are proposed for the Stikine River valley and Lynn Canal. The later project would connect the cities of Skagway and Juneau and thereby affect bird populations along the Katzehin and Antler Rivers directly through losses of habitat. More importantly, the indirect effects of road developments will likely have much larger and lasting effects on avian communities by changing patterns of hydrology and by opening these systems to urban development, timber harvest, mining, oil and gas exploration, hydro-electric development, and pollution.

Any plans that would drastically affect the quality and quantity of habitats within the major mainland river valleys should take into account the that these rivers not only provide unique and valuable habitat to birds during the breeding season but also provide critical staging and stopover areas for birds during migration. For example, species richness of riparian zones is increased dramatically through the transient use of these habitats by migrating birds (Brinson et al. 1981). Riparian zones may attract 10 times the number of migrating birds found in adjacent upland sites during spring migration (Stevens et al. 1977) and 14 times the number of species recorded in upland sites during fall migration (Hehnke and Stone 1979). Although information on bird use of the major mainland rivers during migration is scarce, existing information indicates that major mainland rivers provide important habitat for a large number of migrating birds, particularly for waterbirds and shorebirds. During September, Gibson (1984) recorded 164 species of landbirds, seabirds, shorebirds, and waterfowl at the Stikine River. Less is

known about use of riparian habitats by migrant landbirds, but our casual observations suggest that coniferous-breeding birds, such as Townsend's Warbler, may rely on deciduous fringes of riparian areas as sites for staging or stopover during autumn migration in August.

Several species of regional concern use the major mainland rivers in southeast Alaska and thereby warrant conservation consideration by managers of these river systems. Boreal Partners in Flight (1999) has listed several species associated with the major mainland rivers as priority species of conservation concern due to small and restricted populations. This includes Black and Vaux's Swift, Western Wood-pewee, Hammond's Flycatcher, and MacGillivray's Warbler. Additionally, Vancouver Goose, Queen Charlotte Goshawk, Bald Eagle, Red-breasted Sapsucker, Hairy Woodpecker, and Brown Creeper have been selected in the Tongass National Forest Land and Resource Management Plan (1997) as management indicator species. All of these species are important in assessing the integrity of ecosystems in southeast Alaska and have been recorded at the major mainland rivers in varying degrees of abundance.

Conservation strategies for riparian areas should incorporate monitoring bird populations in relation to changing land use. Because the majority of major mainland rivers either originate in Canada or provide direct connectivity between southeastern Alaska and the Canadian interior, international cooperation may be needed to address conservation issues for these ecosystems. Riparian areas contain unique ecological communities that are sensitive to both human and natural disturbances. Any periodic assessment of the status of bird populations or response to habitat alteration will require designs that address the complex mosaic of habitats and the unique and diverse

assemblages of bird taxa along these mainland river systems. Further knowledge of the magnitude of use of riverine tidal flats by migrating birds is desirable.

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Table 2-1. Location and features of major mainland trans-mountain (TM) and coastal (C) rivers in southeastern Alaska, listed from north to south.

River	Latitude, longitude	Type	Length (km) Alaska/total	Major habitats[1]	Unique features
Alsek	59°40′N, 138°37′W	TM	70/225	CF,DF,DS,FM,AI,TF	Vast alluvial habitats; predominately early successional vegetation; several lakes and rivers, large lake; several glaciers
Taiya	59°28′N, 135°20′W	C	22/28	CF,MF,DF,DS,FM,TF	In rain shadow of coastal mountains; relatively small amount of deciduous vegetation and freshwater marsh
Chilkat	59°12′N, 135°28′W	C	75/89	DF,DS,FM,AI,PD	In rain shadow of coastal mountains; broad, braided river; Klehini River tributary; several lakes and freshwater marshes
Katzehin	59°11′N, 135°17′W	C	18/18	CF,DF,DS,AI	Cold and windy valley due to proximity to Meade Glacier; relatively small amount of deciduous vegetation and freshwater marsh

River	Latitude, longitude	Type	Length (km) Alaska/total	Major habitats[1]	Unique features
Antler	58°48′N, 134°57′W	C	23/23	CF,DF,DS,FM,EM	Flows into Berner's Bay; extensive estuarine meadow and freshwater marsh; Gilkey River tributary
Taku	58°25′N, 133°58′W	TM	40/128*	CF,DF,FM,EM,AI,LK	Numerous glaciers; relatively large amount of coniferous and mixed forest; several large tributaries, lakes, and extensive freshwater marsh
Whiting	57°57′N, 133°52′W	C	40/70	CF,DF,DS,FM,AI	Extremely braided, fast-flowing river; extensive mid-successional deciduous forest; large lake
Stikine	56°33′N, 133°58′W	TM	45/650	DF,DS,FM,LK	Extensive tidal flats and estuarine meadow; numerous large lakes and freshwater marshes;
Unuk	56°04′N, 131°04′W	C	40/110	CF,MF,DS,FM,EM,AI	Dynamic, frequent flood events; several tributaries and lakes;

River	Latitude, longitude	Type	Length (km) Alaska/total	Major habitats[1]	Unique features
Chickamin	55°49′N, 130°55′W	C	60/60	CF,MF,FM,EM,LK,PD	Extensive freshwater marsh; Leduc River tributary
Salmon	55°54′N, 130°01′W	C	20/30	CF,DF,FM,EM	Southernmost mainland river

[1] CF = coniferous forest, MF = mixed forest, DF = deciduous forest, DS = deciduous shrubland, EM = estuarine meadow, FM = freshwater marsh, LK = lake, PD = pond, AI = alluvial bars and islands, and TF = tidal flats. * total length of Taku includes Nakina River to Nakina village

Table 2-2. Effort on past and present studies of the breeding bird communities of the major mainland rivers.

River	Study	Year	Date	No. species
Alsek	Johnson et al. (unpub.)	2001	22 Jun - 9 Jul	72
Chilkat	Jewett (1942)	1942	23-24 Jul	23
	Gibson and MacDonald (1975)	1974	5,10 Aug	27
	Johnson et al. (unpub.)	2000	18 Jun - 8 Jul	77
Taiya	Gibson and MacDonald (1975)	1974	5, 9 Aug	39
	Johnson et al. (unpub.)	2002	4-13 July	54
Katzehin	Johnson et al. (unpub.)	2002	24 Jun - 1 Jul	44
Antler	Johnson et al. (unpub.)	2002	13 Jun - 21 Jun	69
Taku	Bailey (1927)	1927	27-28 Jun, 4 Jul	6
	Gibson and MacDonald (1975)	1974	27 Jul - 1 Aug	67
	Johnson et al. (unpub.)	2000	26 May - 5 Jun	78
Whiting	Johnson et al. (unpub.)	2002	1-10 Jun	65
Stikine	Webster (1950)	1945	8-10 Jun, 5-7 Jul, 5-6 Aug	18
	Gibson and MacDonald (1975)	1974	13-21 Jul	68
	Johnson et al. (unpub.)	2000	6-15 Jun, 26 Jul - 5Aug	67

River	Study	Year	Date	No. species
Unuk	Gibson and MacDonald (1975)	1974	23 Jun - 1 Jul	58
	Schantz (unpub.)	1997	4 Jun - 28 Aug	26
	Johnson et al. (unpub.)	2001	28 May - 7 Jun, 28 Jul - 10 Aug	66
Chickamin	Swarth (1911)	1909	17-28 June	38
	MacDonald and MacDonald (1975)	1973-74	15 May - 15 Aug, 15-22 May	114
	Schantz (unpub.)	1996	3 Jun - 29 Aug	45
	Johnson et al. (unpub.)	2001	7-18 Jun, 15-27 Jul	77
Salmon	Gibson and MacDonald (1975)	1974	4-9 Jul	66
	Gibson (1986)	1986	10-20 Jun	72

Table 2-3. Evidence used to determine breeding status of birds encountered in riparian areas of southeastern Alaska (based on North American Ornithological Atlas Committee 1990).

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 chases 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 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).

Status	Description
Confirmed	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.

Table 2-4. Abundance, distribution, and status of bird species and their use of southeastern Alaska's major mainland rivers during the breeding season, 1911-2002.

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Red-throated Loon	uncommon	45	PR	B	FW/LW	ground	aquatic	piscivore
Pacific Loon	rare	18	V	B	FW	n/a[6]	aquatic	piscivore
Common Loon	uncommon	45	PR	B	LW	ground	aquatic	piscivore
Pied-billed Grebe	rare	9	V	A	FM	n/a	aquatic	insectivore
Horned Grebe	rare	9	V	B	FM	n/a	aquatic	insectivore
Red-necked Grebe	rare	9	V	B	FW	n/a	aquatic	insectivore
American Bittern[6]	rare	27	PR	A	FM	shrub	aquatic	piscivore
Great Blue Heron	uncommon	45	PR	B	FW	tree	aquatic	piscivore
Snow Goose	uncommon	9	V	B	FW	n/a	ground	herbivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Canada Goose	uncommon	91	C	R	FM/FW/LW/TF	ground	ground	herbivore
Brant	rare	18	V	B	LW	n/a	ground	herbivore
Trumpeter Swan	uncommon	45	C	R	FM/LW/FW	ground	aquatic	herbivore
Wood Duck[6]	rare	18	PR	B	FW	cavity	aquatic	insectivore
Gadwall	rare	9	V	B	LW	n/a	aquatic	herbivore
Eurasian Wigeon	rare	9	V	B	FW	n/a	aquatic	herbivore
American Wigeon	rare	54	C	B	FM/FW/LW	ground	aquatic	herbivore
Mallard	fairly common	100	C	R	FM/LM/FW	ground	aquatic	herbivore
Blue-winged Teal	uncommon	45	PR	A	FM/FW/LW	ground	aquatic	herbivore
Northern Shoveler	rare	54	C	B	FM/FW	ground	aquatic	herbivore
Northern Pintail	rare	36	C	B	LW	ground	aquatic	herbivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Green-winged Teal	uncommon	82	C	A	FM/FW	ground	aquatic	herbivore
Ring-necked Duck	uncommon	45	C	A	FM/FW	ground	aquatic	herbivore
Greater Scaup	rare	9	V	B	FW	n/a	aquatic	insectivore
Lesser Scaup	rare	9	PR	A	FW	ground	aquatic	insectivore
Harlequin Duck	uncommon	63	C	R	FW	ground	aquatic	insectivore
Surf Scoter	uncommon	54	V	B	FW	n/a	aquatic	molluscivore
White-winged Scoter	uncommon	18	V	B	FW	n/a	aquatic	molluscivore
Black Scoter	uncommon	9	V	B	FW	n/a	aquatic	molluscivore
Long-tailed Duck	rare	9	V	B	FW	n/a	aquatic	insectivore
Common Goldeneye	uncommon	54	C	R	FW	cavity	aquatic	insectivore
Barrow's Goldeneye	uncommon	36	PR	B	FW	cavity	aquatic	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Hooded Merganser[6]	uncommon	64	C	R	FW/FM	cavity	aquatic	piscivore
Common Merganser	common	100	C	R	FW/FM	cavity/ground	aquatic	piscivore
Red-breasted Merganser	uncommon	9	PO	A	FW	ground	aquatic	piscivore
Osprey	rare	36	PR	A	FW/LW	tree	aerial	piscivore
Bald Eagle	common	100	C	R	CF/DF/FW/TF	tree	aerial	piscivore
Steller's Sea Eagle	rare	9	V	?	FW	n/a	aerial	piscivore
Northern Harrier	rare	27	PO	A	EM	ground	aerial	carnivore
Sharp-shinned Hawk	uncommon	45	PR	A	MF/DS	tree	aerial	carnivore
Northern Goshawk	rare	27	C	B	CF	tree	aerial	carnivore
Red-tailed Hawk	uncommon	82	C	A	CF	tree/cliff	aerial	carnivore
Golden Eagle	rare	9	V	B	?	n/a	aerial	carnivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
American Kestrel	rare	27	C	A	FM/DF	cavity	aerial	insectivore
Merlin	uncommon	63	C	A	CF/FM	tree	aerial	carnivore
Peregrine Falcon	rare	9	V	A	FW	n/a	aerial	carnivore
Ruffed Grouse[6]	uncommon	27	C	R	DS	ground	ground	omnivore
Spruce Grouse	uncommon	9	C	R	CF/MF	ground	ground	herbivore
Blue Grouse	fairly common	91	C	R	CF	ground	ground	herbivore
Virginia Rail	rare	9	V	A	FM	n/a	ground	insectivore
Sora[6]	rare	18	PR	A	FM	ground	ground	insectivore
American Golden Plover	rare	9	V	A	TF	n/a	ground	insectivore
Semipalmated Plover	uncommon	63	C	A	FW/AI	ground	ground	insectivore
Killdeer	rare	45	C	A	FW/AI	ground	ground	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Greater Yellowlegs	uncommon	36	C	A	FM	ground	ground	insectivore
Lesser Yellowlegs	rare	36	C	A	FM	ground	ground	insectivore
Solitary Sandpiper	rare	45	PR	A	FM/DS	tree	ground	insectivore
Spotted Sandpiper	common	100	C	A	FW	ground	ground	insectivore
Upland Sandpiper	rare	9	V	A	EM	n/a	ground	insectivore
Whimbrel	rare	18	V	A	FW	n/a	ground	insectivore
Hudsonian Godwit	rare	9	V	A	FW	n/a	ground	insectivore
Marbled Godwit	rare	9	V	A	TF	n/a	ground	insectivore
Black Turnstone	rare	9	V	B	FW	n/a	ground	insectivore
Semipalmated Sandpiper	uncommon	27	V	A	FW/TF	n/a	ground	insectivore
Western Sandpiper	uncommon	18	V	A	FW/TF	n/a	ground	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Least Sandpiper	uncommon	73	C	A	FW/AI	ground	ground	insectivore
Pectoral Sandpiper	rare	27	V	A	FM	n/a	ground	insectivore
Dunlin	rare	9	V	A	TF	n/a	ground	insectivore
Short-billed Dowitcher	rare	27	PR	A	EM	ground	ground	insectivore
Common Snipe	uncommon	54	C	A	FM	ground	ground	insectivore
Red-necked Phalarope	rare	18	V	A	LW	n/a	aquatic	insectivore
Parasitic Jaeger	uncommon	36	C	B	FW/AI	ground	aerial	carnivore
Bonaparte's Gull	uncommon	64	V	B	FW	n/a	ground	insectivore
Mew Gull	common	100	C	R	FW/LW/AI	ground	ground	omnivore
Herring Gull	uncommon	73	C	R	FW/LW/AI	ground	ground	omnivore
Glaucous-winged Gull	uncommon	36	C	R	FW/AI	ground	ground	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Black-legged Kittiwake	uncommon	18	V	B	FW	n/a	aquatic	piscivore
Caspian Tern[6]	rare	18	C	A	FW/LW/AI	ground	aquatic	piscivore
Arctic Tern	uncommon	100	C	B	FW/LW/AI	ground	aquatic	piscivore
Aleutian Tern	uncommon	9	C	B	FW/LW/DS/AI	ground	aquatic	piscivore
Marbled Murrelet	uncommon	18	PR	B	CF/LW	tree	aquatic	piscivore
Band-tailed Pigeon	rare	36	PR	A	CF/DF	tree	ground	granivore
Mourning Dove	rare	9	V	A	EM	n/a	ground	granivore
Western Screech-Owl	rare	9	PR	R	CF	cavity	aerial	carnivore
Great Horned Owl	uncommon	27	PR	R	CF/MF/DF	tree/cliff	aerial	carnivore
Northern Hawk Owl	rare	18	PO	R	DS	cavity/tree	aerial	carnivore
Northern Pygmy Owl	uncommon	36	PR	R	CF	cavity	aerial	carnivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Barred Owl	rare	18	PR	R	CF	cavity	aerial	carnivore
Short-eared Owl	rare	18	C	A	DS	ground	aerial	carnivore
Northern Saw-whet Owl	uncommon	36	C	R	CF/MF	cavity	aerial	carnivore
Common Nighthawk[6]	rare	9	C	A	DS/AI	ground	aerial	insectivore
Black Swift	uncommon	45	PR	A	LW/FW	cliff	aerial	insectivore
Vaux's Swift	uncommon	82	C	A	DF/FM	cavity	aerial	insectivore
Rufous Hummingbird	fairly common	100	C	A	CF/MF/DF/DS	tree	foliage	insectivore
Belted Kingfisher	uncommon	100	C	A	FW	bank	aquatic	piscivore
Red-breasted Sapsucker	fairly common	91	C	B	MF/DS	cavity	bark	insectivore
Downy Woodpecker	uncommon	64	C	R	DF/DS	cavity	bark	insectivore
Hairy Woodpecker	fairly common	100	C	R	CF/MF	cavity	bark	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Three-toed Woodpecker	rare	27	C	R	CF	cavity	bark	insectivore
Northern Flicker	uncommon	72	C	B	CF/MF	cavity	ground	insectivore
Olive-sided Flycatcher	uncommon	54	PR	A	MF/FM	tree	aerial	insectivore
Western Wood-Pewee	uncommon	82	C	A	DF	tree	aerial	insectivore
Alder Flycatcher	fairly common	82	C	A	DS	shrub	aerial	insectivore
Willow Flycatcher[6]	rare	18	PO	A	DS	shrub	aerial	insectivore
Least Flycatcher[6]	rare	36	PR	A	DF	tree	aerial	insectivore
Hammond's Flycatcher	fairly common	91	C	A	DF/MF	tree	aerial	insectivore
Pacific-slope Flycatcher	fairly common	100	C	A	CF/MF	tree	aerial	insectivore
Eastern Phoebe	rare	9	V	A	DS	n/a	aerial	insectivore
Say's Phoebe	rare	9	V	A	DS	n/a	aerial	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Western Kingbird	rare	9	V	A	DS	n/a	Aerial	Insectivore
Eastern Kingbird	rare	27	V	A	DS/FM	n/a	aerial	insectivore
Cassin's Vireo[6]	rare	54	PR	A	MF	tree	foliage	insectivore
Warbling Vireo[6]	fairly common	91	C	A	DF/DS	tree	foliage	insectivore
Red-eyed Vireo[6]	rare	27	PR	A	DS	shrub	foliage	insectivore
Steller's Jay	uncommon	100	C	R	CF/MF	tree	ground	omnivore
Black-billed Magpie	rare	18	C	R	DS	tree/shrub	ground	omnivore
American Crow[6]	rare	18	C	B	CF/TF	tree	ground	omnivore
Northwestern Crow	uncommon	73	PR	R	TF/CF	tree	ground	omnivore
Common Raven	uncommon	91	C	R	CF/TF	cliff/tree	ground	omnivore
Tree Swallow	common	100	C	A	FM/FW	cavity	aerial	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Violet-green Swallow	uncommon	64	C	A	FM/FW	cavity	aerial	insectivore
N. Rough-winged Swallow	rare	45	C	A	FW	bank	aerial	insectivore
Bank Swallow	uncommon	45	C	A	FW	bank	aerial	insectivore
Cliff Swallow	rare	18	C	A	FW	cliff/building	aerial	insectivore
Barn Swallow	fairly common	91	C	A	FM/FW	building	aerial	insectivore
Black-capped Chickadee[6]	uncommon	36	C	R	DS	cavity	foliage	insectivore
Chestnut-backed Chickadee	common	100	C	R	CF	cavity	foliage	insectivore
Red-breasted Nuthatch	uncommon	54	PR	R	CF	cavity	bark	insectivore
Brown Creeper	uncommon	73	C	R	CF	tree	bark	insectivore
Winter Wren	common	100	C	B	CF/MF	ground	ground	insectivore
American Dipper	uncommon	64	C	R	FW	bank	aquatic	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Golden-crowned Kinglet	fairly common	100	C	R	CF	tree	foliage	insectivore
Ruby-crowned Kinglet	common	100	C	A	MF/CF	tree	foliage	insectivore
Gray-cheeked Thrush	uncommon	54	C	A	DS	shrub	ground	insectivore
Swainson's Thrush	fairly common	91	C	A	DS/MF	shrub	ground	insectivore
Hermit Thrush	fairly common	100	C	A	MF/CF	ground	ground	insectivore
American Robin	common	100	C	A	DF/MF	tree	ground	insectivore
Varied Thrush	common	100	C	B	CF/DF	tree	ground	insectivore
European Starling	rare	45	C	R	EM	snag	ground	insectivore
American Pipit	rare	27	V	A	FS/AI	n/a	ground	insectivore
Bohemian Waxwing	rare	36	PR	B	CF	tree	foliage	insectivore
Cedar Waxwing	uncommon	64	C	A	MF	tree	foliage	herbivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Tennessee Warbler	rare	36	C	A	MF	ground	foliage	insectivore
Orange-crowned Warbler	common	100	C	A	DS	ground	foliage	insectivore
Yellow Warbler	common	100	C	A	DS/DF	shrub	foliage	insectivore
Magnolia Warbler	rare	45	C	A	MF/CF	tree/ground	foliage	insectivore
Yellow-rumped Warbler	fairly common	100	C	A	MF	tree	foliage	insectivore
Townsend's Warbler	fairly common	100	C	A	CF	tree	foliage	insectivore
Blackpoll Warbler	rare	18	PO	A	DS	tree/ground	foliage	insectivore
Black-and-White Warbler	rare	9	PR	A	DS	ground	bark	insectivore
American Redstart[6]	fairly common	91	C	A	DS/DF	tree	foliage	insectivore
Northern Waterthrush	uncommon	91	C	A	FM/DS/DF	ground	ground	insectivore
MacGillivray's Warbler	uncommon	54	C	A	DS	shrub	ground	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Common Yellowthroat	fairly common	82	C	A	FM	shrub	foliage	insectivore
Wilson's Warbler	fairly common	100	C	A	CF	ground	foliage	insectivore
Western Tanager[6]	uncommon	82	PR	A	MF	tree	foliage	insectivore
Chipping Sparrow[6]	rare	64	C	A	DS	tree	ground	insectivore
Savannah Sparrow	uncommon	100	C	A	EM	ground	ground	insectivore
Fox Sparrow	fairly common	73	C	R	DS	ground	ground	insectivore
Song Sparrow	fairly common	82	C	R	DS/FM	ground	ground	insectivore
Lincoln's Sparrow	fairly common	100	C	A	EM	ground	ground	insectivore
Golden-crowned Sparrow	rare	18	PR	B	DS	ground	ground	insectivore
Dark-eyed Junco	fairly common	91	C	B	CF	ground	ground	granivore
Red-winged Blackbird	uncommon	64	C	A	FM	ground/shrub	ground	insectivore

Species	Regional abundance[1]	% of Rivers (n=11)	Breeding status[2]	Migratory status[3]	Primary habitat[4]	Guilds[5]		
						nest location	foraging habitat	foraging behavior
Rusty Blackbird	uncommon	64	C	B	FM	tree/shrub	ground	insectivore
Brown-headed Cowbird	rare	27	C	A	EM	parasite	ground	insectivore
Pine Grosbeak	uncommon	54	C	R	CF	tree	foliage	granivore
Red Crossbill	fairly common	54	PR	R	CF	tree	foliage	granivore
White-winged Crossbill	uncommon	45	PR	R	CF	tree	foliage	granivore
Common Redpoll	uncommon	9	PR	R	DS	ground/shrub	foliage	granivore
Pine Siskin	common	91	PR	R	DS	tree	foliage	granivore

[1]Based on Gibson and MacDonald (1975), MacDonald and MacDonald (1975), Kessel and Gibson (1979), and the authors. [2]C = confirmed, PR = probable, PO = possible, V = visitant. [3]A = nearctic-neotropical, B = nearctic-nearctic, R = resident. [4]CF = coniferous forest, MF = mixed forest, DF = deciduous forest, DS = deciduous shrubland, EM = estuarine meadow, FM = freshwater marsh, LK = lake, PD = pond, AI = alluvial bars and islands, and TF = tidal flats. [5]Based on Ehrlich et al. 1988 and the authors. [6]Species with ranges in southeastern Alaska primarily restricted to the major mainland rivers.

Table 2-5. Total number of species, number of species known or suspected to breed, percentage of visitants and vagrants, and effort (days) recorded at each mainland river in southeastern Alaska by all studies, 1911-2002.

River	No. species recorded	No. breeding species	% visitants or vagrants	No. of survey days
Alsek[1]	72	63	12.5	18
Chilkat	123	105	15.0	25
Taiya	54	54	5.0	12
Katzehin	44	44	0	8
Antler	68	67	1.5	8
Taku[1]	100	92	8.0	19
Whiting	67	65	3.0	10
Stikine[1]	96	87	9.5	37
Unuk	90	85	5.5	119
Chickamin	126	109	13.5	225
Salmon	83	81	2.0	17
Mean	84.2	77.5	6.9	45.3
CV(%)[2]	31	26.6	75	149

[1] = trans-mountain rivers; [2] = coefficient of variation calculated as the standard deviation divided by sample mean (Zar 1999).

Table 2-6. Sorensen similarity matrix comparing bird community composition among major mainland rivers of southeastern Alaska, 1911-2002.

	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Alsek	1.00										
Chilkat	0.59	1.00									
Taiya	0.63	0.64	1.00								
Katzehin	0.55	0.57	0.77	1.00							
Antler	0.56	0.75	0.73	0.77	1.00						
Taku	0.63	0.84	0.70	0.64	0.73	1.00					
Whiting	0.54	0.69	0.74	0.73	0.82	0.74	1.00				
Stikine	0.58	0.80	0.65	0.63	0.75	0.77	0.75	1.00			
Unuk	0.60	0.78	0.68	0.66	0.76	0.84	0.78	0.81	1.00		
Chickamin	0.57	0.89	0.63	0.57	0.73	0.82	0.69	0.80	0.82	1.00	
Salmon	0.52	0.76	0.71	0.62	0.70	0.78	0.78	0.81	0.80	0.79	1.00

Table 2-7. Occurrence of species common to the Canadian interior and primarily restricted to the major mainland rivers of southeastern Alaska that are known or suspected to breed at the major mainland rivers of southeastern Alaska based on all known studies from 1911 to 2002.

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon	Coastal	Trans-mountain
American Bittern		•						•		•		•	•
Hooded Merganser		•			•	•	•	•		•	•	•	•
Ruffed Grouse						•		•			•	•	•
Sora		•								•		•	
Common Nighthawk		•										•	
Willow Flycatcher								•			•	•	•
Least Flycatcher		•						•		•	•	•	•
Cassin's Vireo		•				•	•		•	•	•	•	•
Warbling Vireo		•	•	•	•	•	•	•	•	•	•	•	•
Red-eyed Vireo								•	•	•		•	•
Black-capped Chickadee	•	•				•		•				•	•
American Redstart		•	•	•	•	•	•	•	•	•	•	•	•
Common Yellowthroat		•		•	•	•	•	•	•	•	•	•	•
Chipping Sparrow		•				•	•	•	•	•	•	•	•
Western Tanager		•	•		•	•	•	•	•	•	•	•	•

Table 2-8. Habitat use by bird species breeding at major mainland rivers of southeastern Alaska.

River	No. species Recorded	No. (%) of species breeding	No. (%) of breeding species	
			migrants	Residents
Coniferous forest	50	42 (83)	24 (58)	18 (42)
Mixed forest	49	46 (94)	31 (67)	15 (33)
Deciduous forest	40	35 (88)	26 (73)	9 (27)
Deciduous shrubland	43	21 (48)	16 (78)	5 (22)
Estuarine meadow	20	8 (40)	6 (75)	2 (25)
Freshwater marsh	36	27 (75)	24 (89)	3 (11)
Lacustrine waters/shoreline	35	6 (17)	4 (74)	2 (26)
Fluviatile waters/shoreline	64	15 (23)	12 (80)	3 (20)
Alluvial bars	28	11 (39)	8 (75)	3 (25)
Tidal flats	18	0	0	0

Table 2-9. Nest guilds of bird species breeding at major mainland rivers of southeastern Alaska.

River	No. breeding species	% breeding species						
		GRN[1]	BNK	SHR	TRE	SNG	WAT	OTH
Alsek	63	57	0	3	21	14	0	4
Chilkat	105	29.5	1	7	36.5	17	3	6
Taiya	54	37	2	4	37	16	0	4
Katzehin	44	39	2	9	36	14	0	0
Antler	67	36	1.5	7	34	12	3	6
Taku	92	32	2	8	40	15	1	2
Whiting	65	31	1.5	6	36	17	3	6
Stikine	87	34	1	10	35	13	1	6
Unuk	85	31.5	2	9	38.5	14	0	4
Chickamin	109	31	3	7	35	16	3	5
Salmon	81	28	4	9	40	15	0	4

[1] GRN = ground, BNK = bank, SHR = shrub, TRE = tree, SNG = snag, WAT = water, OTH = other (includes rock, cliff, building, and parasitic).

Table 2-10. Foraging substrate guilds of bird species breeding at major mainland rivers of southeastern Alaska.

River	No. breeding species	% of breeding species					
		GRN[1]	FOL	BRK	AQU	AIR	PRD
Alsek	63	32	19	5	29	6	9
Chilkat	105	30	23	6	19	11	9
Taiya	54	37	29	8	12	10	4
Katzehin	44	39	30	4	14	11	2
Antler	67	33	22	3	26	12	5
Taku	92	30	27	6	17	13	7
Whiting	65	30	23	6	23	13	5
Stikine	87	28	29	5	18	13	7
Unuk	85	29	24	6	19	12	10
Chickamin	109	29	23	5	20	11	12
Salmon	81	30	31	5	13	16	5

[1] GRN = ground foragers, FOL = foliage foragers, BRK = bark foragers, AQU = aquatic foragers, AIR = aerial foragers, PRD = predatory foragers

Table 2-11. Diet guilds of bird species breeding at major mainland rivers of southeastern Alaska.

River	No. breeding species	% breeding species							
		AI[1]	TI	PI	CA	OM	VE	GR	NE
Alsek	63	8	46	14	8	8	10	5	1
Chilkat	105	4	56	10	6	6	11	6	1
Taiya	54	4	62	8	2	6	8	8	2
Katzehin	44	5	61	11		9	9	2.5	2.5
Antler	67	3	54	13	3	8	15	3	1
Taku	92	4	59	8	6	7	9	6	1
Whiting	65	8	58	12.5	3	5	9	3	1.5
Stikine	87	7	58	9	4	7	8	6	1
Unuk	85	6	57	8	8	6	9	5	1
Chickamin	109	7	54	9	9	5	9	6	1
Salmon	81	4	67	7.5	2.5	6	6	6	1

[1] AI = Aquatic invertebrates, TI = terrestrial invertebrates, PI = fish, CA = birds and rodents, OM = omnivorous, VE = vegetation, foliage, GR = seeds, NE = nectar

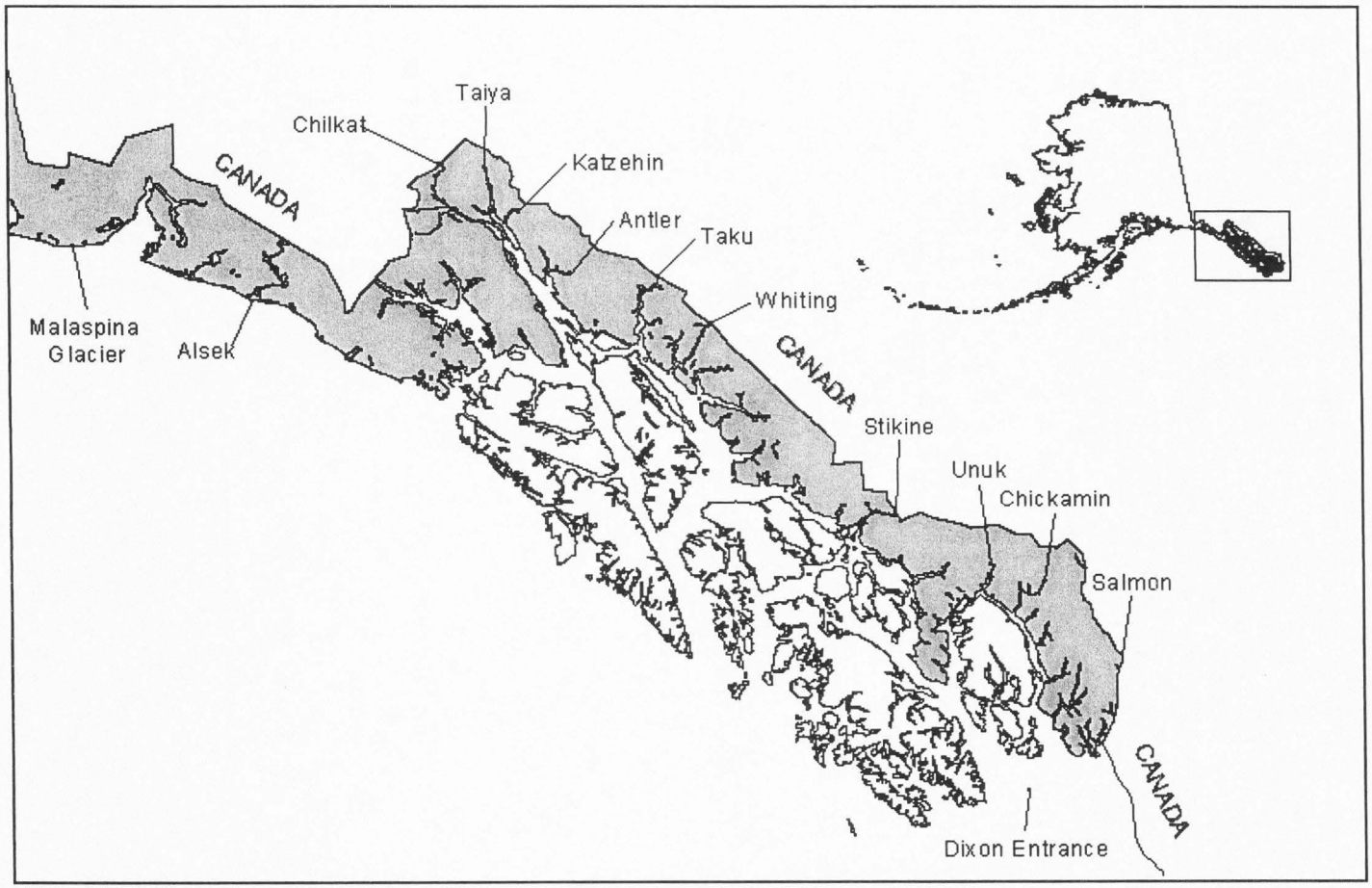

Fig. 2-1. Map of southeastern Alaska showing the locations of the 11 major mainland rivers described in this report. Shaded area denotes mainland.

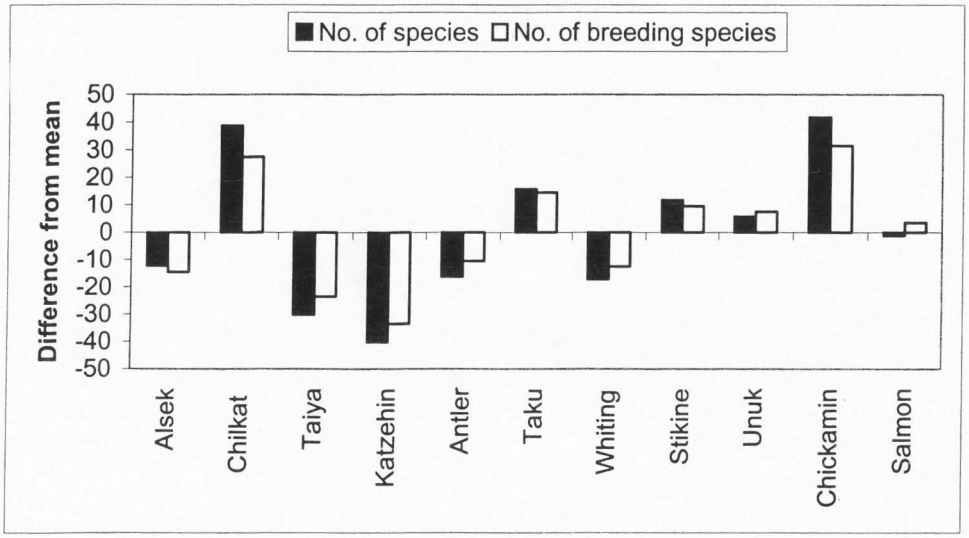

Fig. 2-2. Difference of number of total bird species and number of breeding bird species from mean at major mainland rivers of southeastern Alaska.

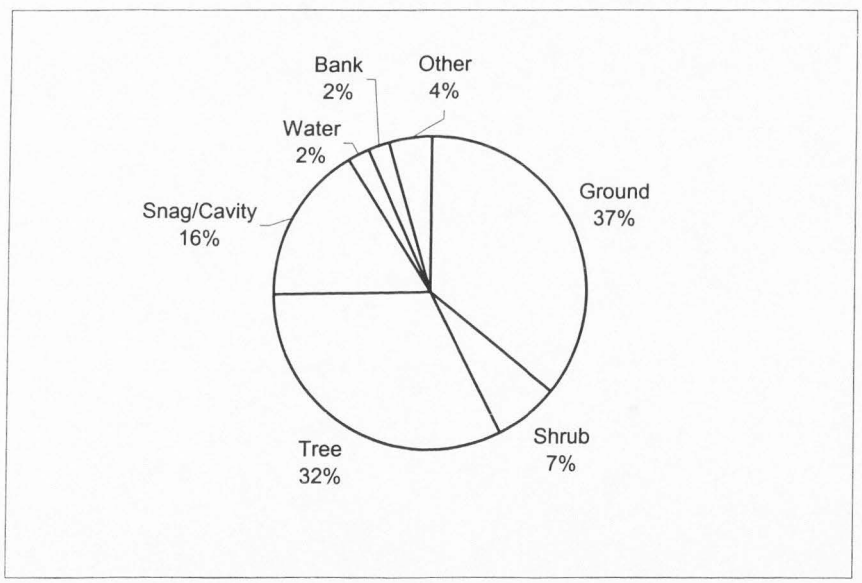

Fig. 2-3. Proportion of breeding birds of southeastern Alaska's major mainland rivers belonging to primary nest guilds.

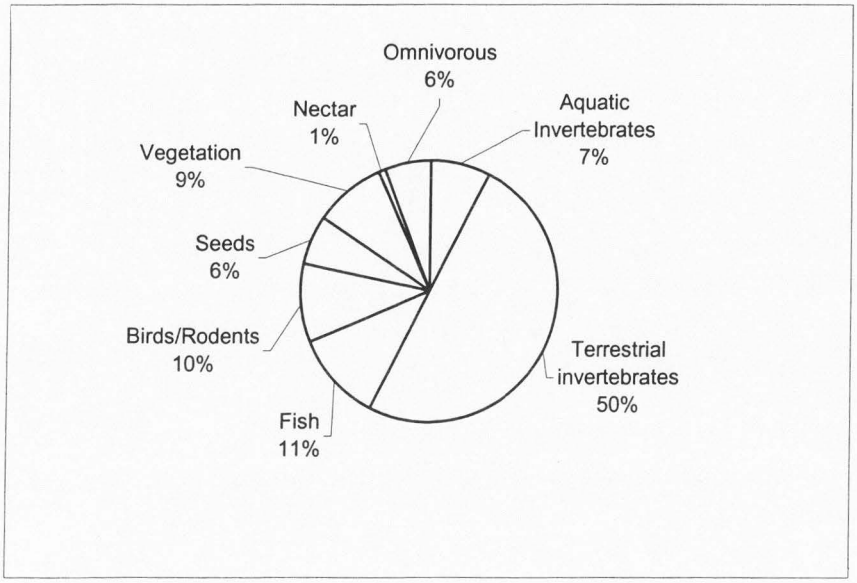

Fig. 2-4. Proportion of breeding birds of southeastern Alaska's major mainland rivers belonging to primary diet guilds.

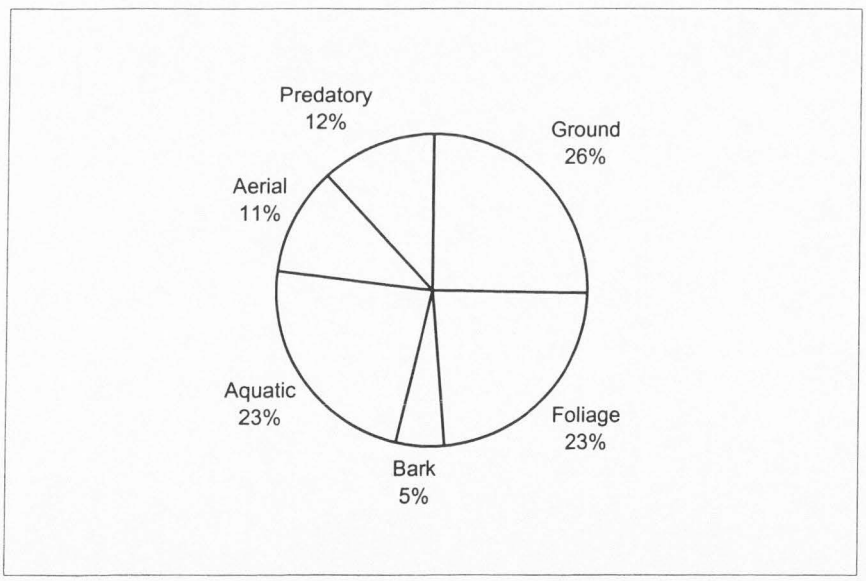

Fig. 2-5. Proportion of breeding birds of southeastern Alaska's major mainland rivers belonging to primary foraging guilds.

CHAPTER 3

DIFFERENCES IN BIRD COMMUNITY COMPOSITION AMONG MAJOR MAINLAND RIVERS OF SOUTHEASTERN ALASKA

Introduction

Riparian zones are functionally dominant features of a landscape that contain and connect habitats at multiple spatial scales (Malanson 1993). Because of the unique and important role that they play on a landscape, riparian zones have been referred to as the "aorta of an ecosystem" (Wilson 1979: 82). This is especially true in the arid western U.S., where numerous studies have shown that riparian zones support a disproportionately high number of wildlife species relative to drier upland habitats (see Brinson et al. 1981 and Knopf et al. 1988 for overview). Although information describing bird use of riparian areas is abundant for the contiguous U.S., information on the breeding bird communities of riparian zones of southeastern Alaska is almost totally lacking. This study represents the only quantitative research that has focused on the bird communities of major mainland rivers of southeastern Alaska.

The major mainland rivers of southeastern Alaska are interspersed throughout the region, representing a latitudinal gradient from 59°40′ to 55°49′ and a distance of approximately 650 km (Fig. 3-1). These rivers can be separated into two distinct classes: trans-mountain and coastal. Trans-mountain rivers are the largest riparian systems in the region. Transecting the steep coastal mountains, they provide a continuous corridor for the movement and dispersal of flora and fauna between the ecologically distinct regions

of coastal southeastern Alaska and the Canadian interior. Coastal rivers are also large riparian systems; however, these watersheds occur entirely on the seaward side of the Coast Range mountains. Although coastal rivers do not provide direct connectivity between southeastern Alaska and the Canadian interior, they may be indirectly connected to the interior by major tributaries, their proximity to trans-mountain rivers, or their location at the end of long inlets that penetrate the mainland. Both trans-mountain and coastal rivers are shaped by dynamic biological and physical processes that form a mosaic of habitats, including the majority of the region's cottonwood (*Populus trichocarpa*) forest and willow (*Salix* spp.) shrublands.

Even though the major mainland rivers and their associated riparian habitats comprise a relatively small area of southeastern Alaska, they support a disproportionately large number of bird species known or suspected to breed within the region (see chapter 2). Because of the lack of demographic information and negative population trends in other portions of their ranges, several species that regularly occur at major mainland rivers have been listed as species of management concern. In addition, the major mainland rivers support a suite of bird species that are more common to the Canadian interior and whose distribution in southeastern Alaska is primarily restricted to these rivers.

The main emphasis of this study was to provide quantitative baseline data for breeding birds using major deciduous riparian vegetation types at six major mainland rivers of southeastern Alaska. Our specific objectives were to determine: (1) habitat characteristics among four vegetation types at six major mainland rivers; (2) species

composition and relative abundance of breeding birds that use deciduous riparian vegetation; (3) if and how bird species composition and abundances differed among rivers; (4) whether species composition and abundances differed among trans-mountain and coastal rivers; and (5) if and how latitude influenced bird species richness and bird community composition. I predicted higher overall species richness and diversity as well as a greater presence of birds associated with the Canadian interior at trans-mountain rivers than coastal rivers because of the connectivity of trans-mountain rivers with the Canadian interior. I also predicted that bird species richness would decrease with increased latitude. In addition, I also provide information on bird species of special management concern.

Methods

Study Area

I conducted our study at 6 major mainland rivers of southeastern Alaska during May to August 2000-2001. These rivers are, from north to south, the Alsek, Chilkat, Taku, Stikine, Unuk, and Chickamin. The three trans-mountain rivers of southeastern Alaska are, from north to south, the Alsek, Taku, and Stikine (Fig. 3-1).

Vegetation Sampling

I sampled vegetation from mid-July to mid-August. I measured 12 vegetation characteristics of the major deciduous riparian vegetation types among rivers (see chapter 4 for details).

Bird Sampling

I sampled birds using point counts following the protocol of Ralph et al. (1995; see chapter 4 for details). Two observers knowledgeable of the birds of the region worked together to record all birds during a 10-min period. At the beginning of each field season, I practiced and confirmed distance estimations with a laser range finder. Because certain bird species are easier to detect than others and certain vegetation types affect detection of bird species more than others, abundance estimates should be interpreted with caution. However, I feel this potential problem was minimized because the same primary observer was present during all point counts and I was confident that all singing males present during the time of the counts were recorded, regardless of vegetation type. Also, if it is assumed that the same errors in detection were made throughout the study, then data can be used to compare differences among rivers.

Point counts began at sunrise (approximately 0300, AST) and ended within 7 hours past sunrise. I visited each sampling station one time. Scientific names and four letter codes of bird species are listed in Appendix B-1.

Analytical Techniques

Only singing males estimated to be within a 100-m radius were included in analyses. I recorded fledglings, birds in flight, and species not well sampled using point counts (waterbirds, raptors, shorebirds) separately and excluded them from the analysis. I calculated species-accumulation curves to determine whether sampling effort sufficiently recorded the majority of species occurring per site. Due to differences in

sampling effort among rivers, I made comparisons based on presence or absence of species as well as proportion of occurrence. I also made some comparisons based on rarefaction estimates. Rarefaction allows a comparison of the number of species expected per site based on the lowest number of individuals recorded among sites. In other words, comparisons are made based on the same number of individuals (James and Rathburn 1981). For example, if the minimum number of individuals detected at all sites was 500, then species richness based on the first 500 individuals counted was compared among sites.

Using EstimateS (Colwell 1997), I compared total species richness among the different rivers using three non-parametric estimation methods (bootstrap, first-order jackknife, and Chao2). I calculated bird species diversity for each site and for trans-mountain and coastal rivers using the Shannon index:

$$H' = \sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

where s = total number of species and p_i = observed proportion of individuals that belong to the i^{th} species. Values range from 0 to 5, usually raanging from 1.5 to 3.5 (Krebs 1999).

In addition, I classified each bird species according to its primary nesting guild based on Ehrlich et al. (1988), Campbell et al. (1990, 1997, 2001) and from our observations in the field. I also classified each bird species according to its primary migratory guild, based on DeGraaf and Rappole (1995) and Boreal Partners in Flight (BPIF) (1999).

I compared vegetation characteristics of four habitat types among rivers using the chi-square approximation of the Kruskal-Wallis test (Zar 1999). Vegetation characteristics of four habitat types were compared between trans-mountain and coastal rivers using Mann-Whitney tests (Zar 1999). Point richness (the mean number of species per sampling point) and point abundance (the mean number of individuals per sampling point) were compared among rivers using Kruskal-Wallis tests. For comparisons between trans-mountain and coastal rivers I used Mann-Whitney tests (Zar1999). I tested whether frequency of bird species was different among rivers and between trans-mountain and coastal rivers using an indicator species analysis in PC-ORD (ver. 4.17, McCune and Mefford 1999). Indicator species analysis is a procedure for identifying species that show preferential distributions for user-defined groups. Indicator values are based on the relative abundance and relative frequency of species across groups. In contrast to relative abundance, relative frequency is based on the presence or absence of the species. Species with greater abundance and occurrence in a group are given higher indicator values. I used a Monte Carlo permutation procedure to test whether a random assignment of group memberships produced a higher indicator value for each species (Dufrene and Legendre 1997). I also used Horn's modification of the Morisita index of similarity (Krebs 1999) to compare species composition among rivers and between trans-mountain and coastal rivers. Statistical significance of all analyses was based on alpha levels < 0.05.

Results

I sampled birds between 26 May and 10 July, 2000 and 2001. During 2000, I visited the Chilkat, Taku, and Stikine rivers. During 2001, I visited the Alsek, Unuk, and Chickamin rivers. I recorded a total of 4073 individuals of 52 bird species at 326 point count sampling stations. For all of the rivers, species accumulation leveled off during sampling (Fig. 3-2). However, I did note a few new species at the Chickamin throughout our sampling efforts. The number of sampling points necessary to detect 90% of the total species recorded at each river ranged from 17 points (38% of points sampled) at the Alsek to 55 points (87% of all points sampled) at the Chickamin. For the remainder of the rivers, the number of sampling points necessary to detect 90% of the total species was 42 points (79% of points sampled) at the Chilkat, 39 points (63% of points sampled) at the Taku, 42 points (70% of points sampled) at the Stikine, and 30 points (60% of the points sampled) at the Unuk.

Vegetation

Differences in habitat characteristics among vegetation types reflected the criteria I used in grouping sites by vegetation type (see chapter 4 for details; Table 3-1). Vegetation characteristics for the four main habitat types differed among rivers. In general, vegetation characteristics of forested habitats varied more among rivers than shrub habitats, as indicated by the higher number of significantly different vegetation characteristics in forested habitats ($\overline{X} = 8.3$) compared to shrubland habitats (6; Table 3-

2). The most obvious difference among rivers was the low percent cover of surface water and lack of mature and mixed forest stands at the Alsek (Table 3-2).

Differences in vegetation characteristics also existed between trans-mountain and coastal rivers; however, the numbers of significant variables among habitat types were lower than comparisons among the six rivers (Table 3-3). Young forest, mixed forest, and mature forest stands had similar numbers (7, 7, and 6, respectively) of significantly different vegetation characteristics, whereas shrub habitats had three significantly different vegetation variables.

Birds

I detected 52 species during point counts at all rivers. Ten species were recorded at all rivers, whereas 15 species were recorded ≤ 2 times at rivers (Appendix B-2). The most common species at all rivers combined were Yellow Warbler (13.1% of all individuals, 78.2% of all stations), Warbling Vireo (8.5% of all individuals, 65.3% of all stations), Wilson's Warbler (7.7% of all individuals, 52.4% of all stations), Yellow-rumped Warbler (7.4% of all individuals, 59.2% of all stations), and Orange-crowned Warbler (6.3% of all individuals, 47.8% of all stations).

Comparison Among Rivers

Total species richness was highest at the Chickamin (42 species) and lowest at the Alsek (14 species; Table 3-4). Point richness (the mean number of species per sampling station) was significantly different among rivers and was highest at the Unuk and lowest at the Alsek ($\chi^2 = 82.3$, $P = <0.001$; Table 3-4).

Species richness based on rarefaction (bird species richness standardized at all rivers by comparing the same number of individuals) showed a distinct separation between the Alsek and the other rivers; Chilkat, Taku, Stikine, Unuk, and Chickamin had similar species richness (Table 3-4, Fig. 3-3).

All three of the estimators (Bootstrap, Chao2, and first-order jackknife) predicted that the Chickamin supported more species than the other rivers and the Alsek had the lowest species richness of all rivers (Fig. 3-4). The estimators predicted that the remainder of rivers had similar species richness. Diversity, based on rarefaction, was highest for the Stikine and Chickamin (3.03 and 3.02, respectively), and lowest for the Alsek (2.25, Table 3-4).

Frequency of bird species differed among the six rivers; however, the Yellow Warbler was the most frequently occurring species at four rivers, and within the top 5 most common species at five rivers. Wilson's Warbler was the most common species at the Alsek and Chilkat, the two northernmost rivers, and within the top five most common species at three rivers (Table 3-5).

Point abundance (mean number of individuals recorded at each sampling point) was significantly different among rivers and highest at the Unuk and lowest at the Alsek ($\chi^2 = 53.8$, $P = <0.001$; Table 3-4). Of the 52 species, relative abundances of 31 species were significantly different among the six rivers (Appendix B-2).

Comparison Between Trans-mountain and Coastal Rivers

Coastal rivers had more species (48 species) than trans-mountain rivers (44 species; Table 3-4). Point richness was significantly different between coastal rivers and trans-mountain rivers and was highest at coastal rivers (including Alsek $\chi^2 = 54.2$, $P = <0.001$; excluding Alsek $\chi^2 = 29.4$, $P = <0.001$; Table 3-4).

There was little discernable difference between rarefaction curves of the trans-mountain rivers, (both including and excluding the Alsek), and Coastal Rivers (Fig. 3-5). In addition, two of the three estimators predicted that species richness was greater for coastal rivers than trans-mountain rivers (Fig. 3-6). Diversity, based on rarefaction, was higher for coastal rivers than trans-mountain rivers (Table 3-4).

The most common species at the trans-mountain rivers differed slightly – the Warbling Vireo was among the most common species when the Alsek was excluded (Table 3-5). Composition of the most common species at the trans-mountain rivers differed among trans-mountain rivers and coastal rivers – Swainson's Thrush and Ruby-crowned Kinglet were among the five most common species at the coastal rivers, but not among trans-mountain rivers (Table 3-5).

Point abundance was significantly greater at coastal rivers than trans-mountain rivers (incl. Alsek $\chi^2 = 37.1$, $P = <0.001$; excl. Alsek $\chi^2 = 20.8$, $P = <0.001$; Table 3-4). When comparing between trans-mountain rivers including the Alsek and coastal rivers, 26 species were significantly different. Nineteen species were significantly different when comparing between trans-mountain rivers excluding the Alsek and coastal rivers

(Appendix B-3).

Bird Community Similarity

Similarity of bird communities ranged from 0.33 to 0.91 (Table 3-6). I found a significant relationship between the distance between rivers and the similarity of bird community composition ($df = 1,14$, $F = 27.32$, $r^2 = 0.68$, $p=0.0002$). With increased distance between rivers, I found a corresponding decreasing trend in the similarity of bird communities (Fig. 3-7). For example, the Chilkat was more similar to the Taku (distance = 180 km; similarity = 0.86) then to the Chickamin (distance = 520; similarity = 0.67; Table 3-7). Overall similarity of trans-mountain rivers compared to coastal rivers was 85.8% when the Alsek was included and 91.6% when the Alsek was excluded.

Influence of Latitude

Because of the lack of mature forest and the low species richness at the Alsek, I considered this river as an outlier and excluded it from further analyses. Although there was no discernible trend in bird species richness across a latitudinal gradient, I found a pattern in community similarity that may suggest that latitude does influence bird communities at the major mainland rivers. Bird community similarity was greater between the Chilkat and Taku (northernmost river pair) and the Unuk and Chickamin (southernmost river pair). Similarity between the two most distant rivers (Chilkat and Chickamin) was nearly 30% less similar compared to the two closest rivers (Unuk and Chickamin; Fig. 3-8).

Several species were notable for increasing or decreasing trends across all rivers. For example, Fox Sparrows, Gray-cheeked Thrushes, and Hermit Thrushes were more

abundant at northern rivers and decreased in abundance to the south. Conversely, Orange-crowned Warblers, Pacific-slope Flycatchers, Townsend's Warblers, Wilson's Warblers, and Winter Wrens were more abundant at southern rivers and decreased in abundance to the north (Appendix B-3).

Nest Guilds

Of the 52 species recorded, most species nested in trees (22 species or 42%), on the ground (15 species or 29%) and fewer nested in shrubs (8 species or 15%) or in cavities (7 species or 13%). The proportion of ground-nesting species was greatest at the Alsek and lowest at the Unuk. The proportion of shrub-nesting species and tree-nesting species was similar for all rivers, except the Alsek, which had the lowest proportion of species belonging to the shrub-nesting guild. The proportion of cavity-nesting species was highest at the Alsek, Chilkat, Taku, and Unuk and lowest for the Chickamin and Stikine (Table 3-8). There were no discernible differences in the proportion of nesting guilds between trans-mountain and coastal rivers (Table 3-8).

Migratory Guilds

Thirty-two species (62.7%) recorded were long-distance migrants. Of the remaining 20 species, 13 were residents and 7 were short-distance migrants. The proportion of long-distance migrants was similar at all rivers; however, this proportion was slightly lower at the Chilkat and Unuk than the other rivers. The Chilkat had the highest proportion of short-distance migrants and the Stikine had the lowest proportion of short-distance migrants. The proportion of resident species was highest at the Unuk

and lowest at the Stikine; however, values were similar at all rivers (Table 3-9). There were no discernable differences in the proportion of migratory guilds at trans-mountain rivers and coastal rivers (Table 3-9).

Species

Information for the following species is based on results from 100-m point counts; however, the lack of detections during point count surveys does not exclude a species' presence from a river. For a complete description of overall bird species distribution and abundance, see chapter 2.

Canadian Interior Associated Species

American Redstarts were detected at all rivers except for the Alsek and occurred most frequently at the Chickamin ($\overline{X}$ = 0.84 individuals/pt), Stikine ($\overline{X}$ = 0.78/individuals/pt), and the Chilkat ($\overline{X}$ = 0.75 individuals/pt) than at the other rivers where they are known to occur ($\overline{X}$ = 0.15 individuals/pt; Appendix B-2). Black-capped Chickadees were infrequently detected at the Alsek, Chikat, and Taku. Cassin's Vireos were detected once at the Taku. Chipping Sparrows were detected at the Chilkat, Taku, and Stikine in low numbers. Common Yellowthroats were detected at all rivers except for the Alsek and Unuk and were most frequently detected at the Chilkat. Hammond's Flycatchers were detected at all rivers except for the Alsek; frequency ranged from 1.0 individuals/pt at the Chilkat to 0.24 individuals/pt at the Taku. Least Flycatchers were recorded only once at the Chickamin. Although detected at all rivers except for the Alsek, MacGillivray's Warblers were relatively uncommon, ranging in frequency from 0.25

individuals/pt at the Chickamin to 0.05 individuals/pt at the Taku. Magnolia Warblers were detected only once at the Chickamin. Red-eyed Vireos were recorded in low numbers at the Stikine and Chickamin. Likewise, Tennessee Warblers were detected once at the both the Stikine and Chickamin. Warbling Vireos were one of the most common species detected at the major mainland rivers (except for the Alsek where they are not known to occur). Relative frequency of Warbling Vireos ranged from 1.56 individuals/pt at the Unuk to 0.92 individuals/pt at the Taku. Western Tanagers were detected at all rivers except for the Alsek; frequency of this species was higher at rivers in the southern portion of the region than in the north (Appendix B-2). Overall, 8 of the 10 interior associated species were recorded at both trans-mountain and coastal rivers (Table 3-10).

Species of Concern

Boreal Partners in Flight (1999) listed Hammond's Flycatcher, MacGillivray's Warbler and Western Wood-Pewee as species of priority species of concern for southeastern Alaska. Western Wood-Pewees, although not uncommon at the major mainland rivers (see chapter 1), were recorded in low numbers at the Chilkat, Stikine, and Unuk (Appendix B-2).

Three of the five species selected as management indicator species in the Tongass National Forest Land and Resource Management Plan (1997) were recorded during point counts. Brown Creepers were detected in low numbers at the Chilkat, Taku, Unuk, and Chickamin. Hairy Woodpeckers were detected at all rivers except for the Taku, and most frequently encountered at the Alsek and Unuk ($\overline{X}$ = 0.14 individuals/pt). Red-breasted

Sapsuckers were detected at all of the rivers except for the Alsek. Relative frequency for this species was greatest at the Chilkat (0.32 individuals/pt) than other rivers where they were detected ($\overline{X}$ = 0.1 individuals/pt; Appendix B-2, Table 3-10).

Rare Species

Eleven rare or accidental species in southeastern Alaska (Armstrong 1995) were detected at the major mainland rivers (Table 3-10). The greatest number of these species was recorded at the Chickamin (5 species) followed by the Taku (4 species; Appendix B-2).

Discussion

Deciduous riparian vegetation of the major mainland rivers of southeastern Alaska is clearly important for breeding birds in this region. Vegetation characteristics within habitat types differed among rivers; the most obvious differences being low percent cover of surface water and the lack of mature and mixed forest stands at the Alsek. Not surprisingly, differences in bird community composition, species richness, and certain nesting guilds among rivers were greatest between the Alsek and other rivers. Species associated with mature and mixed forests, such as Red-breasted Sapsucker, Brown Creeper, Hammond's Flycatcher, and Warbling Vireo, were not detected and are not known to occur at the Alsek. Additionally, species associated with mesic shrubland habitats, such as Alder Flycatcher, Common Yellowthroat, Northern Waterthrush, and Song Sparrow, were not detected at the Alsek. The lack of mature and mixed forest

stands and mesic shrub habitats explains the low proportion of tree- and shrub-nesting guilds and high proportion of ground-nesting guild at the Alsek, compared to other rivers.

Although the lack of appropriate habitat conditions undoubtedly plays an important role in explaining the absence of species frequently occurring at the majority of major mainland rivers at the Alsek, the more northern location of the Alsek is also a factor influencing the absence of certain species at the Alsek. Twenty-seven percent of species recorded at the major mainland rivers reach their northern range limits in northern southeastern Alaska, several which are species associated with the Canadian interior. The absence of species associated with the Canadian interior at the Alsek is also likely influenced by the low connectivity of the Alsek compared to other rivers. Although the Alsek is a trans-mountain river, the early successional vegetation that dominates this river valley may not offer the necessary habitat conditions that interior species such as Hammond's Flycatcher, Warbling Vireo, American Redstart, and Western Tanager need to disperse from the interior to coastal regions.

Contrary to our expectations, species richness, point richness, point abundance, and diversity were greater at coastal rivers than trans-mountain, even when excluding the Alsek. Bird species that were not shared by both trans-mountain rivers and coastal rivers were typically rare species detected only once such as Black-and-White Warbler, Cassin's Vireo, Least Flycatcher, Magnolia Warbler. However, the majority of species detected at only one class of river may be influenced more by sampling effort than restrictions in range or habitat preferences; these species were detected at both trans-mountain and coastal rivers during widespread area searches (see chapter 1).

The majority of species more common to the Canadian interior and primarily restricted to the major mainland rivers was recorded at both trans-mountain and coastal rivers. Although Canadian interior associated species probably reached southeastern Alaska via the trans-mountain rivers, it is apparent by their presence and abundance that these species have successfully colonized coastal rivers. There are no data regarding how species originally colonized coastal rivers, however short overland flights from the interior in the case of the Chilkat or from trans-mountain rivers via major tributaries in the case of the Stikine-Iskut rivers and the Unuk appears most likely.

There was a relationship between the distance between rivers and the similarity of bird community composition. Rivers that were separated by large distances tended to have less similar bird communities. This may indicate that there is a level of connectivity between neighboring rivers resulting from dispersal of birds from the mouths of rivers or by overland flights.

The only exception of a Canadian interior associated species not present at coastal rivers is the Ruffed Grouse, which was recorded only at the Taku and Stikine. This species is the only Canadian interior associated species that is a resident of southeastern Alaska and may be confined to these trans-mountain rivers due to a decreased ability to disperse compared to more mobile migratory species.

Excluding the Alsek, there was no discernible trend in bird species richness from north to south – species richness was similar at all rivers. Initially, this suggested that latitude did not influence bird communities at the major mainland rivers. However, upon comparing the similarity of bird communities of the northernmost and southernmost river

pairs, and between the most distant rivers, it was evident that bird community composition and abundance was affected by latitudinal changes in the region. One possible explanation is that bird species more abundant in the extreme northern and southern portions of southeastern Alaska, which decreased with distance from their most populous zones influenced both bird species richness and community similarity values. As a result, bird species richness was similar among rivers, but the similarity index based on both bird species presence and abundance provided a more informative description of these regional differences.

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Table 3-1. Vegetation characteristics (mean ± SE) of shrub, young forest, mature forest, and mixed forest riparian vegetation at major mainland rivers of southeastern Alaska.

Vegetation characteristic	Shrub	Young Forest	Mature Forest	Mixed Forest
Average canopy ht (m)	6.7±0.2	12.4±1.0	26.9±1.1	31.6±1.4
Coniferous tree cover (%)	0.85±0.3	1.3±0.39	2.9±0.5	28.8±1.8
Deciduous tree cover (%)	7.04±1.1	67.2±2.9	78.2±2.1	60.5±3.0
Tall tree cover (%)	1.8±0.6	42.3±3.0	54.7±2.8	59.9±3.0
Short tree cover (%)	7.1±0.9	42.1±1.9	28.4±1.5	27.1±1.3
Tall shrub cover (%)	23.5±3.0	40.0±2.4	44.7±1.9	42.7±2.0
Medium shrub cover (%)	34.7±3.0	36.6±2.2	53.6±2.3	70.9±2.4
Low shrub cover (%)	41.7±2.3	36.3±2.0	54.3±2.1	64.0±1.8
Herb cover (%)	61.6±3.5	46.3±2.4	43.5±2.3	37.2±0.2
Water cover (%)	15.0±3.1	5.9±1.2	5.5±1.5	1.9±0.6
% points containing snags	0.07±0.04	0.14±0.04	0.4±0.05	0.7±0.06
% points containing cavities	0.05±0.03	0.06±0.02	0.2±0.04	0.3±0.04

Table 3-2. Differences in vegetation characteristics (mean ± SE) among four habitat types at six major mainland rivers of southeastern Alaska.

Habitat	River	Canopy Height	Coniferous tree cover (%)	Deciduous tree cover (%)	Tall tree cover (%)	Short tree cover (%)	Tall shrub cover (%)	Mid-shrub cover (%)	Low shrub cover (%)	Herb cover (%)	Water cover (%)	% points with snags	% points with cavities
Shrub	Alsek	n/a	0.26±0.03	6.2±0.2	0.16±0.02	6.3±0.2	16.0±0.34	25.8±0.49	45.0±0.38	57.9±0.80	0.05±0.1	0.04	0.00
	Chilkat	n/a	0.11±0.03	8.4±0.34	1.8±0.1	6.8±0.56	18.1±1.7	20.4±1.8	31.9±1.01	44.6±2.1	24.8±3.1	0.17	0.17
	Taku	n/a	0.00	6.1±1.3	0.26±0.12	5.9±1.2	18.8±3.51	32.3±4.3	47.5±3.12	34.4±5.8	19.2±3.7	0.00	0.00
	Stikine	n/a	2.3±0.9	4.3±1.2	1.0±0.5	5.6±1.2	17.7±1.9	24.0±2.2	21.3±3.2	90.7±0.98	11.7±5.2	0.00	0.00
	Unuk	n/a	3.4±0.71	9.4±1.3	3.1±0.81	7.4±1.1	20.2±2.3	41.5±2.8	47.2±3.6	72.1±2.3	14.5±3.7	0.14	0.00
	Chickamin	n/a	4.0±0.81	17.3±1.8	9.1±1.1	12.2±1.4	66.1±3.8	63.1±3.8	54.5±4.1	68.7±3.4	19.8±3.1	0.14	0.14
	χ^2	n/a	9.5	5.6	17.1	2.7	16.2	14.9	14.6	16.2	17.9	3.0	5.6
	P	n/a	0.05	0.23	0.002	0.6	0.003	0.005	0.006	0.003	0.001	0.56	0.23
Young	Alsek	10.1±0.23	0.49±0.05	44.1±1.0	5.4±0.38	39.2±0.8	42.2±1.2	32.8±0.66	29.0±0.55	48.8±0.73	0.42±0.1	0.05	0.00
forest	Chilkat	15.1±0.39	1.1±0.18	62.3±1.3	28.3±1.21	38.0±0.72	43.3±0.86	26.3±0.7	45.9±1.2	54.8±1.6	9.9±0.66	0.26	0.05
	Taku	11.5±0.38	2.3±0.19	43.6±1.19	6.9±0.4	39.0±0.84	59.4±0.83	52.71.09	38.8±1.0	48.6±1.65	7.9±0.88	0.15	0.1
	Stikine	12.2±0.5	1.9±0.36	56.5±1.25	13.6±1.0	44.9±0.72	57.8±1.08	56.8±1.15	40.9±1.03	40.4±1.27	4.0±0.38	0.00	0.00
	Unuk	12.9±1.14	1.3±0.46	97.3±1.18	62.1±7.32	46.1±7.51	11.2±1.9	17.9±1.62	21.1±3.54	55.2±5.1	2.1±0.82	0.2	0.2
	Chickamin	17.0±0.49	0.00	98.5±0.3	70.7±5.3	45.9±2.7	26.4±2.1	32.9±1.9	44.8±2.3	32.3±1.5	3.3±0.92	0.2	0.00
	χ^2	11.6	7.9	38.5	40.6	3.8	29.4	34.6	11.5	8.8	20.6	7.0	6.4
	P	0.04	0.16	<0.0001	<0.0001	0.57	<0.0001	<0.0001	0.04	0.12	0.0009	0.22	0.27

Habitat	River	Canopy Height	Coniferous tree cover (%)	Deciduous tree cover (%)	Tall tree cover (%)	Short tree cover (%)	Tall shrub cover (%)	Mid-shrub cover (%)	Low shrub cover (%)	Herb cover (%)	Water cover (%)	% points with snags	% points with cavities
Mature	Alsek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
forest	Chilkat	23.3±0.43	0.49±0.09	70.7±1.08	41.5±0.95	31.5±0.76	44.0±0.83	29.4±0.72	44.6±1.13	60.8±1.32	15.8±1.35	0.42	0.37
	Taku	26.9±0.31	5.3±0.28	71.3±1.08	44.8±0.93	32.0±0.47	56.7±0.55	43.3±0.54	42.0±0.62	49.5±1.01	6.9±0.57	0.42	0.16
	Stikine	32.2±0.36	1.1±0.13	82.8±0.56	48.0±0.83	36.3±0.83	46.5±0.72	61.4±1.03	52.5±0.72	25.1±0.58	0.46±0.5	0.48	0.13
	Unuk	24.8±0.45	3.8±0.28	99.5±0.11	95.1±0.46	18.8±0.67	19.7±0.91	68.2±1.41	56.8±0.96	40.6±1.18	2.7±0.27	0.38	0.08
	Chickamin	27.3±0.33	4.4±0.37	72.1±1.21	54.7±1.30	23.5±0.64	43.0±0.97	64.5±0.89	77.9±0.55	44.4±0.87	1.7±0.2	0.28	0.11
	χ^2	17.5	25.4	27.5	17.5	16.3	32.0	39.9	40.7	29.1	15.9	1.8	6.6
	P	0.001	0.001	0.001	0.001	0.003	<0.0001	<0.0001	<0.0001	<0.0001	0.003	0.78	0.16
Mixed	Alsek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
forest	Chilkat	25.0±5.1	21.8±3.2	56.9±2.31	44.0±5.62	34.7±2.44	49.8±4.7	51.6±3.38	73.8±1.78	26.2±1.7	2.2±0.54	0.6	0.4
	Taku	31.8±0.29	34.2±0.89	53.2±1.55	51.8±0.96	35.7±0.65	50.8±0.74	44.2±0.62	48.8±0.55	51.0±0.75	1.8±0.18	0.61	0.39
	Stikine	40.0±0.32	24.4±1.39	59.3±2.21	54.3±1.67	29.5±0.63	48.3±1.41	83.2±0.10	58.7±0.11	27.2±0.12	0.00	0.6	0.00
	Unuk	27.0±0.25	25.8±0.5	85.5±0.64	92.8±0.54	22.9±0.29	21.1±0.21	76.8±0.66	61.3±0.49	37.20.64	3.3±0.29	0.72	0.16
	Chickamin	34.3±0.4	31.1±0.75	49.9±1.01	56.9±1.17	24.6±0.58	40.1±0.86	79.2±0.71	78.2±0.57	44.6±0.66	0.84±0.1	0.73	0.23
	χ^2	20.1	4.2	29.9	39.0	15.1	38.8	34.9	37.5	19.2	8.0	2.4	9.9
	P	0.0005	0.38	<0.0001	<0.0001	0.004	<0.0001	<0.0001	<0.0001	0.0007	0.09	0.67	0.04

Note: Differences among rivers were examined using the χ^2 approximation of the Kruskal-Wallis test (SAS Institute Inc. 1999). Alpha value based on Kruskal-Wallis tests, where p=<0.05 indicates significant difference among rivers.

Table 3-3. Differences of vegetation characteristics (mean ± SE) among four habitat types at trans-mountain and coastal rivers of southeastern Alaska.

Habitat	River	Canopy Height	Coniferous tree cover (%)	Deciduous tree cover(%)	Tall tree cover (%)	Short tree cover (%)	Tall shrub cover (%)	Mid-shrub cover (%)	Low shrub cover (%)	Herb cover (%)	Water cover (%)	% points with snags	% points with cavities
Shrub	Trans-mt	0.00	0.5±0.04	6.0±0.14	0.3±0.02	6.2±0.14	16.6±0.29	20.2±0.39	42.6±0.39	58.3±0.33	4.2±0.35	0.03±0.005	0.00
	Coastal	0.00	1.5±0.31	11.7±0.58	4.5±0.31	8.8±0.43	35.8±1.66	36.1±1.65	40.29±1.18	53.57±1.45	22.9±1.67	0.2±0.02	0.2±0.02
	U	0.00	0.5	2.6	12.6	0.9	2.8	0.2	1.7	0.3	8.1	2.8	5.6
	P	0.00	0.47	0.11	0.0004	0.34	0.09	0.66	0.19	0.57	0.004	0.09	0.02
Young	Trans-mt	11.1±0.13	1.6±0.08	47.7±0.41	8.5±0.21	40.9±0.27	53.3±0.37	47.4±0.38	36.3±0.29	45.7±0.36	4.0±0.21	0.07±0.005	0.04±0.003
forest	Coastal	15.4±0.19	0.8±0.08	78.1±0.76	45.0±0.96	41.5±0.65	33.6±0.6	27.0±0.44	41.9±0.68	48.2±0.79	6.8±0.32	0.23±0.01	0.06±0.007
	U	9.8	2.1	23.4	32.8	0.0006	15.9	21.6	0.7	0.2	4.4	4.9	0.3
	P	0.002	0.15	<0.0001	0.0001	0.98	<0.0001	<0.0001	0.41	0.67	0.04	0.03	0.61
Mature	Trans-mt	29.8±0.18	3.0±0.11	77.6±0.42	46.6±0.44	34.3±0.37	51.1±0.35	53.2±0.5	47.5±0.37	36.2±0.49	3.4±0.19	0.45±0.01	0.14±0.01
forest	Coastal	25.2±0.14	2.7±0.09	78.7±0.44	60.2±0.56	25.3±0.26	39.2±0.39	52.1±0.48	59.8±0.4	49.6±0.4	7.3±0.3	0.4±0.01	0.2±0.01
	U	10.3	0.1	1.1	5.1	9.5	12.5	0.02	9.8	9.3	3.0	0.8	0.5
	P	0.001	0.79	0.29	0.02	0.002	0.0004	0.89	0.002	0.002	0.08	0.37	0.47
Mixed	Trans-mt	34.7±0.22	30.7±0.57	55.4±0.92	52.7±0.59	33.5±0.37	49.9±0.48	58.1±0.78	52.3±0.4	42.5±0.62	1.2±0.1	0.61±0.02	0.2±0.02
forest	Coastal	30.1±0.17	27.9±0.29	68.6±0.48	72.8±0.47	24.2±0.21	30.7±0.31	76.7±0.34	69.3±0.28	39.9±0.32	2.2±0.11	0.7±0.01	0.2±0.01
	U	6.2	0.8	4.4	12.5	11.7	21.0	13.1	23.2	1.2	0.2	1.2	0.2
	P	0.01	0.38	0.04	0.0004	0.0006	<0.0001	0.003	<0.0001	0.27	0.62	0.26	0.67

Note: Differences among rivers were examined using Mann-Whitney tests (Zar 1999). Alpha value based on Mann-Whitney tests, where p=<0.05 indicates significant difference among rivers.

Table 3-4. Number of point counts, bird species richness, point richness, point abundance, and diversity for birds recorded at six major mainland rivers of southeastern Alaska.

Rivers	No. sampling points	Total species richness[a]	Standardized species richness[b]	Point richness[c]	Point abundance[d]	Total species diversity[e]	Standadized species diversity[f]
Individual Rivers							
Alsek	44	14	14.0	5.9	9.5	2.2	2.2
Chilkat	53	36	32.0	8.5	14.3	3.0	3.0
Taku	62	35	31.5	6.9	11.1	2.7	2.7
Stikine	54	38	35.2	8.1	12.0	3.1	3.0
Unuk	50	34	30.9	9.6	15.1	3.0	2.9
Chickamin	63	42	36.1	8.9	12.8	3.1	3.0
Trans-mountain and Coastal Rivers							
Trans-mt incl Alsek	160	44	42.3	7.1	11.0	2.9	2.9
Trans-mt excl. Alsek	116	43	43.0	7.5	11.5	2.9	2.9
Coastal	166	48	42.7	9.0	14.0	3.2	3.1

[a]Total species richness = the total number of species recorded. [b]Standardized species richness = number of species based on rarefaction estimate. [c]Point richness = mean number of species recorded per sampling point. [d]Point abundance = mean number of individuals recorded per sampling point. [e]Total species diversity = total diversity based on Shannon index.[f]Standardized species diversity = diversity based on rarefaction estimate of Shannon index.

Table 3-5. The five most frequent bird species recorded at six major trans-mountain and coastal mainland rivers of southeastern Alaska, 2000-2001.

Rivers	Species	% individuals	% stations
Individual Rivers			
Alsek	Wilson's Warbler	19.0	79.5
	Fox Sparrow	15.5	77.3
	Orange-crowned Warbler	14.3	77.3
	Hermit Thrush	12.0	75.0
	Gray-cheeked Thrush	10.0	68.2
Chilkat	Wilson's Warbler	12.0	81.1
	Orange-crowned Warbler	8.5	70.0
	Warbling Vireo	8.3	66.0
	Yellow Warbler	8.1	60.4
	Yellow-rumped Warbler	7.7	62.3
Taku	Yellow Warbler	18.0	82.2
	Wilson's Warbler	11.7	69.3
	Yellow-rumped Warbler	10.6	66.1
	Orange-crowned Warbler	8.9	53.2
	Warbling Vireo	8.3	67.7
Stikine	Yellow Warbler	13.2	81.5
	Warbling Vireo	11.5	76.0
	Yellow-rumped Warbler	8.4	65.0
	Orange-crowned Warbler	7.0	55.5
	American Redstart	6.5	48.1

Rivers		Species	% individuals	% stations
		Yellow Warbler	14.1	88.0
	Unuk	Warbling Vireo	10.3	92.0
		Ruby-crowned Kinglet	8.9	74.0
		American Robin	7.8	68.0
		Yellow-rumped Warbler	5.8	60.0
	Chickamin	Yellow Warbler	15.4	92.1
		Warbling Vireo	9.2	77.8
		Ruby-crowned Kinglet	9.1	65.1
		Swainson's Thrush	9.0	79.4
		American Redstart	6.6	57.1
Trans-mountain and Coastal Rivers				
	Trans-mountain	Yellow Warbler	13.9	75.6
	rivers including	Wilson's Warbler	11.1	66.2
	Alsek	Orange-crowned Warbler	9.4	60.6
		Yellow-rumped Warbler	9.3	63.7
		Warbling Vireo	7.4	51.9
	Trans-mountain	Yellow Warbler	15.6	81.9
	rivers excluding	Warbling Vireo	9.8	71.5
	Alsek	Yellow-rumped Warbler	9.5	65.5
		Wilson's Warbler	8.7	61.2
		Orange-crowned Warbler	7.9	54.3

Rivers	Species	% individuals	% stations
Coastal rivers	Yellow Warbler	12.4	80.7
	Warbling Vireo	9.2	78.3
	Ruby-crowned Kinglet	6.9	5.5
	Swainson's Thrush	6.4	5.9
	Yellow-rumped Warbler	5.9	5.5
	American Robin	5.9	5.5

Table 3-6. Similarity matrix based on Horn's modification of Morisita's index of similarity comparing bird community composition among six major mainland rivers of southeastern Alaska.

	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin
Alsek	1.0					
Chilkat	0.72	1.0				
Taku	0.74	0.86	1.0			
Stikine	0.55	0.87	0.87	1.0		
Unuk	0.35	0.68	0.77	0.84	1.0	
Chickamin	0.33	0.67	0.72	0.86	0.91	1.0

Table 3-7. Distance between major mainland river pairs and similarity between river pairs using Horn's modification of Morisita index.

River pair	Distance between Rivers (km)	Similarity
Unuk-Chickamin	30	0.91
Stikine-Unuk	80	0.84
Stikine-Chickamin	110	0.86
Alsek-Chilkat	120	0.72
Chilkat-Taku	180	0.86
Taku-Stkine	230	0.87
Alsek-Taku	300	0.74
Taku-Unuk	310	0.77
Taku-Chickamin	340	0.72
Chilkat-Stikine	410	0.87
Chilkat-Unuk	490	0.68
Chilkat-Chickamin	520	0.67
Alsek-Stikine	530	0.55
Alsek-Unuk	610	0.35
Alsek-Chickamin	640	0.33

Table 3-8. Proportion of species belonging to four nesting guilds at six major mainland rivers and trans-mountain and coastal rivers of southeastern Alaska.

Rivers	Nesting Guild			
	Ground	Shrub	Tree	Cavity
Individual Rivers				
Alsek	0.44	0.14	0.28	0.14
Chilkat	0.28	0.22	0.36	0.14
Taku	0.29	0.18	0.41	0.12
Stikine	0.29	0.18	0.42	0.11
Unuk	0.26	0.18	0.44	0.12
Chickamin	0.29	0.17	0.43	0.11
Trans-mountain and Coastal Rivers				
Trans-mt. incl. Alsek	0.30	0.16	0.43	0.11
Trans-mt. excl. Alsek	0.28	0.16	0.44	0.12
Coastal	0.27	0.17	0.42	0.14

Table 3-9. Proportion of species belonging to three migratory guilds at six major mainland rivers and trans-mountain and coastal rivers of southeastern Alaska.

Rivers	Migratory Guild		
	Long-distance	Short-distance	Resident
Individual Rivers			
Alsek	0.71	0.08	0.21
Chilkat	0.61	0.17	0.22
Taku	0.65	0.14	0.21
Stikine	0.68	0.14	0.18
Unuk	0.59	0.12	0.29
Chickamin	0.67	0.12	0.21
Trans-mountain vs. Coastal Rivers			
Trans-mt. incl. Alsek	0.66	0.09	0.25
Trans-mt. excl. Alsek	0.65	0.1	0.25
Coastal	0.65	0.1	0.25

Table 3-10. Species associated with Canadian interior, species of management concern and rare species recorded at major mainland rivers of southeastern Alaska, 2000-2001.

Species	No. of rivers recorded	Recorded at trans-mountain	Recorded at coastal	Interior associated[a]	Species of concern[b]	Rare[c]
American Redstart	5	x	x	x		
Black-capped Chickadee	3	x	x	x		
Bohemian Waxwing	1	x				x
Brown Creeper	4	x	x		x	
Black-and-white Warbler	1		x			x
Cassin's Vireo	1	x				x
Chipping Sparrow	3	x		x		x
Common Yellowthroat	4	x		x		
Hammond's Flycatcher	5	x	x	x		
Hairy Woodpecker	5	x	x		x	
Least Flycatcher	1		x	x		x
MacGillivray's Warbler	5	x	x		x	
Magnolia Warbler	1		x			x
Olive-sided Flycatcher	2	x	x			x
Red-breasted Nuthatch	3	x	x		x	
Red-breasted Sapsucker	5	x	x		x	
Red-eyed Vireo	2	x	x	x		x
Rusty Blackbird	1		x			x
Ruffed Grouse	2	x		x		x

Species	No. of rivers recorded	Recorded at trans-mountain	Recorded at coastal	Interior associated[a]	Species of concern[b]	Rare[c]
Tennessee Warbler	2	x	x			x
Warbling Vireo	5	x	x	x		
Western Tanager	5	x	x	x		
Western Wood-Pewee	3	x	x		x	

[a]Species more common to the Canadian interior with ranges in southeastern Alaska primarily restricted to the major mainland rivers. [b]Species of concern listed by BPIF (1999) and management indicator species listed in the Tongass National Forest Land and Resource Management Plan (1997). [c]Species classified as rare by Armstrong (1995).

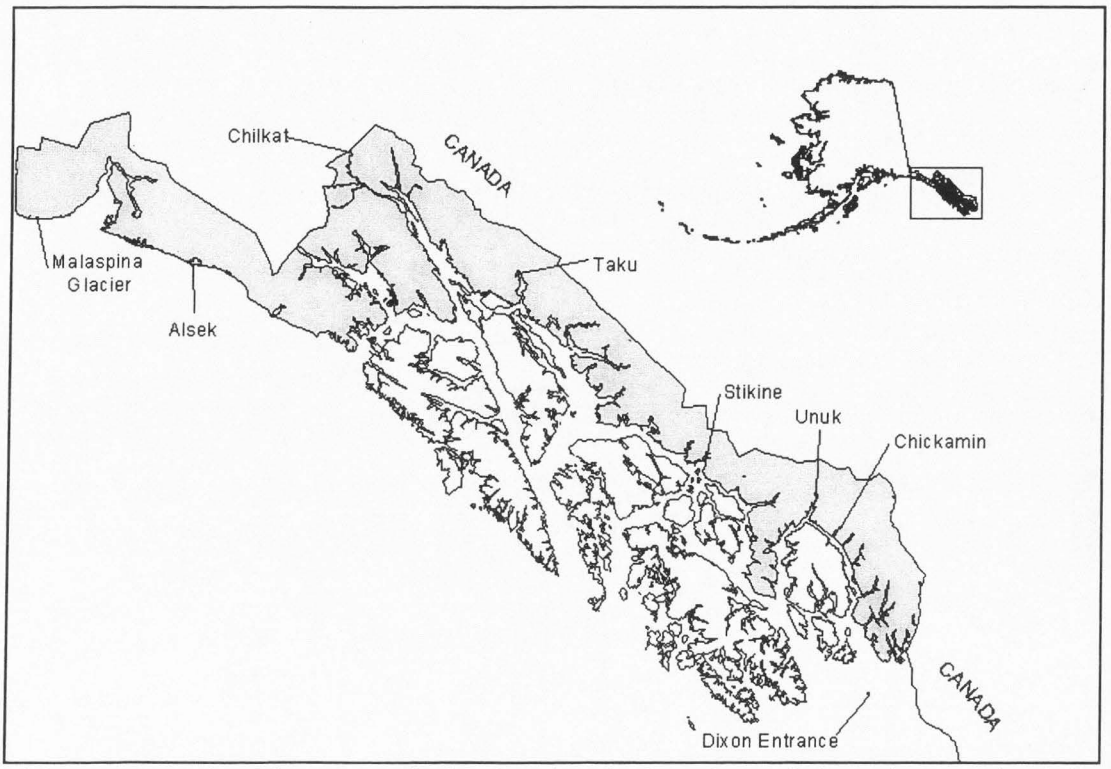

Fig. 3-1. Map of southeastern Alaska showing the locations of six major mainland rivers. Shaded area denotes mainland.

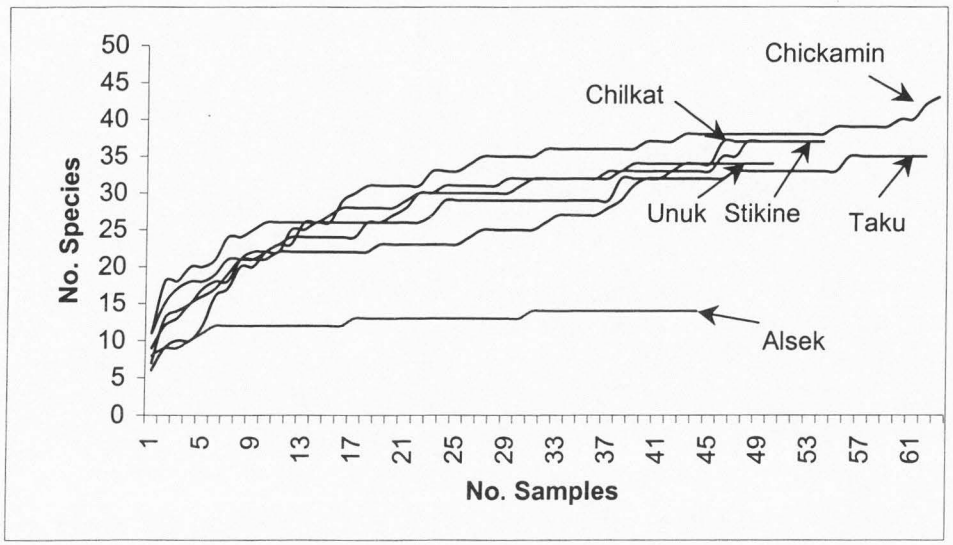

Fig. 3-2. Species accumulation curves from 100 m radius point counts conducted at six major mainland rivers.

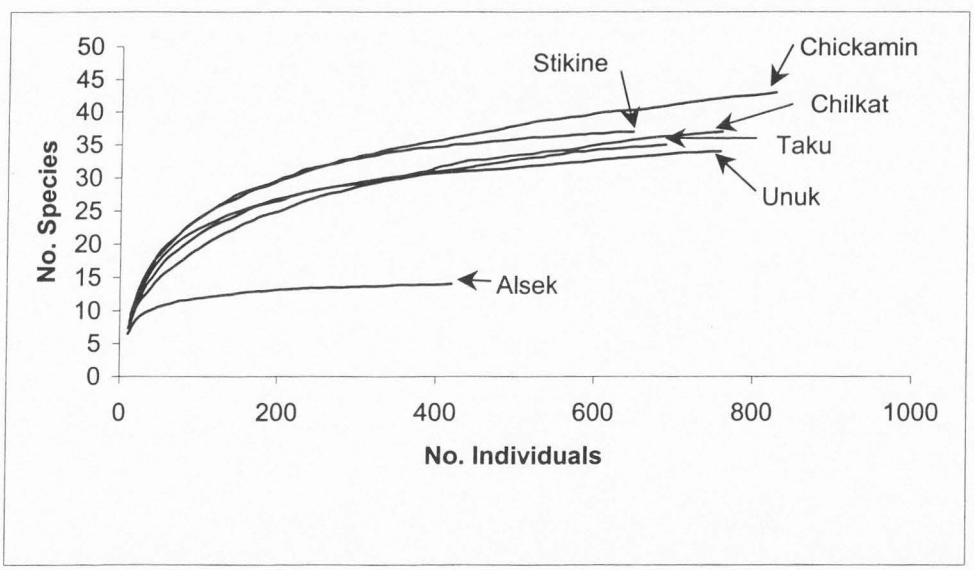

Fig. 3-3. Rarefaction curves for the six major mainland rivers of southeastern Alaska.

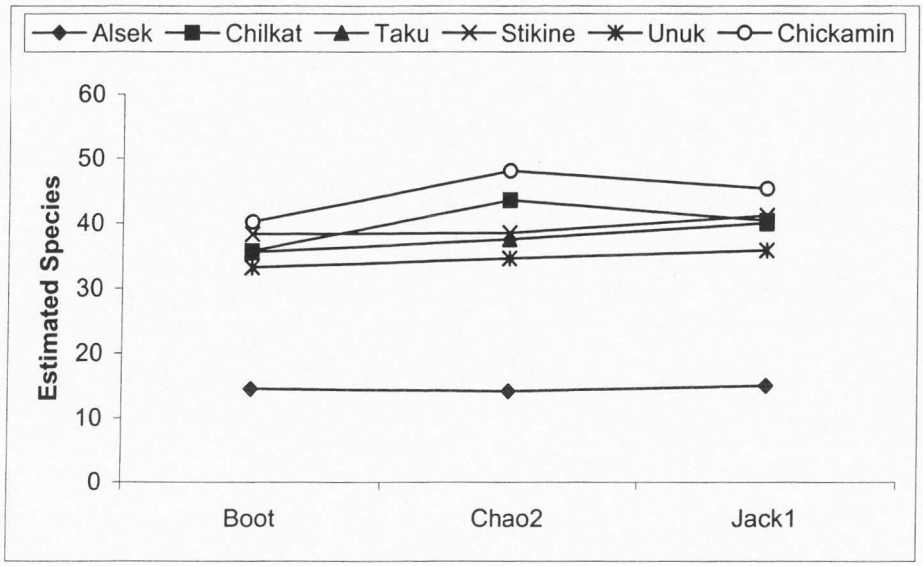

Fig. 3-4. Estimated species richness of the six rivers for three different estimators.

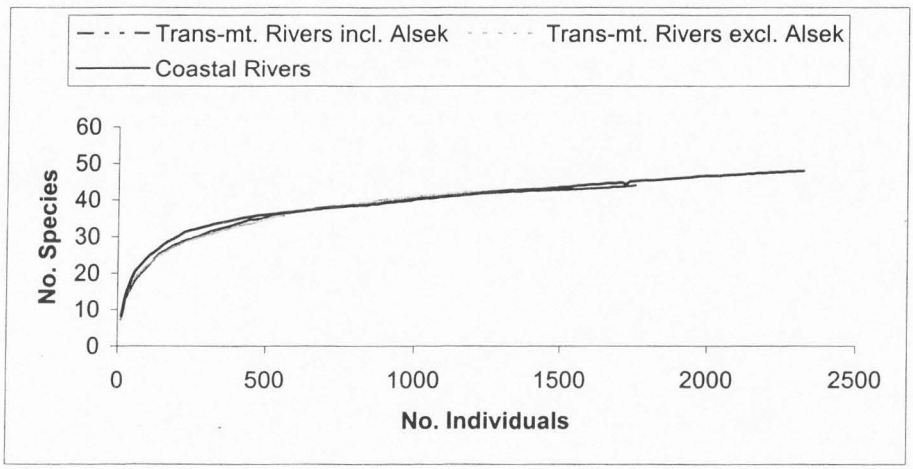

Fig. 3-5. Rarefaction curves for three trans-mountain rivers (including Alsek), two trans-mountain rivers (excluding Alsek), and three coastal rivers of southeastern Alaska.

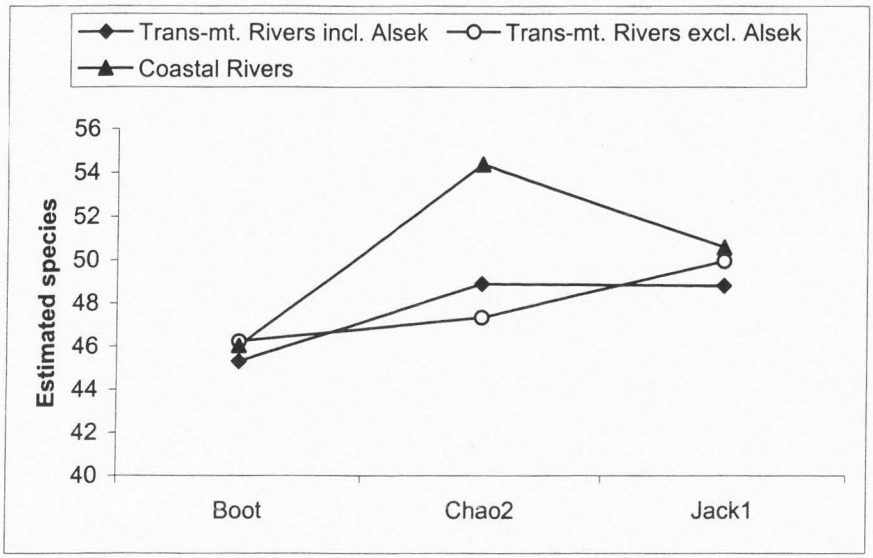

Fig. 3-6. Estimated species richness of trans-mountain and coastal rivers for three different estimators.

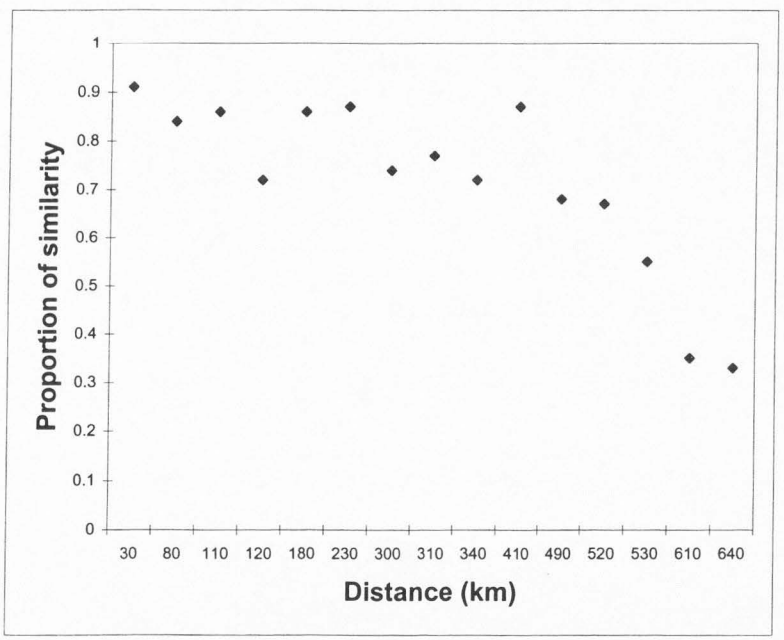

Fig. 3-7. Scatter plot of river pairs based on distance between rivers.

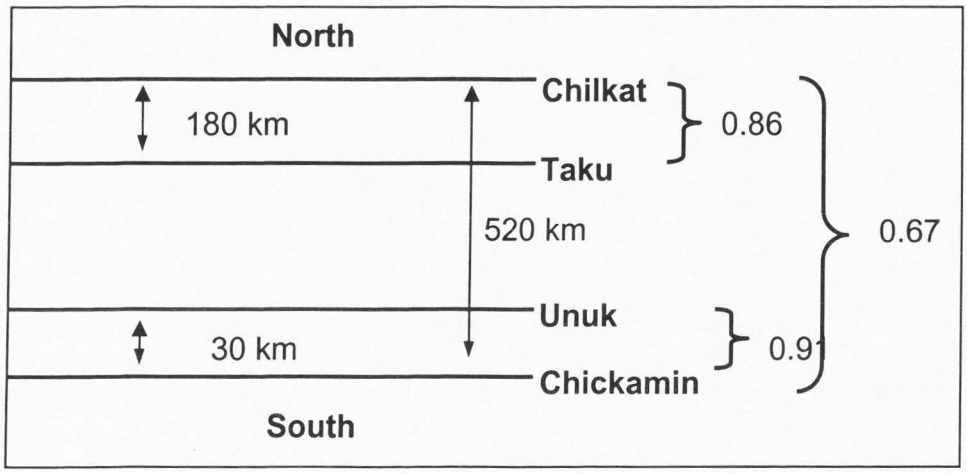

Fig. 3-8 Comparison of bird community similarity of the northernmost, southernmost, and most distant river pairs.

CHAPTER 4

BIRD-HABITAT RELATIONSHIPS IN DECIDUOUS RIPARIAN VEGETATION AT MAJOR MAINLAND RIVERS OF SOUTHEASTERN ALASKA

Introduction

Breeding landbird communities of the major mainland rivers of southeastern Alaska are among the richest and most diverse in Alaska. Even though these river systems and their associated riparian habitats comprise a relatively small area of southeastern Alaska, they support a disproportionately large number of bird species known or suspected to breed within the region (see chapter 2). In addition, the major mainland rivers support a suite of bird species that are more common to the Canadian interior and whose distribution in southeastern Alaska is primarily restricted to these rivers. Because of the lack of demographic information, as well as population declines occurring in other portions of their ranges, several species that regularly occur at major mainland rivers have been listed as species of management concern by Boreal Partners in Flight (1999).

The major mainland rivers support the largest riparian areas in southeastern Alaska and contain a mosaic of highly productive and dynamic habitats. Deciduous riparian vegetation communities contrast sharply with the coniferous forests dominating the majority of the region's vegetated landscape. Indeed, deciduous riparian vegetation can be thought of as corridors within an extensive matrix of coniferous vegetation.

In contrast to the wealth of information available on the use of riparian vegetation

by birds in the contiguous U.S., few studies have examined bird use of riparian vegetation in southeastern Alaska (Willson and Comet 1996a,b; Gende and Willson 2001). As a result, detailed information of riparian habitat associations of birds can greatly assist in the effective management of these habitats and their associated bird communities. To my knowledge, this is the first study to focus extensively on the bird communities of major mainland rivers of southeastern Alaska. My primary goal was to provide a broad overview of bird-habitat relationships that would provide information useful for managers.

In this study I examined bird species abundance and composition in relation to habitat characteristics of deciduous riparian vegetation at six major mainland rivers. My objectives were twofold. First, I examined patterns of individual bird species presence and abundance in four main vegetation types of deciduous riparian vegetation. I also examined how bird species richness, diversity, nesting guilds and migratory guilds differed among vegetation types. Second, I determined the most important environmental gradients contributing to variation in the bird species assemblage.

Methods

Study Area and Vegetation Communities

The major mainland river systems in southeastern Alaska (from north to south, the Alsek, Chilkat, Taku, Stikine, Unuk, and Chickamin rivers; Fig. 4-1) contain a mosaic of heterogeneous, floristically diverse, and structurally complex habitats, including extensive deciduous riparian vegetation that is relatively scarce elsewhere in the region.

Deciduous riparian vegetation forms a physiognomic continuum from shrublands to forest and occurs throughout the valley bottoms where soil conditions and flood disturbance keep the conifers from replacing the deciduous vegetation. Riparian vegetation consists of four primary vegetation types: mixed deciduous/coniferous forest, mature deciduous forest, young deciduous forest, and shrublands. Mixed deciduous/coniferous forests are late-successional communities occurring on stable, well-drained soils that are rarely flooded. This habitat is composed of large-diameter (>50 cm), well-spaced black cottonwood (*Populus trichocarpa*) and Sitka spruce (*Picea sitchensis*) with neither species dominant. Canopy cover is relatively open (25-60% cover) and there is a well-developed shrub layer (Viereck et al. 1992). Trees reach heights >45 m. The dense shrub understory is dominated by Sitka alder (*Alnus sinuata*), willow (*Salix* spp.), red-osier dogwood (*Cornus stolonifera*), highbush cranberry (*Viburnum edule*), nootka rose (*Rosa nutkana*), red elderberry (*Sambucus racemosa*), salmonberry (*Rubus spectabilis*) and devil's club (*Oplopanax horridus*).

Deciduous forests are mid-successional vegetation communities that can be further classified as either mature forest or young forest. Mature forests occur on well-developed soils and consist of wide-spaced large diameter (>35 cm) cottonwood and alder trees. Paper birch (*Betula papyrifera*) occurs in the Chilkat river valley. The canopy is relatively open (25-60%) and subsequently, there is a dense shrub layer (Viereck et al. 1992). Trees may reach heights of 40 m. The shrub layer primarily consists of salmonberry, red-osier dogwood, red elderberry, nootka rose, Douglas' maple (*Acer glabrum*), and devil's club. Young forest consists of closely spaced, small to medium

diameter (<35 cm) cottonwood and/or red alder (*Alnus rubra*) with a closed (>60%) canopy (Viereck et al. 1992). Trees may reach heights of 30 m. The understory is fairly open and consists of nootka rose, red-osier dogwood, Douglas' maple, and salmonberry.

Shrublands are early successional communities primarily occurring on rocky soils in recently disturbed, frequently flooded zones that lack a well-developed organic layer. Shrublands are defined as vegetation <5 m tall with <10% tree cover (Viereck et al. 1992). Species are predominately alder and willow, yet there may also be a few scattered tall deciduous trees. Other understory shrubs include red elderberry, devil's club, red-osier dogwood and highbush cranberry. Myrica (*Myrica gale*) occurs on extremely mesic sites.

Sampling Methods

I conducted fieldwork during mid-May to August 2000 and 2001. During the 2000 field season, I sampled the Chilkat, Taku, and Stikine. I sampled the Alsek, Unuk, and Chickamin during the 2001 field season (Fig. 4-1).

Sample Plot Selection

I used a systematic, random design to place sampling stations. A random starting point was selected and subsequent points were systematically placed at a minimum of 300 m apart in deciduous riparian vegetation, from the mouth of the river to the Canadian border. My goal was to place sample points, to the highest degree possible, within distinct vegetation types (i.e., shrub, deciduous forest, mixed forest) 100 to 300 m from the river's edge. I chose the minimum distance (100 m) to the river to ensure that no

portion of the river occurred within the sampling plots, and the maximum cutoff distance (300 m) to increase sampling efficiency by increasing the number of points surveyed per day. I reached sampling points by following an angle perpendicular to the riverbank.

Bird Sampling

I sampled birds using 50-m radius point counts. I began sampling after mid-May to reduce the number of migrants recorded and completed sampling by mid-July to reduce the number of fledglings and migrants recorded. A pair of observers knowledgeable of the calls, songs, and appearances of birds in the region conducted one point count at each sampling station. Observers worked together to record all birds seen and heard during a 10-min period. Observers recorded the approximate location and movements of birds to reduce the likelihood of counting the same individual twice. I conducted point counts between sunrise (0230-0300 hr A.S.T) and up to 6 hours past sunrise depending on weather and bird activity. I did not conduct surveys during periods of heavy rain, high wind, or unseasonably cold temperatures. I recorded fall fledglings and individuals that flew over the plot separately (Ralph et al. 1995). Scientific names of and four letter codes of bird species are listed in Appendix C-1.

Vegetation Sampling

I sampled vegetation from mid-July to mid-August. At each sampling plot I determined the percent cover of vegetation at 5 vertical strata using the point-intercept method (Hamel et al. 1996). Vertical strata correspond with physiognomic features of

the habitat: low shrub (0.1-1 m), medium shrub (1.1-2.5 m), tall shrub (2.6-5.0 m), short tree (5.0-10.0 m), and tall tree (>10.0 m). I delineated six 50-m transects, radiating from the plot center at 60-degree intervals (60, 120, 180, 240, 300, and 360) in each plot. Using an ocular tube with cross hairs, I recorded the presence or absence of vegetation at five vertical strata at 4-m intervals for a total of 12-13 points per transect and 75 points per plot. For each "hit" I also recorded the plant species. I estimated the percentage of the ground surface covered by herbaceous vegetation and water, the average tree and shrub canopy height, and the presence of snags and excavated cavities within a 50-m radius circular plot (Hamel et al. 1996). I calculated measures of species richness independently for trees and shrubs for each plot.

Analysis

Vegetation

I compared habitat characteristics among vegetation types using Kruskal-Wallis tests (Zar 1999). Vegetation data were not normally distributed. I also evaluated the vegetation data using canonical discriminant analysis (CDA). CDA creates new variables by creating linear combinations of the original variables. The canonical variables are created so that they contain all of the useful data in a set of variables (Johnson 1998). I summarized each vegetation characteristic as its mean value.

Birds

Bird species abundances data consisted of only singing males detected within a 50 m radius. This is based on the assumption that singing males had selected a breeding

location and were actively defending a territory. The abundances of bird species should be interpreted with caution as certain species are easier to detect than others and certain vegetation types affect detection of bird species more than others. However, this potential problem was minimized because the same primary observer was present during all point counts and I was confident that all singing males present during the time of the counts were recorded within the 50-m radius, regardless of vegetation type.

I excluded rare species recorded less than 5 times from analyses. I also excluded from analyses raptors, shorebirds, and other species (e.g., Belted Kingfisher) that were not well sampled with the point count sampling method.

I classified each bird species according to its primary nesting guild based on Ehrlich et al. (1988), Campbell et al. (1990, 1997, 2001) and from the authors' field observations. I also classified each bird species based on its migratory guild based on DeGraaf and Rappole (1995) and Boreal Partners in Flight (1999).

Numbers of sampling points differed among habitat types, preventing direct comparisons of species abundances and richness. Therefore, I calculated rarefaction curves using the program EstimateS (Colwell 1997) to estimate how species richness was influenced by bird abundance. Rarefaction allows the comparison of the number of species expected at each site based on the same number of individuals (James and Rathburn 1981). I compared species richness among habitat types based on the minimum number of observations recorded among habitat types using six different estimation methods (bootstrap, Chao2, ICE, first-order jackknife, second-order jackknife, and Michaelis-Menten; see Colwell 1997 for overview).

Species diversity was calculated in EstimateS (Colwell 1997) and standardized by bird abundance. Diversity indices measure the number of species as well as the evenness of species. Maximum diversity exists when all species are equally abundant (even). I used the Shannon diversity index:

$$H' = \sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

where s = total number of species and pi = observed proportion of individuals that belong to the i^{th} species. I used the Shannon diversity index because it is relatively sensitive to changes in rare species in a community (Krebs 1999). Values range from 0 to 5, usually raanging from 1.5 to 3.5 (Krebs 1999).

I tested whether point richness (the average number of species recorded at a sampling point) and point abundance (the average number of individuals regardless of species recorded at a sampling point) varied significantly among habitat types using Kruskal-Wallis tests. I tested whether frequency of bird species was different among habitat types using an indicator species analysis in PC-ORD (version 4.17, McCune and Mefford 1999). Indicator species analysis is a procedure for identifying species that show preferential distributions for user-defined groups (in this case, vegetation types). Indicator values are based on the relative abundance and relative frequency of species across groups. In contrast to relative abundance, relative frequency is based on the presence or absence of the species. Species with greater abundance and occurrence in a group are given higher indicator values. I used a Monte Carlo permutation procedure to test whether a random assignment of group memberships produced a higher indicator value

for each species compared to actual values (Dufrene and Legendre 1997).

Abundance of bird species and habitat variables were used in a canonical correspondence analysis (CCA) for all plots to examine whether variation in bird communities was related to variation in vegetation communities. CCA is a direct gradient analysis that constrains ordination axes to be linear combinations of explanatory variables. In other words, CCA attempts to find gradients of variation within one group of variables that are correlated within a second set of variables (see ter Braak 1986 and 1995 for overview). Compared to ordination techniques such as CA and DCA, CCA performs well even when there is high level of colinearity among habitat variables, when dependent variables are highly skewed, and when there are extremely high quantitative noise levels resulting from measurement error, inadequate sampling intensity, and stochastic variations of true abundance around the mean or ideal distribution (Palmer 1993). Using CANOCO 4.0 (terBraak and Smilauer 1998), I logarithmically transformed bird abundances, with no down-weighting of rare species.

I conducted two different CCAs in order to reduce confusion when examining the relative importance of explanatory variables. The first examined how vegetation structure and physical habitat features influenced bird species abundance and presence. The second CCA examined how vegetation species composition influenced bird species abundance and presence. I used forward stepwise selection of variables to determine the importance of explanatory variables in CCA. Only statistically significant environmental variables ($p=<0.01$, Monte Carlo permutation test, 199 (default) permutations) were included in graphical output. All statistical tests were termed significant with alpha levels <0.05.

Scientific names and species codes of bird species are listed in Appendix C-1.

Results

Vegetation Characteristics

Differences in habitat characteristics among vegetation types reflected the criteria I used in grouping sites by vegetation type. All of the 14 habitat characteristics differed significantly among vegetation types (Table 4-1). Canopy height, coniferous tree canopy cover, tall tree canopy cover, medium shrub cover, presence of snags, presence of cavities, tree species richness, and shrub species richness increased from shrub to mixed forest. Herb cover and water cover decreased from shrub to mixed forest. Deciduous tree canopy cover was greatest in mature forest stands. Short tree canopy cover was greatest for young forest stands. Medium shrub cover and low shrub cover were greatest for mixed forest stands and lowest for shrublands and young forest stands (Table 4-1).

Vegetation types differed significantly ($F = 31.9$, (F approximation from Wilks' λ) $P < 0.0001$, $df = 42$) and accounted for 89% of the variation on the first canonical discriminant function. This function was highly (>0.60) positively correlated with canopy height, tall tree canopy cover, coniferous tree canopy cover, and cover of medium shrub, and moderately negatively correlated with cover of water and cover of herb (Table 4-2). I interpreted this function to represent a gradient of structural heterogeneity because of the positive correlation with variables associated with mixed forest and the negative correlation with variables associated with early successional shrublands. Vegetation types also differed significantly ($F = 17.9$, $P<0.0001$, $df = 26$) and accounted for 74% of the

variation on the second canonical discriminant function. This function was highly positively correlated with deciduous tree cover and short tree cover and highly negatively correlated with coniferous tree cover (Table 4-2). I named this function "tree canopy type" because of the highly contrasting values of deciduous and coniferous tree canopy cover. Combined, the first two canonical functions accounted for 92% of the total variability.

Birds

I detected 2,497 individuals of 47 bird species at 326 point count stations. Total species richness was similar across all vegetation types; 33 species were recorded in shrublands and young forest, 32 species were recorded in mixed forest, and 31 species were recorded in mature forest. Species recorded <5 times were detected more often in shrub and young forest than in mature and mixed forest stands. For example, 6 species (Black-and-White Warbler, Northern Flicker, Olive-sided Flycatcher, Rusty Blackbird, Tennessee Warbler, and Western Wood-Pewee) were detected only within shrub and young forest, whereas, three species (Downy Woodpecker, Magnolia Warbler, and Red Crossbill) were detected only in mature and mixed forests. The remaining two species (Black-capped Chickadee and Chipping Sparrow) were recorded in multiple habitat types (Appendix C-2).

Eleven species that were detected ≤ 5 times in at least one habitat were excluded from statistical analyses. Abundance of the 36 species included in analyses varied considerably; Yellow Warbler (13% of all individuals, 65% of all stations), Warbling Vireo (9% of all individuals, 52% of all stations), Yellow-rumped Warbler (7.7% of

all individuals, 46% of all stations), Wilson's Warbler (7.6% of all individuals, 39% of all stations), and Orange-crowned Warbler (5.7% of all individuals, 34% of all stations) comprised nearly half (43%) of the total number of individuals detected, whereas 14 species were detected <25 times.

Bird Species Richness and Diversity

Species richness differed slightly among vegetation types; mixed forest and young forest had the highest species richness (31 and 30, respectively); mature forest and shrub had slightly lower species richness (28 and 27 species, respectively; Table 4-3). The majority (77%) of species occurred in ≥ 3 habitat types. Bird species richness, as estimated by rarefaction was virtually identical for mixed forest and young forest and slightly lower for mature forest and shrub (Fig. 4-3; Table 4-3). Point richness (mean number of species recorded at a sampling station) differed significantly ($\chi^2 = 30.7$, $P = <0.0001$) among vegetation types and was greatest in mixed forest and lowest in young forest (Table 4-3). Based on rarefaction estimates, mixed forest had the greatest species diversity, followed by young forest, mature forest, and shrublands (Table 4-3).

Abundance

Point abundance (mean number of individuals observed per sampling point) differed significantly ($\chi^2 = 17.2$, P = .001) among habitat types and was highest in mixed forest and lowest in young forest stands (Table 4-3).

Twenty-five of the 36 species tested had abundances that were significantly different among habitat types (Appendix C-2). Ten species (Alder Flycatcher, Common

Yellowthroat, Fox Sparrow, Gray-cheeked Thrush, Hermit Thrush, Lincoln's Sparrow, Orange-crowned Warbler, Savannah Sparrow, Song Sparrow, and Wilson's Warbler) were more abundant in shrub habitat; Alder Flycatchers and Savannah Sparrows were only observed in shrub habitat. Red-eyed Vireos only occurred in young forest stands. American Redstarts, Hammond's Flycatchers, and Warbling Vireos were more abundant in mature forest stands. Of the 24 significant species, 11 (Brown Creeper, Chestnut-backed Chickadee, Golden-crowned Kinglet, Hairy Woodpecker, Pacific-slope Flycatcher, Ruby-crowned Kinglet, Swainson's Thrush, Townsend's Warbler, Varied Thrush, Western Tanager, and Winter Wren) were more abundant in mixed forest stands (Appendix C-2).

Nest Guilds

Of the 36 bird species included in analyses, the majority of species belonged to the tree and ground nesting guilds (22 species or 63%). I detected a total of four cavity nesting species and 10 shrub nesting species. Although the number of ground nesting species was similar across vegetation types, the frequency and proportion of individuals belonging to this guild was highest in shrublands and lower in forested stands (Table 4-4). The number of species and proportion of individuals belonging to the shrub nesting guild was highest in shrublands; however, the frequency of individuals belonging to this guild was highest in mature forest. The number of species, frequency, and proportion of individuals belonging to tree and cavity nesting guilds were highest in mixed forest (Table 4-4).

Migratory Status

The majority (23 species or 64%) of species included in analyses were long distance migrants. Of the remaining 13 species, 9 were residents and 4 were short distance migrants. The number of species, frequency, and proportion of individuals belonging to long distance migrant guild was similar among all vegetation types (Table 4-5).

The number of short distance migrant species was identical across vegetation types; however, the frequency and proportion of individuals was greatest in mixed forest and lowest in shrub and young forest stands (Table 4-5). The number of resident species was highest in mixed forest, similar for young forest and mature forest and lowest in shrublands. Frequency and proportion of resident individuals were highest in mixed forest and shrub dominated sites than in young forest and mature forest stands (Table 4-5).

CCA of Bird Species and Vegetation Structure Data

Of the 14 variables corresponding to physiognomic characteristics of vegetation tested individually for significant variation in CCA, 8 accounted for significant variation in the species matrix (Table 4-6). According to stepwise forward selection, the four most important variables were medium shrub cover, deciduous tree cover, coniferous tree cover, and water cover. The first function from the CCA was significant ($F = 18.1$, $P < 0.005$, from the bootstrap Monte Carlo test) and accounted for 9% of the variation in species abundances and 38% of the covariation between birds and vegetation. The first CCA function was a gradient from shrublands with high percent herb and water

cover and low structural complexity, to forest stands with tall trees and diverse structure (low and med. shrub were positively correlated with this axis; Fig. 4-3). Because of the positive loading of tall tree canopy cover and the negative loading of water and herb cover, I interpreted this function to explain a gradient of structural heterogeneity from shrub to mixed forest. The second function was also significant ($F = 3.7$, $P = .005$) and accounted for 5% of the variation between species abundances and 18% of the covariance between birds and vegetation. The most important (positively loaded) variable was coniferous tree cover. Deciduous tree cover and tall shrub cover were at the opposite end of the gradient (Fig. 4-3). As a result, I interpreted this function to represent tree canopy type.

Bird species associated with shrub habitats were clearly separated at the negative end of the first function (Fig. 4-3). Environmental indicators of these species were cover of herbaceous vegetation and water. Species associated with the coniferous component of mixed forest stands were also clearly grouped in the upper right quadrant. Species that were equally abundant in all habitat types, such as Yellow Warbler, American Robin, and Rufous Hummingbird were centrally positioned (Fig. 4-3).

CCA of Bird Species and Vegetation Composition

I also included vegetation composition data in CCA tests to examine whether the composition of vegetation was useful in explaining bird presence and abundance. Of the 38 vegetation species variables tested individually for their significance in CCA, 10 accounted for significant variation in the species matrix (Table 4-7). According to forward stepwise selection the 5 most important variables were elderberry low shrub

cover, spruce tall tree cover, alder tall tree cover, salmonberry low shrub cover, and cottonwood tall tree cover (Table 4-7). The first function from the CCA was significant ($F = 19.7$, $P < 0.005$, from the bootstrap Monte Carlo test) and accounted for 11% of the variation in species abundances and 39% of the covariation between birds and vegetation. The most important variable (positively loaded) for the first function was elderberry low shrub cover, an indicator of dense shrublands with low structural complexity of vegetation. Spruce tall tree cover, alder tall tree cover, and dogwood medium shrub cover were negatively loaded with this function and were variables correlated with mixed forest stands (Fig. 4-4). I interpreted this function to explain a gradient of structural heterogeneity. The second function was also significant ($F = 5.9$, $P = .005$) and accounted for 7% of the variation between species abundances and 22% of the covariance between birds and vegetation. This function was positively correlated with elderberry low shrub cover and spruce low tree cover and negatively correlated with alder tall shrub cover, willow short tree cover, willow low shrub cover, and cottonwood tall tree cover (Fig. 4-4). As a result, I interpreted this function to represent a moisture gradient between vegetation associated with drier well-developed soil conditions (i.e., spruce, elderberry) and vegetation associated with more mesic soil conditions (i.e., alder, cottonwood, willow). The positive loading of spruce tall tree cover and negative loading of cottonwood, alder, and willow cover may also indicate that this function is influenced by differences between coniferous (and shrub species associated with coniferous sites) and deciduous vegetation.

Birds associated with forested stands were located at the negative end of the first

function with spruce associated species clearly separated in the upper left quadrant and cottonwood associated species clearly separated in the lower left quadrant (Fig.4- 4). Birds located in the positive end of the first function were primarily ground nesting species with birds associated with drier soil conditions in the upper right quadrant (e.g., Fox Sparrow, Wilson's Warbler) and species associated with mesic soil conditions located in the lower right quadrant (e.g., Common Yellowthroat, Song Sparrow; Fig. 4-4).

Species of Interest and Conservation Concern

I recorded 6 species during point counts that were more common to the Canadian interior and primarily restricted to the major mainland rivers. Of these, Hammond's Flycatchers, Warbling Vireos, Red-eyed Vireos and American Redstarts were most abundant in young to mature forest stands (Appendix C-2) and were associated with salmonberry low shrub cover and cottonwood tall tree cover (Fig. 4-4). Common Yellowthroats were more frequently encountered in shrublands than other vegetation types (Appendix C-2) and were associated with mesic sites with herbaceous vegetation and willow low shrub cover (Fig. 4-4). Western Tanagers were more abundant in mixed forest stands (Appendix C-2) and were associated with spruce tall tree cover (Fig. 4-4).

Western Wood-Pewees, Hammond's Flycatchers, and MacGillivray's Warblers were listed by Boreal Partners in Flight (1999) as priority species of concern. Western Wood-Pewees, although not entirely uncommon at the major mainland rivers (see chapter 2), were only recorded once within the 50-m radius point counts (Appendix C-2). MacGillivray's Warblers were relatively uncommon yet were most often detected in

shrublands, mature forest, and mixed forest where there was a dense shrub layer (Appendix C-2). MacGillivray's Warblers were associated with salmonberry low shrub cover and cottonwood tall tree cover (Fig. 4-4).

Three of the five species selected as management indicator species in the Tongass National Forest Land and Resource Management Plan were detected during point counts. Brown Creepers were rarely detected and only within mixed forest stands (Appendix C-2). They were associated with mixed spruce and alder tall tree cover (Fig. 4-4). It may be possible that Brown Creepers were under-counted, because of the species' high frequency vocalizations that were difficult to detect at distances greater than 50 m (pers. obs.). Hairy Woodpeckers were recorded in young forest and mixed forest habitats (Appendix C-2) and were associated with spruce tall tree cover (Fig. 4-4). This species was observed foraging in young forest stands, yet the only evidence of breeding was observed in mixed forest stands (pers. obs.). Red-breasted Sapsuckers were detected in all four vegetation types, yet they were detected more often in mature and mixed forest stands than in shrub and young forest (Appendix C-2). They were associated with cottonwood tall tree cover (Fig. 4-4). On several occasions, Red-breasted Sapsuckers were observed feeding at sap wells in shrub and young forest stands, yet evidence of nesting was only observed in older forest sites where large standing snags were present (pers. obs.).

Discussion

Comparison among Vegetation Types

It is generally assumed that there is an increase in the number of bird species as

structural complexity of the habitat increases (MacArthur and MacArthur 1961). However, species richness based on both standardized and non-standarized data was similar among all habitats. This was surprising because of the vast differences in structural complexity among vegetation types as indicated by the percent cover of vegetation at several vertical strate (e.g., low shrub to tall tree). Similarity of species richness values across vegetation types was likely influenced by the higher number of of rare species recorded at shrubland sites, indicating the importance of this relatively uncommon vegetation type outside of the major mainland rivers to a high number of shrub-associated bird species. Species diversity, point richness, and point abundance, however, were greater in mixed forest than other habitat types, suggesting that mixed forests were more spatially and floristically heterogeneous than other vegetation types. This is consistent with other studies that found higher overall bird abundance and diversity in habitats with the most complex vegetation structure (MacArthur and MacArthur 1961, Mosconi and Hutto 1982, Taylor 1986). In addition, differences in total bird species richness (pooled) and point richness (mean number of species per point) suggests that species richness is a scale-sensitive property at major mainland rivers.

The low (five) number of species that comprised nearly half of the total number of detections was similar to what Willson and Comet (1996a) found in southeastern Alaska. Species dominance at the major mainland rivers was also similar to the findings of studies conducted in northern forests (Spindler and Kessel 1980, Haila and Jarvinen 1990) and southcentral Alaska (Kessel 1998). However, bird species richness in deciduous riparian vegetation was lower at major mainland rivers than in similar habitats

further south. For example, Saab (1999) recorded an average of 29 species in riparian cottonwood (*Populus fremontii*) forest patches in Idaho. The lower species richness at major mainland rivers compared to southern regions is probably influenced by the lack of bird species associated with deciduous riparian vegetation, e.g., orioles, grosbeaks, and kingbirds (Willson and Comet 1996a). The lack of these riparian-associated species suggests that bird communities of deciduous riparian vegetation of the major mainland rivers may be unsaturated; this is consistent with studies of other northern bird communities (Enemar et al. 1984, Virkala 1991, Wilson and Comet 1996a).

The majority (77%) of species occurred in three or more vegetation types, indicating the wide habitat breadths of bird species within deciduous riparian vegetation. I considered species that had similar frequencies in three or more habitat types, including American Robin, Dark-eyed Junco, MacGillivray's Warbler, Red-breasted Sapsucker, Yellow-rumped Warbler, and Yellow Warbler, to be habitat generalists within deciduous riparian vegetation. Each of the vegetation types I sampled was influenced in varying degrees by coniferous vegetation. As a result, species abundances and richness values were probably increased for shrublands, young forest, and mature forest because of the presence of coniferous associated species.

Nesting guild structure among vegetation types followed predictable patterns. The number of species, frequency, and proportion of individuals of birds in the tree-nesting and cavity-nesting guilds increased from shrub to mixed forest. There was a trend towards a decrease in the number of species, frequency, and proportion of individuals in the ground-nesting guild from mixed forest to shrublands. The number of shrub-nesting

species and proportion of individuals occurring in the shrubland vegetation type was, although similar across vegetation types, slightly higher in shrublands. The frequency of shrub-nesting birds was highest in mature forest and slightly higher in mixed forest and shrublands than in young forest. Results from ordinations showed a distinct separation between ground-nesting birds that selected sites based on soil moisture levels. Fox sparrows, Hermit Thrushes, Orange-crowned Warblers, and Wilson's Warblers were associated with drier soil conditions, whereas, Common Yellowthroats, Lincoln's Sparrows, Northern Waterthrushes, and Song Sparrows were associated with more mesic soil conditions or areas with a high percentage of surface water cover.

The number of species, frequency, and proportion of long-distance migrants was similar among vegetation types and accounted for the majority of bird species recorded. The number of short-distance migrant species and proportion of individuals was similar across habitat types; however, the frequency of individuals belonging to this guild was much higher in mixed forest than other vegetation types. Although, the number of resident species was highest in mixed forest and young forest, the frequency and proportion of individuals of resident species was higher at shrublands and mixed forests than young forest and mature forests.

Of the species associated with the Canadian interior that showed significant differences in abundance among habitat types, most reached their highest abundances in mature forest stands. American Redstarts, Red-eyed Vireos, and Warbling Vireos were associated with deciduous forests and cottonwood tall tree cover. Common Yellowthroats were associated with mesic shrublands containing high herbaceous cover and willow low

shrub. Western Tanagers were associated with mixed forest and spruce tall tree. Overall, with the exception of Hammond's Flycatcher, species of management concern, including Boreal Partners in Flight's (1999) species of concern and the Forest Service's management indicator species (1997), were not frequently detected during point counts. In order to provide more detailed information on the abundance and habitat preferences of these species, it is recommended that studies be conducted that specifically target these species.

Vegetation Structure and Composition Effects

Ordinations of the bird communities and environmental variables indicated that bird-habitat relationships were primarily influenced by vegetation structure, composition of the tree canopy, and soil moisture. Interestingly, the canonical discriminant analysis and canonical correspondence analyses produced similar structuring of the vegetation even though the CDA was derived only from the vegetation data and the CCA was constructed from both vegetation and bird species abundance data. The first function of both CDA and CCA tests was a gradient from high structural complexity to low structural complexity. Similarly, the second function of CDA and CCA tests described a gradient between deciduous and coniferous tall tree canopy cover. For the CDA, this was indicated by the highly positive correlation with percent cover of coniferous tree canopy cover and the negative correlation with percent cover of deciduous tree canopy. Although the CCA was similarly influenced by vegetation type of the tree canopy, the second function was positively correlated with percent cover of deciduous tree canopy and negatively correlated with coniferous tree canopy. However, the second function of

the CCA that included species composition of vegetation was influenced by a gradient in soil moisture, from drier spruce tall tree and elderberry low shrub to mesic willow low shrub, willow short tree, and alder high shrub.

I found a pattern among Hammond's Flycatchers and Warbling Vireos, both of which are primarily interior species associated with deciduous tall tree canopies. These species were more highly associated with tall cottonwood trees than tall alder trees. This is consistent with the idea that these species have reached southeastern Alaska from the Canadian interior via the major mainland rivers along a gradient of balsam poplar (*Populus balsamifera*) and trembing aspen (*Populus tremuloides*) forests of the interior and cottonwood forests of the coastal regions. Based on ordinations, it is apparent that bird communities of deciduous riparian vegetation respond to both structure and composition of vegetation as well as physical habitat features such as the presence and cover of surface water.

Overall, results of CCAs mirrored bird-habitat relationships expected by the author. CCA allows one to conduct exploratory analyses that indicate environmental variables important to birds. The ease of interpretability of the CCA biplots may also be an important feature of this analysis.

Management Considerations

Results of this study indicate that deciduous riparian vegetation of the major mainland rivers supports a diverse avifauna. Bird communities present in each vegetation type were relatively distinct and each vegetation type was important to certain species. Species of interest to managers, including birds associated with the Canadian

interior, species of concern, and management indicator species occurred in each of the vegetation types. Although major mainland rivers are relatively unchanged by anthropogenic disturbances compared to riparian zones of the contiguous U.S., several major mainland rivers face the increased threats of mining, hydroelectric projects, and road building. In order to preserve the integrity of these riparian systems it is important to consider how changing land use practices will affect the extent and availability of regionally limited habitats as well as the connectivity between rivers and between southeastern Alaska and the Canadian interior.

Although several species of management concern were detected during our sampling efforts, sample sizes were low. More rigorous long-term and species specific sampling is advised in order to provide a more complete understanding of population trends and habitat associations of these rare species.

Finally, managers should use caution when making management decisions based on abundance measures. Although reproductive success has been positively correlated with the abundance of individuals (Thomas 1990), this relationship is not universal. For example, Van Horne (1983) and Vickery et al. (1992) found that reproductive success was negatively related to abundance. Therefore, managers should consider conducting future studies that examine the demographics of birds, especially species of management concern, at the major mainland rivers.

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Table 4-1. Differences in vegetation characteristics (mean ± SE) among shrub, young forest, mature forest, and mixed forest dominated riparian vegetation at major mainland rivers of southeastern Alaska.

	Vegetation Types				Kruskal-Wallis	
Vegetation characteristic	Shrub (n=53)	Young Forest (n=90)	Mature Forest (n=92)	Mixed Forest (n=90)	χ^{2a}	P[b]
Average canopy ht (m)	6.7±0.2	12.4±1.0	26.9±1.1	31.6±1.4	81.1	<0.0001
Coniferous tree cover (%)	0.85±0.3	1.3±0.39	2.9±0.5	28.8±1.8	216.2	<0.0001
Deciduous tree cover (%)	7.04±1.1	67.2±2.9	78.2±2.1	60.5±3.0	142.4	<0.0001
Tall tree cover (%)	1.8±0.6	42.3±3.0	54.7±2.8	59.9±3.0	182.7	<0.0001
Short tree cover (%)	7.1±0.9	42.1±1.9	28.4±1.5	27.1±1.3	136.6	<0.0001
Tall shrub cover (%)	23.5±3.0	40.0±2.4	44.7±1.9	42.7±2.0	44.2	<0.0001
Medium shrub cover (%)	34.7±3.0	36.6±2.2	53.6±2.3	70.9±2.4	102.3	<0.0001
Low shrub cover (%)	41.7±2.3	36.3±2.0	54.3±2.1	64.0±1.8	83.2	<0.0001
Herb cover (%)	61.6±3.5	46.3±2.4	43.5±2.3	37.2±0.2	15.3	0.002
Water cover (%)	15.0±3.1	5.9±1.2	5.5±1.5	1.9±0.6	5.0	0.01
% points containing snags	0.07±0.04	0.14±0.04	0.4±0.05	0.7±0.06	81.9	<0.0001
% points containing cavities	0.05±0.03	0.06±0.02	0.2±0.04	0.3±0.04	16.4	0.01
Tree species richness	1.5±0.2	2.7±0.1	3.1±0.1	3.4±0.7	87.0	<0.0001
Shrub species richness	5.0±0.2	6.0±0.2	6.9±0.2	7.4±0.2	75.6	<0.0001

[a]Differences among vegetation types were tested using the χ^2 approximation for the Kruskal-Wallis test (df=3) (SAS Institute, Inc. 1999). [b]p value based on Kruskal-Wallis tests, where p=<0.05 indicates significant difference among vegetation types.

Table 4-2. Correlations between 14 vegetation characteristics and the first two canonical discriminant functions.

Vegetation characteristic	Canonical discriminant function 1 (structural heterogeneity)	Canonical discriminant function 2 (tree canopy veg. type)
Ave. canopy height (m)	0.85	0.10
Coniferous tree cover (%)	0.74	-0.53
Deciduous tree cover (%)	0.55	0.67
Tall tree cover (%)	0.78	0.12
Short tree cover (%)	0.16	0.63
Tall shrub cover (%)	0.11	0.45
Medium shrub cover (%)	0.63	-0.08
Low shrub cover (%)	0.51	-0.17
Herb cover (%)	-0.24	-0.12
Water cover (%)	-0.21	-0.12
Points containing snag (%)	0.55	-0.12
Points containing cavity (%)	0.44	-0.04
Tree species richness	0.58	0.21
Shrub species richness	0.52	0.08

Table 4-3. Number of point counts, bird species richness, point richness, point abundance, and diversity for birds recorded at six major mainland rivers of southeastern Alaska.

Vegetation type	No. sampling points	Total bird species richness[a]	Bird species richness[b]	Relativized bird species richness[c]	Point richness[d]	Point abundance[e]	Total species diversity[f]	Relativized species diversity[g]
Shrub	53	33	27	27	5.2	7.5	2.72	2.72
Young forest	90	33	30	29	5.0	6.5	2.86	2.85
Mature forest	92	31	28	28	5.7	7.7	2.85	2.83
Mixed forest	90	32	31	30	6.8	8.7	3.05	3.04

[a]Total number of bird species recorded in each vegetation type. [b]Number of bird species recorded ≥ 5 times in at least one vegetation type. [c]Bird species richness based on rarefaction estimate. [d]Mean number of bird species recorded per sampling station. [e]Mean number of individuals recorded per sampling station. [f]Total bird species diversity in each vegetation type. [g]Bird species diversity based on rarefaction estimates.

Table 4-4. Number of species and proportion of individuals belonging to four nesting guilds within four deciduous riparian vegetation types at 6 major mainland rivers of southeastern Alaska.

Nest Guild	Vegetation Types											
	Shrub			Young Forest			Mature Forest			Mixed Forest		
	No. species	Proportion individuals[a]	Frequency individuals[b]	No. species	Proportion individuals	Frequency individuals	No. species	Proportion individuals	Frequency individuals	No. species	Proportion individuals	Frequency individuals
Ground	10	55	4.2	9	36	2.3	8	20	1.5	8	17	1.4
Shrub	7	35	1.9	6	25	1.7	6	32	2.4	5	21	2.0
Tree	8	9	1.5	12	37	2.4	11	45	3.4	14	55	4.9
Cavity	2	1	0.17	3	2	0.18	3	3	0.23	4	7	0.63

[a]Proportion of individuals was calculated by dividing the number of individuals occurring in each guild by the total number of individuals recorded in each vegetation type. The total proportion for each vegetation type = 100%. [b]Mean number of individuals belonging to each guild recorded per sampling station.

Table 4-5. Number of species and proportion of individuals belonging to three migratory guilds within four deciduous riparian vegetation types at 6 major mainland rivers of southeastern Alaska.

	Vegetation Type											
Migratory Guild	Shrub			Young Forest			Mature Forest			Mixed Forest		
	No. species	Proportion individuals[a]	Frequency individuals[b]	No. species	Proportion individuals	Frequency individuals	No. species	Proportion individuals	Frequency individuals	No. species	Proportion individuals	Frequency individuals
LD[c]	19	84	6.3	20	87	5.6	20	89	6.6	19	78	6.8
SD[d]	4	3	0.23	4	4	0.24	4	5	0.36	4	10	0.92
R[e]	4	13	1.1	6	9	0.62	4	6	0.48	8	12	1.2

[a]Proportion of individuals was calculated by dividing the number of individuals occurring in each guild by the total number of individuals recorded in each vegetation type. The total proportion for each vegetation type = 100%. [b]Mean number of individuals belonging to each guild recorded per sampling station. [c]Long-distance migrant. [d]Short-distance migrant. [e]Resident.

Table 4-6. The contribution of single vegetation structure/site variables to CCA model in deciduous riparian vegetation at 6 major mainland rivers of southeastern Alaska. Significant variables (p=<0.01) are in bold.

Variable acronym (description)	Order[a]	Variance[b]	P^c
% cover medium shrub	**1**	**0.21**	**0.005**
% cover deciduous tree	**2**	**0.11**	**0.005**
% cover coniferous tree	**3**	**0.08**	**0.005**
% cover surface water	**4**	**0.07**	**0.005**
% cover tall shrub	**5**	**0.05**	**0.005**
% cover low shrub	**6**	**0.03**	**0.005**
% cover herb cover	**7**	**0.025**	**0.005**
Average canopy height (m)	**8**	**0.024**	**0.005**
Tree species richness	9	0.02	0.04
Points containing snag (%)	10	0.02	0.03
Presence containing cavity (%)	11	0.015	0.4
Tall tree cover (%)	12	0.014	0.45
Short tree cover (%)	13	0.02	0.06
Shrub species richness	14	0.01	0.5

[a]Order added based on forward stepwise selection of variables. [b]Percentage of variance explained by individual variables. [c]Alpha level indicates whether variable is significant in model.

Table 4-7. Contribution of single vegetation composition variables to CCA model in deciduous riparian vegetation at 6 major mainland rivers of southeastern Alaska. Significant variables (p=<0.01) are in bold.

Vegetation species variable acronym (description)	Order[a]	Variance[b]	P^c
% cover elderberry low shrub *Sambucus racemosa*	**1**	**0.19**	**0.005**
% cover spruce tall tree *Picea sitchensis*	**2**	**0.14**	**0.005**
% cover alder tall tree *Alnus rubra*	**3**	**0.07**	**0.005**
% cover salmonberry low shrub *Rubus spectabalis*	**4**	**0.07**	**0.005**
% cover cottonwood tall tree *Populus trichocarpa*	**5**	**0.07**	**0.005**
% cover willow short tree *Salix pacificus*	**6**	**0.05**	**0.005**
% cover dogwood med. shrub *Cornus stolonifera*	**7**	**0.04**	**0.005**
% cover willow low shrub *Salix* spp.	**8**	**0.03**	**0.005**
% cover devil's club med. shrub *Oplopanax horridus*	**9**	**0.03**	**0.005**
% cover alder tall shrub *Alnus sinnuata*	**10**	**0.03**	**0.005**
% cover med. shrub *Salix* spp.	11	0.03	0.015
% cover short tree *Picea sitchensis*	12	0.02	0.015
% cover med. shrub *Sambucus racemosa*	13	0.02	0.08
% cover tall tree *Betula papyrifera*	14	0.02	0.08
% cover short tree *Populus trichocarpa*	15	0.02	0.05
% cover med. shrub *Ribes* spp.	16	0.02	0.08
% cover low shrub *Ribes* spp.	17	0.02	0.05
% cover short tree Malus	18	0.02	0.13
% cover med. shrub *Alnus sinuata*	19	0.02	0.08
% cover med. shrub *Rubus spectabalis*	20	0.02	0.13
% cover short tree *Betula papyrifera*	21	0.02	0.13
% cover low shrub *Viburnum edulis*	22	0.02	0.12
% cover low shrub *Alnus sinuata*	23	0.02	0.2
% cover tall shrub *Cornus stolonifera*	24	0.02	0.26
% cover low shrub *Oplopanax horridus*	25	0.02	0.13

Vegetation species variable acronym (description)	Order[a]	Variance[b]	P^c
% cover low shrub *Myrica gale*	26	0.02	0.2
% cover tall shrub *Salix* spp.	27	0.01	0.23
% cover low shrub *Cornus stolonifera*	28	0.01	0.41
% cover tall shrub *Rubus spectabilis*	29	0.01	0.31
% cover low shrub *Rosa nootka*	30	0.01	0.44
% cover low shrub *Vaccinium* spp.	31	0.01	0.5
% cover low shrub *Acer glabrum*	32	0.01	0.5
% cover low shrub *Sorbus sitchensis*	33	0.01	0.53
% cover tall shrub *Acer glabrum*	34	0.01	0.72
% cover med. shrub *Acer glabrum*	35	0.01	0.77
% cover med. shrub *Rosa nootka*	36	0.01	0.78
% cover tall shrub *Viburnum edulis*	37	0.01	0.97
% cover low shrub *Viburnum edulis*	38	0.01	0.93

[a]Order added based on forward stepwise selection of variables. [b]Percentage of variance explained by individual variables. [c]Alpha level indicates whether variable is significant in model.

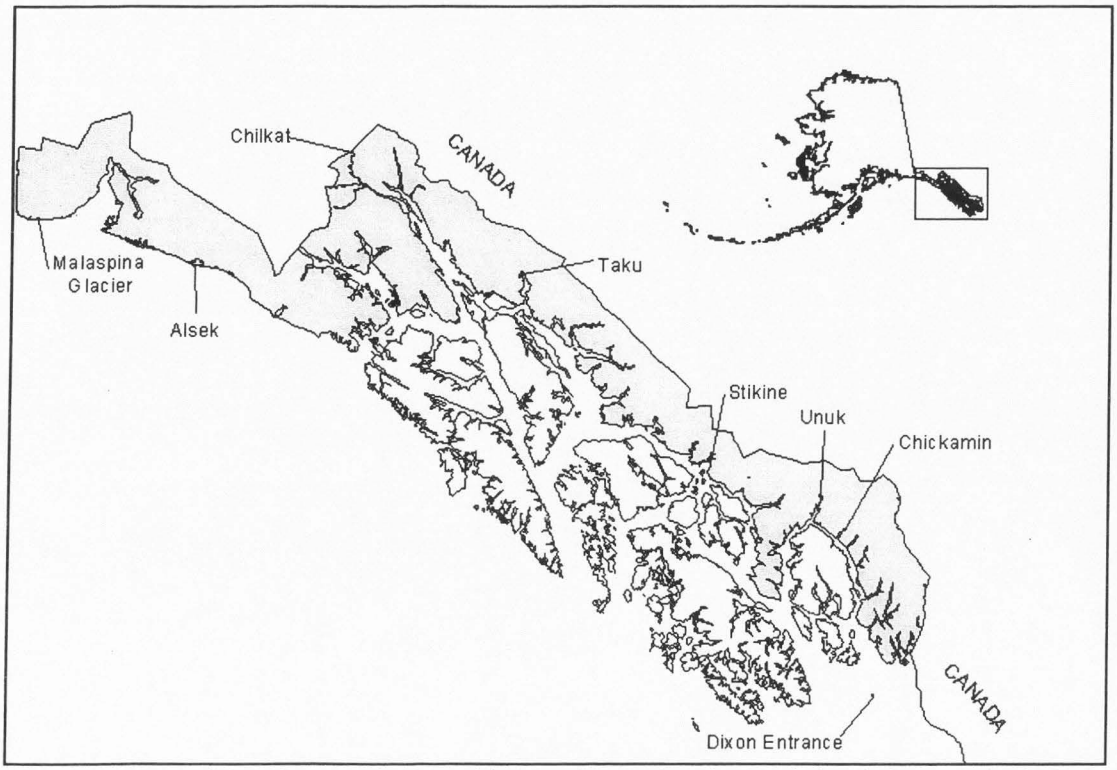

Fig. 4-1. Map of Southeast Alaska with locations of major mainland rivers. Shaded area signifies mainland area.

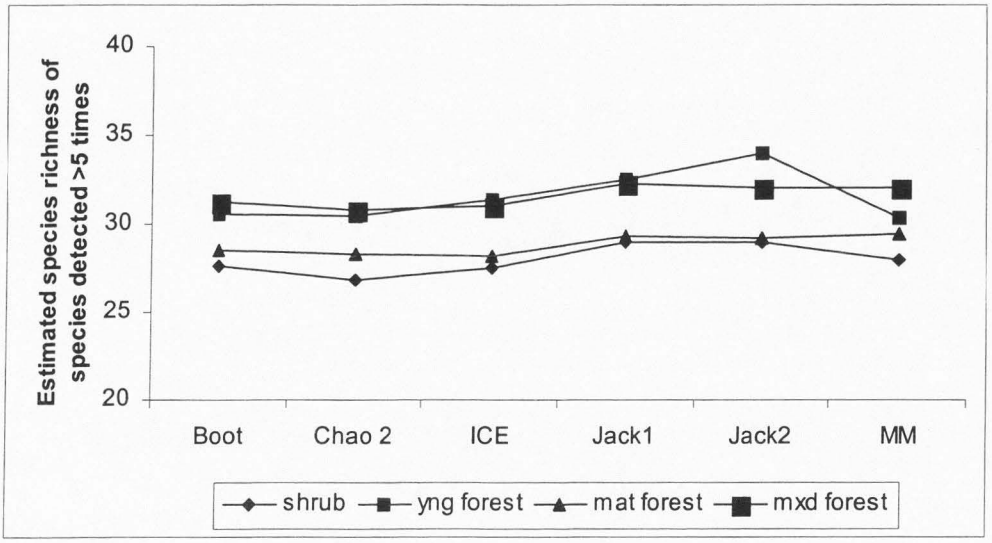

Fig. 4-2. Estimated species richness of the four habitat types for six different estimators.

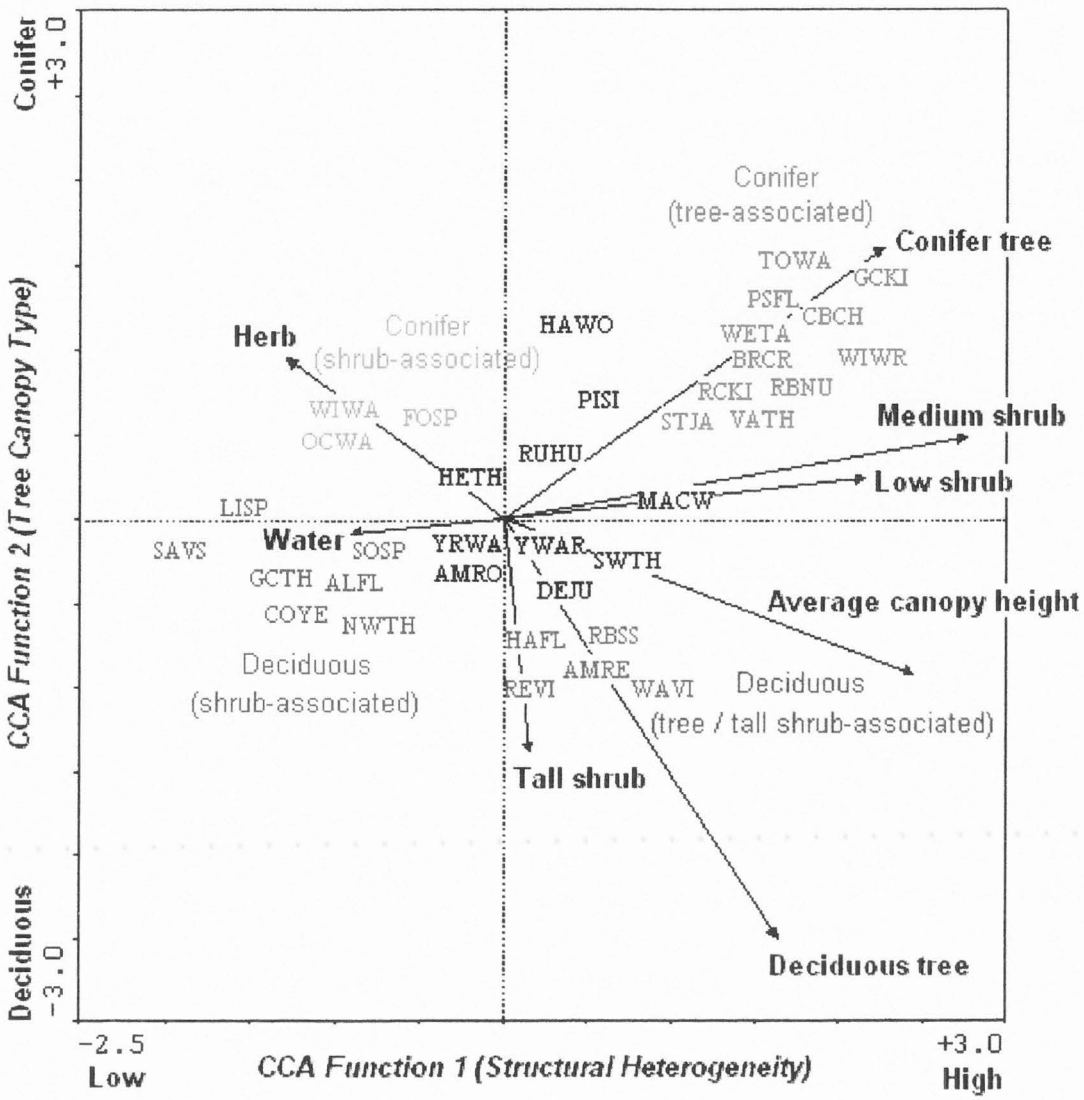

Fig 4-3. Species-environment biplot from the canonical correspondence analysis. Bird species are represented by abbreviations of their common names (see Appendix C-1). Locations of bird species on the biplot indicate where they were most abundant in two-dimensional CCA space. Environmental variables consist of vegetation structure/site characteristics; acronyms are in Table 6. Only the 8 statistically significant environmental variables ($p=<0.01$, Monte Carlo permutation test, 199 permutations) are shown. Arrows indicate the direction within CCA space in which the vegetation characteristics

increased, and the length of the arrows indicates the degree of correlation between the vegetation characteristics and the CCA function.

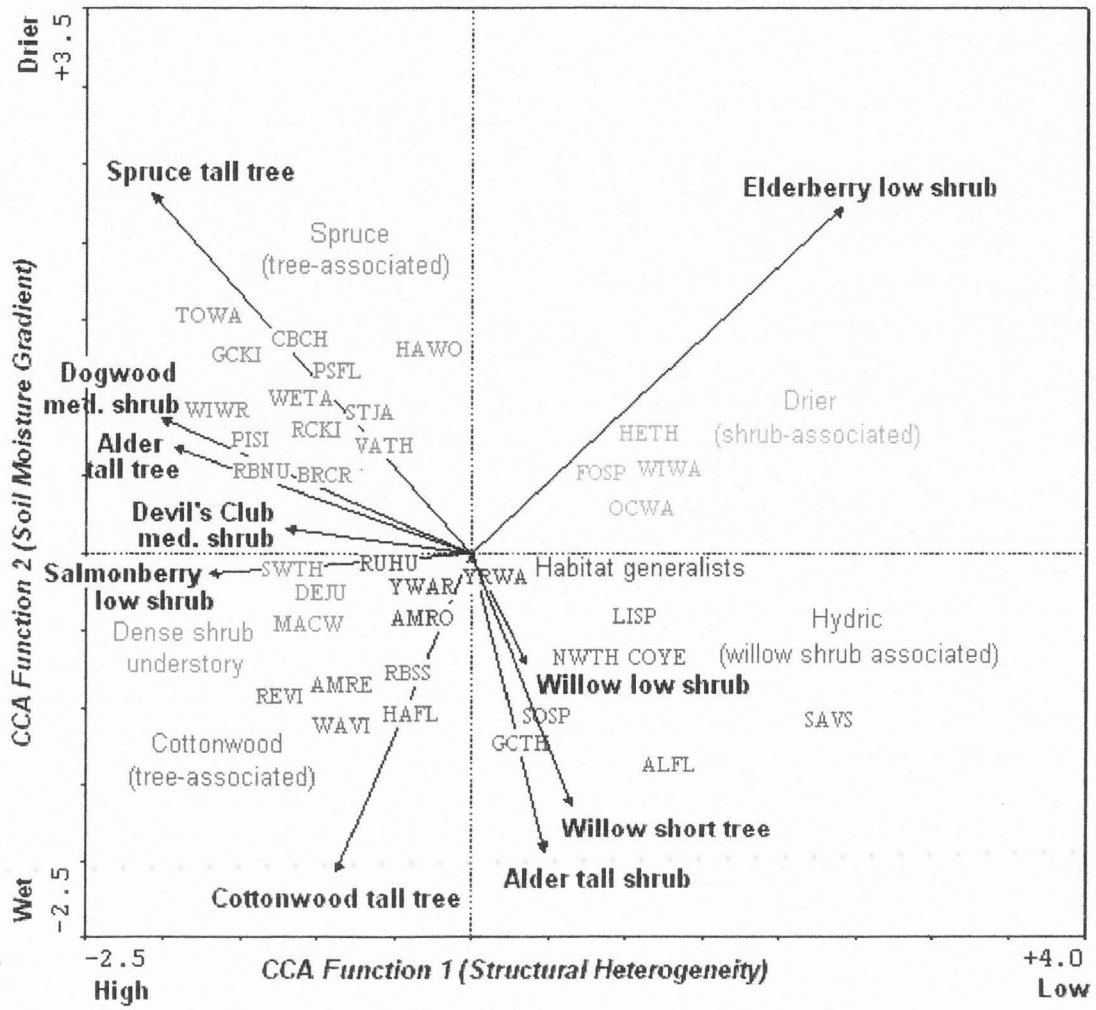

Fig. 4-4. Species-environment biplot from the canonical correspondence analysis of vegetation species composition. Bird species are represented by abbreviations of their common names (Appendix C-1). Locations of bird species on the biplot indicate where they were most abundant in two-dimensional CCA space. Environmental variables consist of vegetation species composition; acronyms are in Table 7. Only the 10 statistically significant environmental variables ($p=<0.01$, Monte Carlo permutation test, 199 permutations) are shown. Arrows indicate the direction within CCA space in which the vegetation characteristics increased, and the length of the arrows indicates the degree of correlation between the vegetation characteristics and the CCA function.

CHAPTER 5

CONCLUSION

Similar to riparian systems in arid environments, the diversity and structural complexity of habitats in riparian areas in southeastern Alaska contrasted markedly with the relative homogeneity of adjacent upland habitats, which in this study were dominated by spruce-hemlock forest. River processes in the region, in particular created novel habitats, such as deciduous plant communities and freshwater marshes, and a dynamic mosaic of vegetation patches characterized by unique interfaces between stream channel and riparian vegetation and between riparian and upland vegetation. Riparian habitats at major mainland rivers supported a diverse breeding avifauna consisting of 80% of the birds known or suspected to breed in southeastern Alaska. Bird communities of the major mainland rivers showed a strong pattern of seasonal use; i.e., the majority (69%) of the 134 breeding species was migrants.

The linearity and connectivity of riparian zones allows for the migration and dispersal of flora and fauna at multiple spatial scales (Malanson 1993). Riparian vegetation may help connect patchy or fragmented habitats at the local scale within a watershed as well as facilitate the transfer of nutrients between aquatic and terrestrial habitats. At larger scales, the major mainland rivers may act as corridors for the movement and dispersal of species across otherwise ecological distinct regions. This is especially evident at the trans-mountain rivers where plant and bird species characteristic of the Canadian interior penetrate into and integrate with sister taxa in the coastal rainforests of southeast Alaska. The extension of interior plant communities into

coastally influenced areas along these rivers in particular acts as a mechanism that allows for the invasion of Canadian boreal forest birds, such as Warbling Vireo, American Redstart, and Common Yellowthroat into the coastal zone. These and other species associated with the Canadian interior have distributions in southeastern Alaska that are primarily restricted to the major mainland rivers. It is apparent from this study that the majority of species associated with the Canadian interior regularly occur at both trans-mountain and coastal rivers. Although Canadian interior associated species probably reached southeastern Alaska via the trans-mountain rivers, it is apparent by their presence and abundance that these species have successfully colonized coastal rivers. There are no data regarding how species originally colonized coastal rivers, however short overland flights from the interior in the case of the Chilkat or from trans-mountain rivers via major tributaries in the case of the Stikine-Iskut rivers and the Unuk appears most likely. The scarcity of appropriate habitats, especially deciduous riparian vegetation, probably limit further dispersal in the region. In southeastern Alaska, the presence of Canadian interior species may be influenced by the size of the river valley and the frequency of flooding which in turn influences the amount of deciduous riparian vegetation available for breeding (Willson and Comet 1996a,b).

Deciduous riparian vegetation of the major mainland rivers of Southeast Alaska is clearly important for breeding birds in this region. Vegetation characteristics within habitat types differed among rivers; the most obvious differences being low percent cover of surface water and the lack of mature and mixed forest stands at the Alsek. Not surprisingly, differences in bird community composition, species richness, and certain

nesting guilds among rivers were greatest between the Alsek and other rivers. Species associated with mature and mixed forests, such as Red-breasted Sapsucker, Brown Creeper, Hammond's Flycatcher, and Warbling Vireo, were not detected and are not known to occur at the Alsek. Additionally, species associated with mesic shrubland habitats, such as Alder Flycatcher, Common Yellowthroat, Northern Waterthrush, and Song Sparrow, were not detected at the Alsek. The lack of mature and mixed forest stands and mesic shrub habitats explains the low proportion of tree- and shrub-nesting guilds and high proportion of ground-nesting guild at the Alsek, compared to other rivers.

Although the lack of appropriate habitat conditions undoubtedly plays an important role in explaining the absence of species frequently occurring at the majority of major mainland rivers at the Alsek, the northern location of the Alsek is also a factor influencing the absence of certain species at the Alsek. Twenty-seven percent of species recorded at the major mainland rivers reach their northern range limits in northern Southeast Alaska, several which are species associated with the Canadian interior. The absence of species associated with the Canadian interior at the Alsek is also likely influenced by the low connectivity of the Alsek compared to other rivers. Although the Alsek is a trans-mountain river, the early successional vegetation that dominates this river valley may not offer the necessary habitat conditions that interior species such as Hammond's Flycatcher, Warbling Vireo, American Redstart, and Western Tanager need to disperse from interior to coastal regions.

Using 100-m point counts, I compared the composition and structure of bird communities among 6 rivers and between trans-mountain and coastal rivers. Contrary to

our expectations, species richness, point richness, point abundance, and diversity, were greater at coastal rivers than trans-mountain, even when excluding the Alsek. Bird species that were not shared by both trans-mountain rivers and coastal rivers were typically rare species detected only once such as Black-and-White Warbler, Cassin's Vireo, Least Flycatcher, Magnolia Warbler. However, the majority of species detected at only one class of river may be influenced more by sampling effort than restrictions in range or habitat preferences; these species were detected at both trans-mountain and coastal rivers during widespread area searches. There was a relationship between the distance between rivers and the similarity of bird community composition. Rivers that were separated by large distances tended to have less similar bird communities. This may indicate that there is a level of connectivity between neighboring rivers resulting from dispersal of birds from the mouths of rivers or by overland flights.

Using 50-m point counts, I compared structure and composition of bird communities among 4 vegetation types. Total bird species richness was similar across all vegetation types and the presence of species detected fewer than 5 times was higher in shrublands and young forest. Abundance of bird species varied considerably; five species accounted for nearly half of the total number of individuals recorded, whereas 14 species were detected with abundances <25 individuals. The number of dominant species found in this study was similar to results of Willson and Comet's (1996a) study in northern forests of Southeast Alaska and adjacent Canada. Species richness based on both relativized and non-relativized data was similar among all habitats. However, species diversity, point richness, and point abundance were greatest in mixed forest than other

habitat types. This is consistent with other studies that found higher overall bird abundance and diversity in habitats with the most complex vegetation structure (Mosconi and Hutto 1982, Taylor 1986).

Of the species that showed significant differences in abundance among habitat types, 10 species were more abundant in shrub habitats and 11 species were more abundant in mixed forest habitats. This is consistent with the idea that although structurally simple, the presence of riparian shrub habitats that rarely occur outside of the major mainland rivers, support a relatively high number of shrub associated bird species. The high species richness of mixed forests is probably influenced by the structural complexity of these stands; mixed forest stands were notable for the presence of certain shrub associated species as well as species associated with both coniferous and deciduous components of the tree canopy.

The majority (77%) of species occurred in three or more vegetation types, indicating the wide habitat breadths of bird species within deciduous riparian vegetation. I considered species that had similar frequencies in three or more habitat types, including American Robin, Dark-eyed Junco, MacGillivray's Warbler, Red-breasted Sapsucker, Yellow-rumped Warbler, and Yellow Warbler, to be habitat generalists within deciduous riparian vegetation. Each of the vegetation types I sampled was influenced in varying degrees by coniferous vegetation. As a result, species abundances and richness values were probably increased for shrublands, young forest, and mature forest due to the presence of coniferous associated species.

The majority of species belonged to tree nesting and ground nesting guilds. There

was a trend towards an increase in the number of species, frequency, and proportion of individuals of birds in the tree and cavity nesting guilds from shrub to mixed forest. The number of species, frequency, and proportion of individuals in the ground nesting guild declined from mixed forest to shrublands. The number of shrub nesting species and proportion of individuals occurring in the shrubland vegetation type was, although similar across vegetation types, slightly higher in shrublands. The frequency of shrub nesting birds was highest in mature forest, and slightly higher in mixed forest and shrublands than in young forest. Results from ordinations showed a distinct separation between ground nesting birds that selected sites based on soil moisture levels. Fox sparrows, Hermit Thrushes, Orange-crowned Warblers, and Wilson's Warblers were associated with drier soil conditions, whereas, Common Yellowthroats, Lincoln's Sparrows, Northern Waterthrushes, and Song Sparrows were associated with more mesic soil conditions or areas with a high percentage of surface water cover.

The number of species, frequency, and proportion of long-distance migrants was similar among vegetation types and accounted for the majority of bird species recorded. The number of short distance migrant species and proportion of individuals was similar across habitat types; however, the frequency of individuals belonging to this guild was much higher in mixed forest than other vegetation types. Although, the number of resident species was highest in mixed forest and young forest, the frequency and proportion of individuals of resident species was higher at shrublands and mixed forests than young forest and mature forests.

Of the species associated with the Canadian interior that showed significant

differences in abundance among habitat types, most reached their highest abundances in mature forest stands. American Redstarts, Red-eyed Vireos, and Warbling Vireos were associated with deciduous forests and cottonwood tall tree cover. Common Yellowthroats were associated with mesic shrublands containing high herbaceous cover and willow low shrub. Western Tanagers were associated with mixed forest and spruce tall tree.

Ordinations of the bird communities and environmental variables indicated that bird-habitat relationships were primarily influenced by vegetation structure, composition of the tree canopy, and soil moisture.

Management Implications and the Need for Future Research

Owing to high bird species richness, uniqueness of breeding bird communities, and presence of rare habitat types, major mainland rivers of southeastern Alaska are regarded as regionally significant to bird populations by biologists, conservationists, and land managers alike. Although these rivers are currently governed by natural processes, few have protective status and therefore face increasing threats by human activities such as road-building, mining, timber harvest, and urban development. Such activities could drastically alter or destroy riparian habitat quality and their value to a unique avifauna. Currently, the most pressing threats to the major mainland rivers are recent increased pressure of road development and proposed mining operations. Major road developments in Southeast Alaska are proposed for the Stikine River valley and Lynn Canal. More importantly, the indirect effects of road developments will likely have much larger and lasting effects on avian communities by changing patterns of hydrology and by opening

these systems to urban development, timber harvest, mining, oil and gas exploration, hydro-electric development, and pollution. Although, mining operations are seemingly at a temporary standstill, the mining industry has long been interested in the heavily mineralized headwaters of several major mainland rivers. Any rises in metal costs would rapidly put several of these rivers at risk (Transboundary Watershed Alliance 2001).

Any plans that would drastically affect the quality and quantity of habitats within the major mainland river valleys should take into account the that these rivers not only provide unique and valuable habitat to birds during the breeding season but also provide critical staging and stopover areas for birds during migration.

Several species of regional concern use the major mainland rivers in southeastern Alaska and thereby warrant conservation consideration by managers of these river systems. Boreal Partners in Flight (1999) has listed several species associated with the major mainland rivers as priority species of conservation concern due to small and restricted populations.

Conservation strategies for riparian areas should incorporate monitoring bird populations in relation to changing land use. Because the majority of major mainland rivers either originate in Canada or provide direct connectivity between southeastern Alaska and the Canadian interior, international cooperation may be needed to address conservation issues for these ecosystems. Riparian areas contain unique ecological communities that are sensitive to both human and natural disturbances. Any periodic assessment of the status of bird populations or response to habitat alteration will require designs that address the complex mosaic of habitats and the unique and diverse

assemblages of bird taxa along these mainland river systems. Further knowledge of the magnitude of use of riverine tidal flats by migrating birds is desirable.

In order to assess population dynamics of species, especially those of management concern, long-term sampling which focuses on species of management concern is needed. Because the major mainland rivers are, at the present time, relatively unaffected by anthropogenic disturbances compared to riparian systems in the contiguous U.S., these rivers may allow managers and researchers the ability to make inferences about how habitat loss and destruction affects bird populations along migration routes and on wintering areas. For example, if migratory species breeding within the major mainland rivers are experiencing long-term population trends, it may be possible to assume that these changes are a result of changes occurring outside of the major mainland river systems.

It is my hope that this study provides managers, from both the U.S. and Canada, with the necessary baseline data to make more informed management decisions. Because the majority of major mainland rivers are trans-boundary and face threats of potentially large-scale human caused disturbances on both sides of the border, cooperation among policy makers, agencies, and biologists from both countries is integral to the conservation of these regionally important riparian systems.

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APPENDICES

Appendix A-1. Breeding Status of All Bird Species Recorded on Major Mainland Rivers of Southeastern Alaska Based on All Known Published Studies (Bailey 1927; Gibson 1986; Gibson and MacDonald 1975; Jewett 1942; MacDonald and MacDonald 1975; Swarth 1911; Webster 1950), Information from Various Contributers, and the Current Study. Codes Indicate Confirmed (C), Probable (PR), Possible (PO), Breeding or Breeding Evidence not Observed (O).

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Red-throated Loon	PR						O	PR	PR		O
Pacific Loon								O		O	
Common Loon		PR			PR		PR	PR		PR	
Pied-billed Grebe		O									
Horned Grebe		O									
Red-necked Grebe							O				
American Bittern		PR						PR		PR	
Great Blue Heron		PR		PO	PR				PR	PR	
Snow Goose								O			
Canada Goose	PR	PR		PR	PR	PR	PR	C	C	C	PO
Brant	O	O									
Trumpeter Swan		C			PR	C	PR			PR	
Wood Duck		PR				O					
Gadwall										O	

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Eurasian Wigeon										O	
American Wigeon	O	C			PR		PO	PR	PO		
Mallard	PR	C	PO	PR	PR	PR	PR	C	PR	C	C
Blue-winged Teal		PR			PO	PR			PR	PR	
Northern Shoveler	C	PO			O	O			O	O	
Northern Pintail	C		PO							O	O
Green-winged Teal	O	PR	PO	PO	PO	C		PR	PR	PO	
Ring-necked Duck		C			PR		PR	C		PR	
Greater Scaup										O	
Lesser Scaup								PR			
Harlequin Duck	PR					O	PO	O	C	PR	O
Surf Scoter		O	O			O		O	O	O	
White-winged Scoter									O	O	
Black Scoter										O	
Long-tailed Duck	O										
Common Goldeneye	O	PR				C		C	O	O	
Barrow's Goldeneye						O	PR		PR	C	
Hooded Merganser		C			PR	C	PR	C		C	PO
Common Merganser	PO	C	PR	PR	PR	C	PR	C	C	C	C

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Red-breasted Merganser	PO										
Osprey		PO				PR			PO	PR	
Bald Eagle	C	C	PR	PR	C	C	PR	C	C	C	PR
Steller's Sea Eagle						O					
Northern Harrier	PO								O	O	
Sharp-shinned Hawk		PO				O			PR	O	PO
Northern Goshawk		C							O	C	
Red-tailed Hawk		PR	PR		PR	PR	PR	C	C	PR	PO
Golden Eagle		O									
American Kestrel		C								O	PO
Merlin		C			PR	C	PR	C	C	C	
Peregrine Falcon								O			
Ruffed Grouse						C		PR			PR
Spruce Grouse		C									
Blue Grouse		PR	PR	PR	PR	PR	PR	PR	PR	PR	PR
Virginia Rail		O									
Sora		PR								PR	
American Golden Plover		O									
Semipalmated Plover	C	C	PR	C		C	PR			O	

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Killdeer		PR	PO			C				O	PO
Greater Yellowlegs	C	C			PR					O	
Lesser Yellowlegs	C		PO			PR			O		
Solitary Sandpiper		O				O			PR	O	PO
Spotted Sandpiper	C	C	PR	PR	PR	C	PR	C	C	C	C
Upland Sandpiper		O									
Whimbrel	O									O	
Hudsonian Godwit	O										
Marbled Godwit						O					
Black Turnstone	O										
Semipalmated Sandpiper	O	O	O								
Western Sandpiper	O									O	
Least Sandpiper	C	O	PO			O		C	O	O	PO
Pectoral Sandpiper		O						O		O	
Dunlin										O	
Short-billed Dowitcher	PO					O				PR	
Common Snipe	C	C			C	C		C		PR	
Red-necked Phalarope	O						O				
Parasitic Jaeger	C					O		O	O		

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Bonaparte's Gull		O			O	O		O	O	O	O
Mew Gull	C	O	PO	PO	PO	PR	PO	C	PO	PO	O
Herring Gull	C	O	O	PO	PO	C		O	O	O	
Glaucous-winged Gull	C	O						O		O	
Black-legged Kittiwake	O	O									
Caspian Tern	PR					C					
Arctic Tern	C	PR	C	PR	PR	C	PR	PR	PR	C	PO
Aleutian Tern	C										
Marbled Murrelet					PR		PR				
Band-tailed Pigeon								O	PR	O	PO
Mourning Dove										O	
Western Screech-Owl										PR	
Great Horned Owl		PR				PR				PR	
Northern Hawk Owl	PO	O									
Northern Pygmy Owl		O				PR			PR	PR	
Barred Owl		O								PR	
Short-eared Owl	C							O			
Northern Saw-whet Owl	PR	C				PR				PR	
Common Nighthawk		C									

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Black Swift		O						O	O	PR	PO
Vaux's Swift		C		PR	PO	PO	PO	PO	PO	C	PO
Rufous Hummingbird	PR	PR	PR	PR	PR	C	PR	PR	PR	PR	PO
Belted Kingfisher	PR	C	PR	C	C	C	PR	C	C	C	PO
Red-breasted Sapsucker		C	C	C	C	C	C	C	C	C	C
Downy Woodpecker	C	C	PR			PO	PR		PR		PO
Hairy Woodpecker	C	C	PR	C	C	PR	C	C	C	C	C
Three-toed Woodpecker		C						PO		PR	
Northern Flicker		PR	PR		PR	O	PR		PO	PR	C
Olive-sided Flycatcher		PR			PR	PR		PR		PR	PR
Western Wood-Pewee		PR	PR		PR	PR	PR	PR	PR	C	PR
Alder Flycatcher		C		PR	PR	PR	PR	PR	PR	PR	PR
Willow Flycatcher								PR			PO
Least Flycatcher		PR						PR		PR	PR
Hammond's Flycatcher		C	PR	PR	PR	C	PR	PR	C	C	PR
Pacific-slope Flycatcher	PO	PR	PR?	PR	PR	C	PR	PR	C	C	PR
Say's Phoebe						O					
Eastern Phoebe		O									
Western Kingbird		O									

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Eastern Kingbird		O								O	O
Cassin's Vireo		PO				PR	PR		PR	PR	PR
Warbling Vireo		C	PR	PR	PR	C	PR	C	C	C	PO
Red-eyed Vireo								PR	PR	PR	
Steller's Jay	PO	C	PR	PR	PR	C	PR	C	C	C	PO
Black-billed Magpie	C	C									
American Crow										O	C
Northwestern Crow		PR	PR	PR	PR	PR		PR	PR	PR	
Common Raven	PO	C	PR		C	PO	PR	PO	PO	C	PO
Tree Swallow	C	C	PR	C	C	C	C	C	C	C	C
Violet-green Swallow		C				C	C	PO	PO	PO	C
N. Rough-wngd Swallow						O			PO	C	C
Bank Swallow	C	PR				C				O	PO
Cliff Swallow		PO						C			
Barn Swallow	C	C	PR		PR	C	PR	C	C	C	PR
Black-capped Chickadee	C	C				C		PR			
Chestnut-backed Chickadee	PO	C	PR	PR	PR	C	PR	C	C	C	PR
Red-breasted Nuthatch	PO	PR				PR		PR	PR	PR	
Brown Creeper		PR	PR			PR	PR	PR	PR	PR	C

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Winter Wren	PO	C	PR	PR	PR	PR	C	PR	C	C	PR
American Dipper		PR			C		PR	C	C	PR	C
Golden-crowned Kinglet	PO	PR	PR	PR	PR	PR	PR	C	PR	PR	PR
Ruby-crowned Kinglet	C	C	C	PR	PR	C	PR	C	C	C	PR
Gray-cheeked Thrush	C	PR				PR		PR	PR	PR	
Swainson's Thrush		C	PR	C	C	C	PR	C	C	C	PR
Hermit Thrush	C	C	PR	PR	PR	C	PR	PR	PR	PR	PR
American Robin	C	C	PR	C	C	C	C	C	C	C	PR
Varied Thrush	C	C	C	C	C	C	C	C	C	C	PR
European Starling		PR	PR					C		O	C
American Pipit			O			O			O		
Bohemian Waxwing		PO				O		O			PR
Cedar Waxwing		PO			PO	O		O	O	O	C
Tennessee Warbler		O						C		PR	C
Orange-crowned Warbler	C	C	PR	C	C	C	PR	C	PR	PR	PR
Yellow Warbler	C	PR	C	C	C	C	PR	C	C	C	PR
Magnolia Warbler							PR	C	PR	PR	PR
Yellow-rumped Warbler	C	C	PR	C	PR	C	PR	C	C	C	C
Townsend's Warbler	PO	PR	C	PR	PR	PR	C	PR	C	PR	PR

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Blackpoll Warbler						O				O	
Black and White Warbler										PR	
American Redstart		C	C	C	PR	C	PR	C	C	C	PR
Northern Waterthrush		C	PR	PR	PR	PR	PR	PR	C	C	C
MacGillivray's Warbler		C				C		PR	C	C	PR
Common Yellowthroat		C		PR	PR	C	PR	C	PR	C	PO
Wilson's Warbler	C	C	PR	PR	PR	C	PR	C	PR	PR	PR
Western Tanager		PR	PR		PR	PR	PR	PR	PR	PR	PR
Chipping Sparrow		C				C	C	PR	PR	PR	PR
Savannah Sparrow	C	PR	PR	C	C	PR	PR	PR	PR	C	PR
Fox Sparrow	C	C			PR	C		C	C	C	PR
Song Sparrow		C		PR	C	PR	C	PR	PR	C	PR
Lincoln's Sparrow	C	C	PR	C	C	C	C	C	C	C	PR
Golden-crowned Sparrow	PR									O	
Dark-eyed Junco	PR	C	PR		PR	PR	PR	C	C	C	PR
Red-winged Blackbird		PR			C	PR		PR	PR	C	C
Rusty Blackbird		C				C	PO	PR	PR	C	PO
Brown-headed Cowbird		PR			PO					PR	
Pine Grosbeak	PR	PR	PR			PO				PR	PO

Species	Alsek	Chilkat	Taiya	Katzehin	Antler	Taku	Whiting	Stikine	Unuk	Chickamin	Salmon
Red Crossbill		PR				PR		PR	PR	PR	PR
White-winged Crossbill		PR	PO			PR		PR		PR	
Common Redpoll	PR										
Pine Siskin		PR	PR	PO	PR	PR	PR	PR	PR	PR	PR

Appendix A-2. Species Accounts of 170 Bird Species Recorded during the Breeding Season at Major Mainland Rivers of Southeastern Alaska.

The following accounts describe the abundance, status, breeding behavior, habitat preferences, and observational records of the 170 species recorded during the breeding season at the Alsek, Taiya, Chilkat, Katzehin, Antler, Taku, Whiting, Stikine, Unuk, Chickamin, and Salmon rivers. Information is compiled from all known documented reports of the bird communities of the major mainland rivers of southeastern Alaska (Swarth 1911, Bailey 1927, Jewett 1942, Webster 1950, Gibson and MacDonald 1975, MacDonald and MacDonald 1975, Gibson 1986, Schantz unpub. notes), the current study, and miscellaneous contributors.

Abundance categories are based on Gibson and MacDonald (1975), MacDonald and MacDonald (1975), and Kessel and Gibson (1979) to maintain consistency. The following categories were assigned to species based on observations from the major mainland rivers. For abundance classifications at the statewide level refer to Gibson (2001); for regional abundances see Armstrong and Gordon (2001) and Armstrong (1995).

Abundant: species occurs repeatedly in proper habitats, with available habitat heavily utilized, and/or the study areas regularly host great numbers of the species.

Common: species occurs in all or nearly all proper habitat, but some areas presumed suitable habitat are occupied sparsely or not at all and/or the study areas regularly hosts large numbers of the species.

Fairly common: species occurs in only some of the proper habitat, and large areas of

presumed suitable habitat are occupied sparsely or not at all and/or the study areas regularly host substantial numbers of the species.

Uncommon: species occurs regularly, but utilizes very little of the suitable habitat, and/or the study areas regularly hosts relatively small numbers of the species; not observed regularly even in proper habitats.

Rare: species occurs, or probably occurs, regularly within the study areas, but in very small numbers.

Casual: a species beyond its normal range, irregular observations are likely over a period of years; usually occurs in very small numbers.

Accidental: a species so far from its normal range that further observations are unlikely; usually occurs singly.

Status (e.g., breeder, resident, visitant) follows Kessel and Gibson (1979) and refers only to the major mainland rivers. Breeding behavior and status follows North American Ornithological Atlas Committee criteria (1990). Species nomenclature follows AOU checklist format (1998, 2000).

Specific dates are included for rare species. Refer to Table 2-2 for dates of specific studies. Otherwise, records occurred between 15 May – 15 August.

The names of observers are abbreviated and include the following: HS = Swarth (1911), AB = Bailey (1927), SJ = Jewett (1942), W = Webster (1950), GM = Gibson and MacDonald (1975), MM = MacDonald and MacDonald (1975), DG = Gibson (1986), TS = Schantz (unpub. notes) and JJ = Johnson and Andres.

Order Gaviiformes

Family Gaviidae

Red-throated Loon (*Gavia stellata*). Uncommon probable breeder. Seen on lacustrine and fluviatile waters. One adult in breeding plumage at Crescent Lake, Whiting River (JJ), two adults on the Stikine River (GM), three in breeding plumage at the Unuk River (TS), and a pair at the Salmon River mouth (DG). Breeding has been confirmed in southeastern Alaska (Gabrielson and Lincoln 1959).

Pacific Loon (*Gavia pacifica*). Rare summer visitant. An adult in breeding plumage on the upper Stikine River on 11 June 2000 (JJ) and one adult in breeding plumage at the mouth of the Chickamin River on 5 July 1996 (TS).

Common Loon (*Gavia immer*). Uncommon possible breeder. Occasional on lacustrine waters. Pairs in breeding plumage at the Antler River, Crescent Lake, Whiting River (JJ), and Chickamin River (MM). Single adults in breeding plumage at the Chilkat River (JJ), Barnes Lake, Stikine River (GM) and on the lower Stikine River (W). Breeding has been confirmed in southeastern Alaska (Gabrielson and Linclon 1959).

Order Podicipediformes

Family Podicipedidae

Pied-billed Grebe (*Podilymbos podiceps*). Rare summer visitant. Freshwater marsh. Observed at the Chilkat River on 25 July 2002 (Demartini, pers. comm.).

Horned Grebe (*Podiceps auritus*). Rare summer visitant. Freshwater marsh. Observed at the Chilkat River on 6 Aug 1999 (Demartini, pers. comm.).

Red-necked Grebe (*Podiceps grisegena*). Rare summer visitant. Fluviatile and

lacustrine waters. A single adult at Crescent Lake, Whiting River 3-10 June 2002 (JJ).

Order Ciconiiformes

Family Ardeidae

American Bittern (*Botaurus lengtiginosus*). Rare probable breeder. Freshwater marsh. Heard on occasion in freshwater marsh at Chilkat River (Demartini, pers. comm.)Observed and heard calling from a freshwater streambank and from sedges at the edge of a beaver pond at the Leduc-Chickamin lowlands on 18 June 1973 (MM). The last sighting of this species on the Chickamin River was 28 September 1973 (MM). Two males heard calling in a freshwater marsh at Barnes Lake, Stikine River on 13 July 1974 (GM).

Great Blue Heron (*Ardea herodia*). Uncommon probable breeder. Estuarine meadows, tidal flats, and the edge of coniferous forest along river mouths. Single adults at the Antler River and Katzehin River (JJ). A group of 3-4 individuals seen perched in spruce and a single adult at the Chickamin River (JJ). Single individuals at the Chilkat and Unuk rivers in similar habitat (JJ). Breeding has been confirmed in southeastern Alaska (Wik and Streveler 1968).

Order Anseriformes

Family Anatidae

Snow Goose (*Chen caerulescens*). Uncommon summer visitant. A flock of 15 near the international boundary, Stikine River on 9 June 1945 (W).

Canada Goose (*Branta canadensis*). Uncommon breeder and resident. Lacustrine and fluviatile waters and shorelines, freshwater marsh. During the breeding season at all

rivers (W, GM, MM, DG, JJ). Most observations consisted of pairs flying over the rivers, however tracks, feathers, and droppings seen on shorelines and alluvial bars, especially near glacial lakes with floating icebergs; adults may use bergs during their summer molt (pers. obs.). Pairs in lacustrine habitats and in flight over all rivers (GM, MM, DG, JJ). A flock of five adults with 20 young at the upper Stikine River (W), pairs with goslings on the Unuk River in late June and mid-July (TS), and a brood at the Chickamin River in late June (HS).

Brant. *Branta bernicla*. Rare summer visitant. Small flocks of 5-10 adults on the East Alsek River in late June and early July 2001 (JJ). Similar sized groups are regularly seen on lacustrine waters of Dry Bay during the breeding season (Jim Capra, NPS, pers. comm.).

Trumpeter Swan (*Cygnus buccinator*). Uncommon breeder and resident. Lacustrine waters and freshwater marshes. Records include pairs at the Antler River (JJ), flocks of up to 35 at the Chilkat River in June and July (JJ), a single adult at the Leduc-Chickamin lowlands (MM), a pair feeding in the lakes and freshwater marshes of the Leduc-Chickamin lowlands (TS, JJ). Adults on nests in a freshwater marsh at Fleming Slough, Taku River in early June (JJ). Several nesting adults in a large freshwater marsh at the Chilkat River in June and July (JJ). Several adults with broods at the Chilkat River in July (JJ).

Wood Duck (*Aix sponsa*). Rare probable breeder. Fluviatile waters. A pair and a female flying out of deciduous forest in the same area on several consecutive days during late-June 2000 at the Chilkat River (JJ). An individual observed at the Taku River on 20

June 2000 (Demartini, pers. comm.).

Gadwall (*Anas strepera*). Rare summer visitant. A pair on a beaver pond at the Chickamin River on 1-2 June 1973 (MM).

Eurasian Wigeon (*Anas penelope*). Rare summer visitant. A single male in a flock of American Wigeon at the mouth of the Chickamin River on 15 May 1973 (MM).

American Wigeon (*Anas americana*). Rare breeder. Fluviatile and lacustrine waters. Pairs at the Antler River and Chilkat River (JJ), small flocks at the Doame River, Alsek River, a pair on Red Slough, Stikine River (JJ), and a group of five on the Unuk River (TS), all observed in June and July. A female on nest with 8 eggs at edge of freshwater marsh, Chilkat River on 28 June (JJ).

Mallard (*Anas platyrhynchos*). Fairly common breeder and resident. Lacustrine and fluviatile waters. Records during the breeding season include pairs, small groups of adults with breeding plumage, and groups of eclipse males at all rivers (W, GM, MM, DG, JJ). Broods on the Chilkat (SJ, JJ), Stikine (GM), Chickamin (MM), and Salmon (GM) rivers.

Blue-winged Teal (*Anas discors*). Rare possible breeder. Fluviatile and lacustrine waters. Several pairs at the Antler River in June (JJ), Chilkat River in June and July (JJ), a pair on the lower Unuk River in early June and two pairs on the Taku River in early June (JJ). Several single individuals and a pair seen several times on beaver ponds at the Leduc-Chickamin lowlands in early and late May and June (MM).

Northern Shoveler (*Anas clypeata*). Rare breeder. Fluviatile waters. Several single individuals, small groups, and pairs on the Chilkat River (JJ), Taku River (JJ),

Unuk River (TS), and Chickamin River (MM); all observations occurred in May, June and July. The only evidence of breeding was of several adults with young of the year at the confluence of the Doame and East Alsek Rivers on 5 July 2001 (JJ).

Northern Pintail (*Anas acuta*). Rare breeder. Fluviatile and lacustrine waters. Several individuals throughout the breeding season on beaver ponds at the Leduc-Chickamin lowlands (MM), a group of three males in this area were thought to be nonbreeders (MM), two males at the mouth of the Salmon River (DG). The only evidence of breeding was of a flock of 25 adults and young of the year on the Doame River, Alsek River on 5 July 2001 (JJ).

Green-winged Teal (*Anas crecca*). Uncommon breeder. Fluviatile and lacustrine waters. A flock of 4-6 on Spud's slough and a flock of 15 on the Doame River, Alsek River (JJ), small flocks at the Whiting River (JJ), Katzehin River (JJ), Antler River (JJ). Birds of the year and a defensive female on the Taku River (GM), pairs on the Chilkat, Taku, Stikine, and Unuk rivers (GM, JJ), a group of males on a beaver pond at the Leduc-Chickamin lowlands (MM) and a female observed on a beaver pond at the Hulakon River, Unuk River (TS).

Ring-necked Duck (*Aythya collaris*). Rare breeder. Lacustrine and fluviatile waters. Records during the breeding season include up to 100 at a large wetland near the Chilkat River 1-15 July 2002 (JJ), pairs on ponds in freshwater marshes on the Chilkat River (JJ) in June and July and several pairs and males throughout the breeding season on a beaver pond at the Leduc-Chickamin lowlands in May, June, and July (MM, JJ). Several females with broods at the Chilkat (JJ) in early July 2002 and a female with

brood at Barnes Lake, Stikine River on 13 July 1974 (GM).

Greater Scaup (*Aythya marila*). Rare summer visitant. Fluviatile waters. The only observations during the breeding season were of several individuals at the Chickamin River estuary on 4 July 1973 (MM) and a pair at the confluence of Clear Creek and the Chickamin River on 8 June 2001 (JJ).

Lesser Scaup (*Aythyla affinis*). Rare possible breeder. Lacustrine waters. A pair on Barnes Lake, Stikine River 13 July 1974 (GM). Breeding confirmed in Glacier Bay area (Grinnell 1909).

Harlequin Duck (*Histrionicus histrionicus*). Uncommon resident and breeder. Fluviatile and lacustrine waters and bays. Single individuals on the Taku River (Demartini, pers. comm.), Stikine River (JJ), pairs on the Alsek, Unuk and the Chickamin rivers (JJ, MM), an agitated female near the confluence of a fast flowing clearwater tributary of the Unuk River (JJ), an adult female with two young of the year on the upper Hulakon River, Unuk River in July (JJ) and a group of 15 at the Salmon River mouth (DG).

Surf Scoter (*Melanitta perspicillata*). Uncommon summer visitant. Rafts of 200+ in estuarine waters of the Chickamin and Unuk Rivers (MM, JJ), pairs and single adults on Mosquito Lake, Chilkat River (GM), Twin Glacier Lake, Taku River (JJ), Red Slough, Stikine River (JJ), and Genes Lake, Unuk River (JJ). These records were most likely of first year non-breeders. An immature male was seen on the Chickamin River on 5 July (TS).

White-winged Scoter (*Melanitta fusca*). Uncommon summer visitant. A group of

10+ adults in estuarine waters of the Unuk and Chickamin (JJ) Rivers. A raft of 100-150 in estuarine waters of the Chickamin River (MM). These individuals were most likely first year non-breeding adults.

Black Scoter (*Melanitta nigra*). Uncommon summer visitant. A raft of 100+ individuals at the mouth of the Chickamin River (JJ). These individuals were most likely first year non-breeding adults.

Long-tailed Duck (*Clangula hyemalis*). Rare summer visitant. A male in breeding plumage on Spud's Slough, Alsek River on 3 July 2001 (JJ).

Common Goldeneye (*Bucephala clangula*). Uncommon breeder and resident. Lacustrine and fluviatile waters. A single adult male on the East Alsek River and a pair on Muddy Creek, Alsek River (JJ), small groups of adult males and females at the Antler River, Crescent Lake, Whiting River, Taku, Stikine, and Chickamin rivers (JJ), two females on the Unuk River (TS), a pair on the Chilkat River (JJ). Broods at Barnes Lake, Stikine River (GM), Stikine River (JJ) and Twin Glacier Lake, Taku River (JJ).

Barrow's Goldeneye (*Bucephala islandica*). Uncommon probable breeder. Lacustrine and fluviatile waters. Several single adults on the Taku River (JJ), Crescent Lake, Whiting River (JJ), Antler River (JJ), and pairs on the lower Unuk and Chickamin rivers (JJ). The most convincing evidence of breeding Barrow's goldeneyes was a defensive female on a beaver pond at the Leduc-Chickamin lowlands on 16 July (MM). Breeding confirmed in southeastern Alaska (Gabrielson and Lincoln 1959).

Hooded Merganser (*Lophodytes cucullatus*). Uncommon breeder and resident. Fluviatile and lacustrine waters. Several individuals throughout the breeding season at

Antler River (JJ), Crescent Lake, Whiting River (JJ), Chilkat (JJ), Taku (JJ), Stikine (JJ), and Salmon (G) Rivers. Broods at the Chilkat River (SJ, GM, JJ), Yehring Creek, Taku River (GM), Barnes Lake, Stikine River (GM), and on a beaver pond at the Leduc-Chickamin lowlands (MM).

Common Merganser (*Mergus merganser*). Common resident and breeder. Fluviatile and lacustrine waters. Records during the breeding season include 10 at the confluence of the Doame and East Alsek rivers (JJ), small flocks at the Katzehin River (JJ), Antler River (JJ), large groups of 50-75 males and females seen on the Unuk and Chickamin rivers in June (JJ), a raft of 150-200 adults at the mouth of the Chickamin River in mid-July (JJ). Broods on the Chilkat (JJ), Taku (GM, JJ), Stikine (GM, JJ), Unuk (GM, JJ), Chickamin (HSb, MM, JJ), and Salmon (DG) rivers. Females seen entering natural cavities in spruce at the Salmon River (G).

Red-breasted Merganser. (*Mergus serrator*). Uncommon possible breeder. Fluviatile waters. Groups of 6-10 were observed several times in late-June on the East Alsek and Spud's Slough, Alsek River (JJ). Breeding confirmed in southeastern Alaska (Gabrielson and Lincoln 1959).

Order Falconiformes

Family Accipitridae

Osprey (*Pandion haliaetus*). Rare probable breeder. Fluviatile shorelines. A single calling adult at Mosquito Lake, Chilkat River on 24 June 2002 (JJ), a pair observed throughout the 2000 breeding season at the upper Taku River (JJ), a single adult near the mouth of the Unuk River on 5 August 2001 (JJ), and a single individual over the

Chickamin-Leduc lowlands on 19 June 1973 (MM). The most convincing evidence of breeding was an agitated pair calling and attacking a Bald Eagle on the upper Chickamin River 12 June 2001 (JJ). Breeding has been confirmed in southeastern Alaska (Gabrielson and Lincoln 1959).

Bald Eagle (*Haliaeetus leucocephalus*). Common resident and breeder. Alluvial bars, tidal flats, and perched on tall spruce along fluviatile shorelines. Seen at all rivers during the breeding season (SJ, GM, MM, DG, JJ). Occupied nests and juveniles at the Alsek (JJ), Taiya (JJ), Chilkat (JJ), Antler (JJ), Taku (GM, JJ), Stikine (JJ), Unuk (GM, JJ) and Chickamin (MM, JJ) rivers. An all white adult on the upper Taku River 27 May – 4 June 2000 (JJ).

Steller's Sea-Eagle (*Haliaeetus pelagicus*). Vagrant. An adult on the lower Taku River 5 June 2000 (JJ). Presumably, this is the same individual first documented at the Taku River in 1989 (R. Gordon, pers. comm).

Northern Harrier (*Circus cyaneus*). Rare possible breeder. Estuarine meadows and freshwater marsh. A male and female seen hunting over estuarine meadow at the lower Antler River on 14 June 2002 (JJ) and Unuk River on 30 May 2001 (JJ), a male hunting over estuarine meadows at the Chickamin River on 10 June 2001 (JJ), and a female at Dry Bay, Alsek River (JJ) on 3 July 2001. These birds may have been possible breeders but most likely were migrating. Breeding confirmed in the Juneau area (R. Gordon, pers. comm.).

Sharp-shinned Hawk (*Accipiter striatus*). Uncommon probable breeder. Usually observed in or at edge of coniferous forests, individuals were also seen hunting in and

over mixed forests and deciduous shrubland. Seen at the Chilkat (JJ), Taku (JJ), Unuk (JJ) and Chickamin (HS, JJ, MM) rivers. Food-carrying adults on the Unuk and Salmon rivers (GM). Breeding confirmed in southeastern Alaska (Gabrielson and Lincoln 1959).

Northern Goshawk (*Accipiter gentilis*). Rare breeder. Coniferous forest. Records during the breeding season include an immature being chased by a Merlin on 23 July 1920 at the Chilkat River (SJ), an agitated adult calling from coniferous forest at the Chilkat River on 20 June 2001 (JJ) two single adults at the Unuk River on 6 June and 30 June 1997 (TS). The only evidence of confirmed breeding is of two immatures at the Chickamin River on 2-5 August 1973 (MM).

Red-tailed Hawk (*Buteo jamaicensis*). Uncommon breeder. Usually observed soaring over fluviatile shorelines and alluvium or perched in spruce. Single adults and pairs at the Chilkat (SJ, JJ), Antler (JJ), Taku (GM, JJ), Whiting (JJ), Stikine (W, GM, JJ), Chickamin (HS, MM, JJ), and Salmon (DG) rivers. Immatures at the Stikine (JJ) and Unuk (JJ) rivers. A pair of Harlan's (*Buteo jamaicensis harlani*) were observed at the Antler and Taku rivers (JJ).

Golden Eagle (*Aquila chrysaetos*). An immature was observed at the Chilkat River on 17 May 1999 (Demartini pers. comm.).

Family Falconidae

American Kestrel (*Falco sparverius*). Fairly common migrant and rare breeder. Observed along forest edges adjacent to open habitat and in the presence of snags. Individuals on the Chilkat (SJ, JJ), upper Chickamin (MM) and Salmon (GM, DG) rivers

during June and July. A male kestrel seen perched on a spruce snag containing cavities at the Chilkat River on 26 June 2000 (JJ). An occupied nest found in a cottonwood snag at the edge of a large freshwater marsh at the Chilkat River on 21 June 2000 (JJ). A male and female were observed carrying food to the same nest on 2 July 2002 (JJ). This is the first known breeding record of American Kestrels in southeastern Alaska.

Merlin (*Falco columbarius*). Fairly common migrant and uncommon breeder. Edges of coniferous forest or hunting over open areas. Single adults at the Antler and Whiting rivers (JJ). Evidence of breeding at the Chilkat, Taku, Stikine, Unuk, and Chickamin rivers (JJ). A pair attacking a raven and Red-tailed Hawk at the Mosquito Lake campground, Chilkat River. A territorial female seen carrying food and defending a probable nest at the Taku River (JJ). Three recently fledged young fed by adults at the Stikine River (JJ). An occupied nest in a large spruce at the edge of a muskeg at the Unuk River (JJ). Adults feeding young at the Chickamin River near the confluence of the South Fork (JJ). Pellets from the breeding pair encountered at the Stikine River consisted of dragonfly exoskeletons and rodent hair.

Peregrine Falcon (*Falco peregrinus*). Uncommon migrant and rare summer visitant. The only record during the breeding season was an adult flying over the Stikine River 7 June 2000 (JJ).

Order Galliformes

Family Phasianidae

Ruffed Grouse (*Bonasa umbellus*). Uncommon resident and breeder. Deciduous forest and deciduous shrubland. During the breeding season heard drumming from cottonwood forest on the Taku (JJ) and Stikine rivers (W, JJ). A female observed "clucking" and performing a distraction display in a dry drainage within a deciduous riparian thicket at the Taku River on 31 May 2000 (JJ). This species was not recorded at the same rivers by Gibson and MacDonald in 1974 (1975). A drumming male was seen at the Salmon River (DG).

Blue Grouse (*Dengragapus obscurus*). Fairly common resident and breeder. Coniferous forest. Heard daily during the breeding season from spruce-hemlock forest at all rivers GM, MM, JJ, GM, DG).

Spruce Grouse (*Falcipennis canadensis*). Rare resident and breeder. Two females with broods in mid-July 2000 and 2002 at the Chilkat River (JJ).

Order Gruiformes

Family Rallidae

Virginia Rail (*Rallus limicola*). Rare visitant. Freshwater marsh. A single adult was observed and heard calling from a freshwater marsh at the Chilkat River on 9-25 July 2002.

Sora (*Porzana carolina*). Rare probable breeder. Freshwater marsh. Up to five individuals heard calling at a large freshwater marsh at the Chilkat River in late June and early July 2002 (JJ). Observed and heard calling near the edge of beaver ponds at the

Leduc-Chickamin lowlands in mid to late June 1973 (MM).

Order Charadriiformes

Family Charadriidae

American Golden Plover (*Pluvialis dominica*). Rare summer visitant. Observed at the Chilkat River on 8 August 1999 (Demartini, pers. comm.).

Semipalmated Plover (*Charadrius semipalmatus*). Uncommon breeder. Fluviatile and lacustrine shorelines and alluvium. Adults at the Whiting River (JJ), Chickamin River estuary and Leduc-Chickamin lowlands (MM) and on the Taku River (GM, JJ). Frequently seen on sand and gravel bars at the edge of deciduous shrubland and/or deciduous forest on the Alsek River (JJ). Evidence of breeding includes a pair with three young near Dog Salmon Creek, Alsek River (JJ), a pair with young at the edge of a pond near the Grand Plateau Glacier, Alsek River (JJ), an adult performing a distraction display near the East Alsek River (JJ), adults with young at the Tsirku River (tributary of the Chilkat River) (Demartini, pers. comm.), adults performing distraction display at the Antler River (JJ), adults with young on the Taku River (GM).

Killdeer (*Charadrius vociferus*). Rare breeder. Fluviatile shorelines and alluvium. Records during the breeding season include a pair on a gravel bar at the Chilkat River on 22 June 2000 (JJ), a pair performing a distraction display at the Taku River 28 May 2000 (JJ), and an adult female with three juveniles at the Taku River on 27 July 1974 (GM). Single individuals seen on the Taiya River on 9 August 1974 (GM), Chickamin River on 24 May 1973 (MM) and gravel flats at the mouth of the Salmon River on 17-19 June 1986 (DG).

Family Scolopacidae

Greater Yellowlegs (*Tringa melanoleuca*). Uncommon migrant and breeder. Freshwater marsh, estuarine meadow, and fluviatile shorelines. An agitated pair at the Antler River (JJ), a single adult at the Chickamin River estuary (MM), an adult with young on a gravel bar on the upper Chilkat River (JJ), two pairs of adults with young at the edge of Dog Salmon Creek, Alsek River (JJ) and the East Alsek River (JJ).

Lesser Yellowlegs (*Tringa flavipes*). Rare breeder. Freshwater marsh and fluviatile shorelines. During the breeding season small groups at the Taku River during late July and early August 1974 that may have included young of the year (GM), a group of four at the Hulakon River, Unuk River on 3 August 2001 and a group of 10-12 adults and juveniles at Dog Salmon Creek, Alsek River 2-5 July 2001 (JJ).

Solitary Sandpiper (*Tringa solitaria*). Rare probable breeder. Fluviatile and lacustrine waters and estuarine meadows. A single individual at the Chilkat River on 6 August 2001 (Demartini, pers. comm.), an immature female at Sergief Island, Stikine River on 15 August 1945 (W), thirteen adults and young thought to be migrants at the Taku River on 27-30 July 1974 (GM), single individuals at the Chickamin River on 16 May 1974 (MM) and Salmon River on 17 June 1986 (DG). A defensive bird in appropriate habitat on the Hulakon River, Unuk River on 1 July 1974 (GM) is the only evidence that this species breed in the major mainland rivers. Breeding confirmed at Glacier Bay (Wik and Streveler 1968).

Spotted Sandpiper (*Actitis macularia*). Common breeder. Alluvial bars and along fluviatile and lacustrine shorelines. Recorded at all rivers (HS, SJ, W, GM, MM,

DG, JJ). Nests found at the Alsek River (JJ), Chilkat (JJ), Taku (GM, JJ), Stikine (GM, JJ), Unuk (GM, JJ), Chickamin (MM, JJ) and Salmon (GM) rivers.

Upland Sandpiper (*Bartramia longicauda*). Rare summer visitant. Observed at the Chilkat River on 7 August 2001 (Demartini, pers. comm.).

Whimbrel (*Numenius phaeopus*). Rare summer visitant. Tidal flats. Two flying over the Dry Bay flats and a lone individual feeding near the mouth of the East Alsek River in late June 2001. A flock of 15 at the mouth of the Chickamin River on 19 May 1973 (MM).

Hudsonian Godwit (*Limosa haemastica*). Rare summer visitant. A flock of 30 feeding on a sandbar on the East Alsek River on 5 July 2001 (JJ).

Marbled Godwit (*Limosa fedoa*). Rare summer visitant. Observed at the Taku River on 23 May 2001 (Demartini, pers. comm.).

Black Turnstone (*Arenaria melanocephala*). Rare summer visitant. A flock of 10 feeding on a gravel bar at the East Alsek River in late June 2001 (JJ).

Semipalmated Sandpiper (*Calidris pusilla*). Uncommon summer visitant. Observed at the Chilkat River 7-12 July 2002 (Demartini, pers. comm.). A flock of 40-50 adults, some still in breeding plumage, feeding with Western Sandpipers along a sandy shoreline of the East Alsek River in early July 2001 (JJ). Smaller groups were seen feeding at the confluence of the Doame and East Alsek rivers also in early July 2001 (JJ).

Western Sandpiper (*Calidris mauri*). Uncommon summer visitant. Several flocks of up to 200 birds on the Chickamin in mid-May and mid-July 1974 (MM). A flock of 600+ on tidal flats at Sergief Island, Stikine River on 20 July 1974 (GM). During mid-

July 2001, a flock of 75-100 birds, some still in breeding plumage, feeding with Semipalmated Sandpipers along a sandy shoreline of the East Alsek River (JJ). A group of 35-40 at the confluence of the Daome and East Alsek rivers also in early July 2001 (JJ).

Least Sandpiper (*Calidris minutilla*). Uncommon breeder. Alluvium, freshwater marsh and fluviatile shorelines. Flocks of adults on tidal flats and fluviatile shorelines at the Chilkat (JJ), Taku (GM, JJ), Stikine (JJ), Unuk (GM, JJ), Chickamin (MM, JJ), and Salmon (GM) rivers. Evidence of breeding consists of a defensive pair in a freshwater marsh at the Stikine River (GM) and several defensive adults performing distraction displays on the Dry Bay Flats, Alsek River (JJ).

Pectoral Sandpiper (*Calidris melanotos*). Rare summer visitant. Single individuals at the Chilkat River 12 August 1999 (Demartini, pers. comm.), Sergief Island, Stikine River in mid June 1945 (W) and the Leduc-Chickamin lowlands in early June 1973 (MM).

Dunlin (*Calidris alpina*). Rare summer visitant. Approximately 5 with a flock of Western Sandpipers on 19 May 1973 at the Chickamin River estuary (MM).

Short-billed Dowitcher (*Limnodromus griseus*). Rare probable breeder. Estuarine meadow and fluviatile shorelines. During the breeding season 14+ individuals that were mostly paired in estuarine meadow at Sergief Island, Stikine River on 20 July 1974 (GM). Single individuals on a sandbar at the edge of the East Alsek River in early July 2001 (JJ).

Common Snipe (*Gallinago gallinago*). Uncommon breeder. Freshwater marsh. During the breeding season they were seen in or heard "winnowing" over freshwater marshes at the Alsek (JJ), Chilkat (JJ), Antler (JJ), Taku (GM) and Stikine (GM) rivers. Nests with eggs found in freshwater marshes at the Alsek, Chilkat, Taku, and Stikine rivers (JJ).

Red-necked Phalarope (*Phalaropus lobatus*). Rare summer visitant. A single individual on a small pond near the East Alsek River on 25 June 2001 (JJ), small flocks at Crescent Lake, Whiting River in early June 2002 (JJ).

Family Laridae

Parasitic Jaeger (*Stercorarius parasiticus*). Rare summer visitant (Fairly common breeder at the Alsek). Seen over fluviatile waters, and alluvial flats of the Dry Bay and Alsek River area (JJ). Several nesting adults and downy young on the sparsely vegetated flats (JJ). Single individuals flying over the Taku River on 7 June 2000 (Demartini, pers. comm.), the Unuk River on 30 June 1974 (GM) and the Stikine River on 13 June 2000 (JJ).

Bonaparte's Gull (*Larus philadelphia*). Fairly common summer visitant. Observed in small numbers on the Antler (JJ), Chilkat (JJ), Taku (GM), upper Stikine (JJ), Unuk (TS) rivers. Also at the Leduc-Chickamin lowlands (MM) and the Salmon River estuary (GM). Large flocks of up to 200+ were observed in the Chickamin estuary in mid-May, at the end of June (MM), and mid-July (JJ).

Mew Gull (*Larus canus*). Common resident and breeder. Fluviatile and estuarine waters/shorelines and alluvium. During the breeding season small numbers on all rivers

(W, GM, MM, DG, JJ). A breeding colony of approx. 50 on the sparsely vegetated lateral moraine of the Grand Plateau Glacier, Alsek River (JJ). A small breeding colony with 15-20 flightless young at Shakes Lake, Stikine River (JJ). By mid-July hundreds of Mew Gulls were present in the estuarine waters of most rivers (JJ).

Herring Gull (*Larus argentatus*). Uncommon resident and breeder. (Common breeder at the Alsek River). Fluviatile and lacustrine waters/shorelines. Observed in flocks of 2-20 on the Chilkat (JJ), Katzehin (JJ), Antler (JJ), Taku (GM), Stikine (W, JJ), Unuk (JJ) and Chickamin (MM, JJ) rivers. A breeding colony of 20-25 adults and at least 5 nests on a small island in Twin Glacier Lake, Taku River (JJ). A large breeding colony with numerous young on an island near Williams Creek, Alsek River (JJ). Groups of 1000+ observed at the mouth of the East Alsek River and along the beaches (JJ).

Glaucous-winged Gull (*Larus glaucescens*). Uncommon resident and breeder. (Common to abundant breeder at the Alsek River). Fluviatile waters, rocky islands, alluvium. During the breeding season individuals at the Chilkat River (Demartini, pers. comm.), a single adult at Kakwan Pt., Stikine River (W) and in small numbers at the Chickamin River estuary (MM). The most numerous gull species on the Alsek River; a large breeding colony with 1000+ birds on Egg Island, Alsek River (JJ). This island had numerous nests with eggs and at least 50 downy young. Flocks of 1000+ at the mouth of the East Alsek River (JJ).

Black-legged Kittiwake (*Rissa tridactyla*). Uncommon summer visitant. Twenty-five individuals observed with Mew, Herring, and Glaucous-winged Gulls at the mouth of the East Alsek River in early July 2001 (JJ). Individuals at the Chilkat River

during the breeding season (Demartini, pers. comm.).

Caspian Tern (*Sterna caspia*). Rare breeder. Lacustrine waters and river mouths. Fluviatile waters/shorelines. A breeding colony of approximately 16 adults and at least four nests with eggs (2 nests found on 2 June and 2 different nests on 4,5 June) on a small rocky island at the Taku River on 2-5 June 2000 (JJ). This is the first documented confirmed breeding record for Caspian Terns in southeastern Alaska. Four adults seen daily at the mouth of the East Alsek River in late June and early July 2001 (JJ).

Arctic Tern (*Sterna paradisaea*). Uncommon breeder. (Common breeder at the Alsek River). Lacustrine and fluviatile waters. During the breeding season at the Chilkat (SJ, JJ), Taku (GM, JJ), Stikine (W, GM, JJ), Unuk (GM, JJ), and Chickamin (MM, JJ) rivers. A single adult over saltwater near the mouth of the Salmon River (DG). A breeding colony of at least a thousand pairs on moraine in front of the Norris Glacier on 26-28 June 1920 (AB). Although Arctic Terns were observed locally in small numbers at the Taku River during the 2000 breeding season, the colony described by Bailey in 1920 was not observed (pers. obs.). Whether the colony is no longer in use or whether it has decreased considerably in size is not known. A breeding pair at the Leduc-Chickamin lowlands (MM). Two breeding colonies at the Alsek River; several adults defended at least 3 downy young on the sparsely vegetated gravel flats of Dry Bay and 15-20 adults defended and fed downy young on the lateral moraine of the Grand Plateau Glacier. On several occasions 10-12 adults were seen cooperatively defending 2 young. Hundreds of adults on a small island across from Williams Creek at the lower Alsek River (JJ). It is not known whether this is the site of a breeding colony.

Aleutian Tern (*Sterna aleutica*). Uncommon breeder at the Alsek River. Fluviatile and lacustrine waters and deciduous shrubland. Aleutian Terns were far less abundant than Arctic Terns at the Alsek River (pers. obs.). A nest with 3 eggs was found in mixed deciduous low shrubland approximately 200 m from the Alsek River on 2 July 2001 (JJ). Two pairs of agitated adults seen flying and calling over this area suggested that another nest may have been close by. A group of 30-35 adults and 8-10 juveniles on the shoreline of Alsek Lake near the terminus of the Grand Plateau Glacier in the company of Mew Gulls and Arctic Terns on 4 July 2001 (JJ).

Order Columbiformes

Family Columbidae

Band-tailed Pigeon (*Columba fasciata*). Rare probable breeder. Coniferous forest. A pair seen over several successive years during the breeding season at the Unuk River Post, Unuk River (GM). At least two Band-tailed Pigeons flying over the lower Chickamin River valley towards coniferous forest on 4 July 1972 (MM). One bird calling at Garnet Ledge, near the mouth of the Stikine River on 20 July (GM). A single bird in an alder tree at the Unuk River on 4 June 1997 (TS). One bird was observed and another heard calling near Fish Creek, Salmon River 5 July 1974 (GM) and a pair was seen flying over Portland Canal, in the Salmon River area on 20 June 1986 (DG).

Mourning Dove (*Zenaida macroura*). Rare summer visitant. Single birds in a meadow on the lower Chickamin River on 18 May 1973 (MM).

Order Strigiformes

Family Strigidae

Western Screech-Owl (*Otus kennicottii*). Rare possible breeder. Coniferous forest. One calling at the lower Chickamin River on 7 June 1996 (TS).

Great Horned Owl (*Bubo virginianus*). Uncommon resident and probable breeder. Coniferous forest. Individuals observed and heard calling at the Chilkat River (JJ), Taku River (Demartini, pers. comm.), and Chickamin River (MM, TS).

Northern Hawk Owl (*Surnia ulula*). Rare possible breeder. Deciduous shrubland. A single adult roosting in a small clump of alders near the terminus of the Grand Plateau Glacier (JJ) in early-July 2001 and an individual at the Chilkat River in July 1994 (Demartini, pers. comm.).

Northern Pygmy-Owl (*Glaucidium gnoma*). Uncommon resident and probable breeder. One observed at the Chilkat River (Demartini, pers. comm.), one bird calling from coniferous forest at Canyon Island, Taku River (JJ), two calling on the Unuk River, and two calling on the Chickamin River (TS).

Barred Owl (*Strix varia*). Rare resident and probable breeder. Coniferous forest. Observed at the Chilkat River (Demartini, pers. comm.) and Chickamin River (TS, JJ) during the breeding season.

Short-eared Owl (*Asio flammeus*). Rare summer visitant. (Uncommon breeder at the Alsek River). Estuarine meadow, freshwater marsh, deciduous shrubland. An adult flying over freshwater marsh and deciduous shrubland at Hot Spring Slough, Stikine River on13 July 1974 (GM), a single bird flying over the Dry Bay flats at the Alsek River

on 30 June 2001 (JJ). Also at the Alsek, a nest with three eggs on a sparsely vegetated gravel flat on 1 July 2001. A week later there were three nestlings with four dead voles in the nest (JJ).

Northern Saw-whet Owl (*Aegolius acadicus*). Uncommon resident and breeder. Coniferous forest. Heard calling at the edge of coniferous forest at the Chickamin River between 8 August and 16 September (TS, MM). Also heard calling from a stand of mature spruce near Grizzly Island, Alsek River (JJ) and two heard calling at the Chickamin River (TS). A fledgling seen in mixed forest at the Chilkat River (JJ).

Order Caprimulgiformes

Family Caprimulgidae

Common Nighthawk (*Chordeiles minor*). Rare breeder. Alluvium. A common breeder in the Canadian Interior, most sightings occur during the fall in southeastern Alaska and are thought to be of birds migrating from the interior. Breeding evidence of nighthawks in southeastern Alaska includes pairs, courtship flights, and adults performing distraction display in appropriate nesting habitat in the Chilkat and Klehini river valleys (Matt and Julie Stotts, pers. comm., Demartini, pers. comm, JJ). The breeding of this species was confirmed for Alaska when two downy, flightless nestlings were found on an alluvial flood plain on 9 July 2002 (JJ). An adult, separate from the above pair, was observed performing a distraction display in similar habitat, suggesting that multiple pairs may have nested in the same area (JJ).

Order Apodiformes

Family Apodidae

Black Swift (*Cypseloides niger*). Fairly common probable breeder. Over fluviatile and lacustrine waters and freshwater marsh near cliffs. Usually seen foraging high over fluviatile and lacustrine waters and in flocks of up to 40 on the Stikine (W, GM, JJ), and Unuk (GM, JJ), and Salmon (GM, DG) rivers. Similar sized flocks seen flying over the Leduc-Chickamin lowlands performing what appeared to be courtship behavior (MM). Smaller flocks (3-5) seen at several locations on the Unuk and Chickamin rivers (JJ). An individual was seen foraging and repeatedly visiting a cliff face on the Chickamin River (JJ). Although a definitive nest site was not located, this individual appeared to be feeding young (pers. obs.).

Vaux's Swift (*Chaetura vauxi*). Uncommon breeder. Over lacustrine and fluviatile waters, freshwater marshes, deciduous and coniferous forests. Observed in flocks of 4-12 at all rivers except for the Alsek and Taiya (HS, W, GM, MM, DG, JJ). Breeding evidence includes an adult feeding young at the Chilkat River (JJ), a female collected with a partly formed egg at the Chickamin River (HS), and the gathering of nestbuilding material (twigs) at the Salmon River (DG).

Family Trochilidae

Rufous Hummingbird (*Selasphorus rufus*). Fairly common breeder. Deciduous and mixed forests and riparian shrub thickets. Widespread during the breeding season at all rivers (HS, GM, MM, DG, JJ). Most frequently observed where there was an abundance of flowering salmonberry (pers. obs.). Evidence of breeding consists of an

unoccupied nest in an alder at the Taku River (JJ).

Order Coraciiformes

Family Alcedinidae

Belted Kingfisher (*Ceryle alcyon*). Uncommon breeder. Fluviatile shorelines, especially near clear water streams and rivers. Observed at all rivers (HS, SJ, W, GM, MM, DG, JJ). Several occupied nests in steep, slightly overhanging sandy cutbanks on the Chilkat, Katzehin, Antler, Taku, Stikine, Unuk, and Chickamin Rivers (JJ).

Order Piciformes

Family Picidae

Red-breasted Sapsucker (*Sphyrapicus ruber*). Fairly common breeder. Deciduous, mixed, and less often in pure coniferous forests and deciduous shrubland. During the breeding season at all rivers except the Alsek (GM, MM, DG, JJ). Evidence of breeding includes apparent food-gathering noted at the Salmon River (G) and occupied nests, primarily found in cottonwood snags but also in dead spruce at the Chilkat (JJ), Katzehin (JJ), Antler (JJ), Taku (JJ), Whiting (JJ), Stikine (JJ), and Unuk (JJ), and Chickamin (HS, MM, JJ) rivers.

Downy Woodpecker (*Picoides pubescens*). Uncommon resident and breeder. Deciduous forest and deciduous shrubland. Observed at the Alsek (JJ), Taiya (GM, JJ), Chilkat (JJ), Taku (GM), Whiting (JJ), Unuk (GM, JJ) and Salmon (GM) rivers. Breeding evidence consists of a nest with young in a cottonwood snag at the Alsek River (JJ). An adult with young in deciduous riparian thicket at the Chilkat River (JJ). A pair drumming, calling, and excavating in a cottonwood snag in a deciduous forest at the

Unuk River (JJ).

Hairy Woodpecker (*Picoides villosus*). Uncommon to fairly common resident and breeder. Deciduous, coniferous, and mixed forests. Seldom encountered by past studies (GM, MM) yet frequently observed during the 2000-2002 breeding seasons. Hairy Woodpeckers were seen at all rivers (HS, GM, DG, JJ). Occupied nests were found in both cottonwood and spruce snags at all rivers (DG, JJ).

Three-toed Woodpecker (*Picoides tridactylus*). Uncommon resident and breeder. Coniferous forest. Observed at the Chilkat (GM, JJ), Stikine (GM), and Chickamin (JJ) rivers. A nest female was seen at the Mosquito Lake campground, Chilkat River (GM). At the same location, an occupied nest in a live spruce in 1999 (Al DeMartini, pers. comm.) and a female feeding young in July 2002 (JJ). A pair in coniferous forest at the Chilkat River (JJ). A pair encountered in coniferous forest at the Chickamin River (JJ).

Northern Flicker (*Colaptes auratus*). Uncommon breeder. Coniferous and mixed forest and seen foraging on sparsely vegetated alluvium. During the breeding season three yellow-shafted flickers were seen at the Chilkat River (JJ), unidentified flickers recorded at the Taku River (Demartini, pers. comm.), Unuk River (GM), the Leduc-Chickamin lowlands (MM). A pair of red-shafted seen at the edge of coniferous forest at Clear Creek, Chickamin River (JJ). Both red-shafted and yellow-shafted subspecies seen at the Salmon River (GM, DG). A nest with young fed by a male red-shafted flicker found in an "upturned giant tree stump" at the edge of Hyder, near the Salmon River (DG).

Order Passeriformes

Family Tyrannidae

Olive-sided Flycatcher (*Contopus cooperi*). Uncommon probable breeder. Usually seen perched in tall live or dead spruces at the edge of freshwater marshes, beaver ponds, or similarly open habitat (pers. obs.). Singing birds at the Chilkat (JJ), Antler (JJ), Taku (GM, JJ), Stikine (W, GM, JJ), Chickamin (MM, GG), and Salmon (GM) rivers.

Western Wood-Pewee (*Contopus sordidulus*). Uncommon breeder. Deciduous and mixed forests and at the edge of forests and open habitats similar to Olive-sided Flycatchers. Singing birds at all rivers except for the Alsek and Taiya (W, GM, MM, DG, JJ). A nest with one egg found in a red alder at the edge of coniferous forest at the Leduc-Chickamin lowlands (MM). A probable pair in the red alder transitional zone near Wolf Cabin, Chickamin River (MM).

Alder Flycatcher (*Empidonax alnorum*). Fairly common breeder. Usually observed in patchy willow shrublands at the edge of freshwater marshes. Singing males and/or pairs at all rivers except for the Alsek and Taiya (W, GM, MM, DG, JJ). An active nest was observed at the Chilkat River (Demartini, pers. comm.).

Willow Flycatcher (*Empidonax trailli*). Rare possible breeder. Deciduous shrubland. The first record of Willow Flycatcher in Alaska was a singing male collected while foraging at the edge of a slough at the Salmon River on 13 June 1986 (DG). Since then there have been two other documented records of singing males at the major mainland rivers; one at Sergief Island, Stikine River on 21 June 1989 and the other at

Texas Creek, Salmon River on 23,25 June 1990 (Gibson and Kessel 1992).

Least Flycatcher (*Empidonax minimus*). Rare probable breeder. Deciduous forest. Two males heard singing in red alder at the Salmon River on 10-19 June 1986 (DG) and a male heard singing and observed in red alder forest at the Chickamin River on 12 June 2001 (JJ). Also, singing males observed in recent years at the Chilkat River (Gibson and Kessel 1992, JJ), the Stikine River (Peg Robertson, USFS, pers. comm.) and Hyder/Salmon River area (Gibson and Kessel 1992).

Hammond's Flycatcher (*Empidonax hammondii*). Fairly common breeder. Mature deciduous and mixed forest. First sighting at the Chickamin River on 24 May (MM). Singing males at all rivers except for the Alsek (SJ, GM, MM, DG, JJ). Evidence of breeding includes food-carrying adults at the Chilkat, Unuk, and Chickamin rivers (JJ), and an adult feeding young at the Taku River (JJ).

Pacific-slope Flycatcher (*Empidonax difficilis*). Fairly common breeder. Coniferous and mixed forest. First observed on 12 May at the Chickamin River (MM). Frequently heard singing from late-May until mid-June when singing levels decline (pers. obs.). Singing males at all rivers (HS, GM, MM, DG, JJ), however, rare at the Taiya, Chilkat, and Alsek rivers. Adults carrying food and nests with young in spruce at the Unuk and Chickamin rivers (JJ). An incubating female collected at the Chickamin River (HS).

Say's Phoebe (*Sayornis saya*). Rare summer visitant. Observed at the Taku River on 18-22 May 2002 (Demartini, pers. comm.).

Western Kingbird (*Tyrannus verticalis*). Rare summer visitant. Observed at the Chilkat River on 18 June 2002 (Demartini, pers. comm.).

Eastern Phoebe (*Sayornis phoebe*). Rare summer visitant. Single singing male seen along the Klehini River (a tributary of the Chilkat River) in June (exact date unknown, Andres).

Eastern Kingbird (*Tyrannus tyrannus*). Rare summer visitant. Records during the breeding season include individuals at the Chilkat River on 4 July 2002 (Demartini, pers. comm.), a female and another individual of unknown sex seen in willow shrub thicket at the Leduc-Chickamin lowlands 16 June 1973 (MM) and a single bird foraging at the Salmon River on 10 June 1986 (DG).

Family Vireonidae

Cassin's Vireo (*Vireo cassinii*). Rare probable breeder. Coniferous and mixed forest. The first records of Cassin's Vireo in Alaska are from the Hyder area; a singing male observed and collected on 11 June 1986; and a singing male heard on 12 – 15 June 1986 (DG). Since 1986, observations of Cassin's Vireo have proliferated in southeastern Alaska, suggesting that this species is undergoing a range expansion into Alaska from central British Columbia. Records from the major mainland rivers during the past 6 years include a singing male observed near the Chilkat River on 8 August 2002 (Demartini, pers. comm.), a pair including a singing male observed in mixed forest at the Taku River between 27 May-3 June 2000 (JJ), a pair, including a singing male observed in mixed forest at the Whiting River on 7 June 2002 (JJ), a singing male heard at the Unuk River on 15 June 1997 (Tim Shantz, unpub. notes), a territorial pair observed vigorously

defending a territory against two Steller's Jay and a Downy Woodpecker near Choca Creek, Chickamin River, on 19 June 1996 (Tim Shantz, unpub. notes), a singing male present at the same location three weeks later on 7 July 1996 (Tim Shantz, unpub. notes), a separate male singing from alders was heard near the South Fork of the Chickamin River on 27 June 1996 (Tim Shantz, unpub. notes), and a singing male was heard in mixed forest on 2 June 2001 (JJ).

Warbling Vireo (*Vireo gilvus*). Fairly common breeder. Deciduous and mixed forests. One of the most common species in deciduous forests during the 2000-2002 breeding seasons at all rivers except for the Alsek (pers. obs). Breeding evidence includes adults feeding fledglings at the Chilkat, Taku, Stikine, and Chickamin rivers (JJ) and food-carrying adults at the Unuk River (JJ).

Red-eyed Vireo (*Vireo olivaceus*). Rare probable breeder. Deciduous forest and deciduous tall shrubland. Four singing males in deciduous forest and riparian alder thicket at the Stikine River on 13-14 July 1974 (GM). Also at the Stikine River, a pair and lone singing male in deciduous shrubland with scattered red alder and pacific willow in mid June 2000 (JJ). One male singing in thick willows at the Unuk River on 27 June 1997 (TS). Four singing males and one individual of unknown sex in deciduous forest and riparian willow thicket at the Leduc-Chickamin lowlands in June and July 1972 and 1973 (MM). Also, at the Chickamin River, three singing males heard in similar habitat in early June 2001 (JJ).

Family Corvidae

Black-billed Magpie (*Pica hudsonia*). Rare resident and breeder. (Uncommon breeder at the Alsek River). Deciduous tall shrubland. A flock of adults and young of the year in deciduous shrubland at the edge of Spud's Slough, Alsek River in early July 2001 (JJ). Five seen along the Haines Highway on 23 July 1941 (SJ). A nest that had been recently built and used but not occupied was found in deciduous tall shrubland at the Chilkat (JJ). This is the first known breeding record for Black-billed Magpies in southeastern Alaska.

Steller's Jay (*Cyanocitta stelleri*). Uncommon resident and breeder. (Rare possible breeder at the Alsek River). Primarily coniferous forests but also in mixed forests. Seen throughout the year at the Chickamin River (MM). During the breeding season at all rivers (GM, MM, DG, JJ). Fairly inconspicuous during most of the breeding season but became more noticeable when young fledge (pers. obs.). Fledglings at the Chilkat (JJ), Taku (JJ), Stikine (JJ), Unuk (GM, JJ), and Chickamin (MM, JJ) rivers. Only one Steller's Jay seen at the Alsek River, a bird calling from a mature spruce stand near Grand Plateau Glacier Lake (JJ).

American Crow (*Corvus brachyrhynchos*). Rare resident and breeder. Coniferous forest and tidal flats. The only substantiated records of American Crow in Alaska are from Hyder; up to 70 American Crows were identified in June 1986. Several individuals were collected and included 2 females, 3 adult males, and a recently fledged male (Gibson and Kessel 1992). The only other known records of American Crow outside of the Hyder Area consisted of 2 individuals heard and observed on several

occasions at the headwaters of Indian Creek, Chickamin River, on 26 July 1996. This area is less than 30 miles from Hyder. Attempts to collect a bird were unsuccessful (Tim Schantz, unpub. notes).

Northwestern Crow (*Corvus caurinus*). Uncommon resident and breeder. Coniferous forest, estuarine meadows, and fluviatile shorelines. Seen throughout the year at the Chickamin River and in flocks of up to 75 in March and April and in a flock of 100 in late-August (MM). Recorded during the breeding season at all rivers except the Alsek, Whiting, and Salmon (HS, W, GM, MM, JJ).

Common Raven (*Corvus corax*). Uncommon resident and breeder. Coniferous forest, cliffs, and tidal flats. During the breeding season groups of 2-5 and single birds flying over most habitats of all rivers surveyed (GM, MM, DG, JJ). Evidence of breeding includes adults with 3-4 begging young in coniferous forest near the Mosquito Lake campground, Chilkat River (JJ), and a food carrying adult making several trips to a probable nest site at the Leduc-Chickamin lowlands (MM).

Family Hirundinidae

Tree Swallow (*Tachycineta bicolor*). Common breeder. Over fluviatile and lacustrine waters, freshwater marshes, and estuarine meadows. First observed at the Chickamin River on 23 April (MM). Recorded during the breeding season at all rivers (SJ, W, GM, MM, DG, JJ). Nests in old woodpecker cavities in cottonwood and spruce snags at the edges of freshwater marshes at all of the rivers surveyed (GM, MM, DG, JJ).

Violet-green Swallow (*Tachycineta thalassina*). Fairly common migrant and uncommon breeder. Most often observed foraging over freshwater marshes with Tree

Swallows. Observed at the Chilkat (JJ), Taku (GM, JJ), Whiting (JJ), Stikine (JJ), and Chickamin (HS, MM) rivers. Observed nesting in buildings in the town of Hyder and foraging over the mouth of the Salmon River, but none encountered upriver (GM, DG). Observed nesting along with Tree Swallows in cottonwood snags at the edge of a large freshwater marsh at the Chilkat (JJ), Taku (JJ), and Whiting (JJ) rivers.

Northern Rough-winged Swallow (*Stelgidopteryx serripennis*). Rare breeder. Fluviatile waters and shorelines. Breeding of Northern Rough-winged Swallow was confirmed for Alaska when a burrow containing 5 newly-hatched young was found near Wrangell (GM). The first mainland breeding record in southeastern Alaska was of a female collected with a soft-shelled egg in her oviduct at the Salmon River in June 1986 (DG). The second mainland breeding record of Northern Rough-winged Swallow in southeastern Alaska was of adults entering a nest cavity in a sandy bank along the Stikine River on 19 July 1997 (Paul Cotter, pers. comm.). Other breeding records include an individual seen entering a cavity in a mud bank on 27 July 1996 (TS), and elliptical shaped burrows, indicative of this species, found at the Chickamin River on 23 July 2001 (JJ) and Salmon River on 5-9 July 1974 (GM). Other observations include individuals at the Taku River on 27 May 2001 (Demartini, pers. comm.), a pair at the Unuk River on 30 June 1974 (GM), the Chickamin River during May and June 1973 (MM, TS) and Salmon River during June 1986 (DG).

Bank Swallow (*Riparia riparia*). Uncommon migrant and breeder. Fairly common breeder at the Alsek River. Over fluviatile waters and shorelines, especially where cutbanks are present. Breeding colonies of 70+ birds at several locations at the

Alsek River (JJ). A small breeding colony of 3-4 nesting pairs at the Taku River (JJ). Individuals seen at the Chilkat River (Demartini, pers. comm.), Leduc-Chickamin lowlands (MM) and a flock of 70 near the mouth of the Salmon River (DG).

Cliff Swallow (*Petrochelidon pyrrhonota*). Rare breeder. Fluviatile waters, buildings. During the breeding season two birds flying over beaver ponds at the Leduc-Chickamin lowlands on 25 May and 9 June 1973 (MM) and another individual at the mouth of the Chickamin River on 14 May 1974 (MM). Three individuals were seen foraging with Barn and Tree Swallows over fluviatile waters near the town of Klukwan, Chilkat River in late June 2001 (JJ). The first confirmed breeding record of Cliff Swallows in southeastern Alaska is from Sergief Island, Stikine River, where three pairs of adults were observed feeding young at the Stikine Duck Club cabin on 20 July 1974 (GM).

Barn Swallow (*Hirundo rustica*). Fairly common migrant and breeder. Over fluviatile and lacustrine waters, estuarine meadows, freshwater marshes, and buildings. First seen at the Chickamin River on 9 May and last observed on 7 September (MM). Seen during the breeding season at all rivers, except the Katzehin (SJ, GM, MM, DG, JJ). Nests placed on buildings at the Alsek, Chilkat, Taku, Stikine, Unuk, and Chickamin rivers (JJ).

Family Paridae

Black-capped Chickadee (*Poecile atricapilla*). Uncommon resident and breeder. Deciduous shrubland and to a lesser degree in deciduous forest. A few singing males heard during the breeding season, but fairly inconspicuous until approximately the first

week in July when family groups were seen in deciduous tall shrubland. Recorded at the Alsek (JJ), Chilkat (SJ, GM, JJ), Taku (GM, JJ), and Stikine (GM, JJ) rivers. Adults feeding young at the Alsek (JJ), Chilkat (JJ), and Taku rivers (JJ).

Chestnut-backed Chickadee (*Poecile rufescens*). Common resident and breeder. Coniferous forest and to a lesser degree, mixed forests. Family groups occasionally seen in deciduous forest. Seen throughout the year at the Chickamin River (MM). During the breeding singing males, pairs, adults carrying food, occupied nests, and adults with fledglings at all rivers (W, GM, MM, DG, JJ). Only record at the Alsek River was a single individual in a spruce stand near Grand Plateau Glacier Lake (JJ).

Family Sittidae

Red-breasted Nuthatch (*Sitta canadensis*). Uncommon resident and probable breeder. (Rare possible breeder at the Alsek River). Coniferous forests and mixed forests. Although seldom observed, singing males heard at the Alsek, Chilkat, Taku, Stikine, Unuk, and Chickamin rivers (GM, MM, DG, JJ). Only one record of a Red-breasted Nuthatch at the Alsek River; a male heard calling from a spruce stand near Grand Plateau Glacier Lake (JJ).

Family Certhiidae

Brown Creeper (*Certhia americana*). Uncommon resident and breeder. Coniferous, deciduous, and mixed forests. Singing males in small numbers at the Taiya (GM), Chilkat (JJ), Taku (JJ), Whiting (JJ), Stikine (JJ), Unuk (JJ), and Chickamin (JJ) rivers. Breeding evidence includes a fledgling at the Unuk River (TS) and a family group in the Hyder/Salmon River area (DG).

Family Troglodytidae

Winter Wren (*Troglodytes troglodytes*). Common resident and breeder. (Rare probable breeder at the Alsek River). Coniferous forest but also in mixed forest and deciduous riparian thickets with scattered spruce trees. First seen on 17 March and observed through late-October at the Chickamin River (MM). Common during the breeding season at all rivers except for the Alsek River where there was only one record; a singing male in a spruce stand near the Grand Plateau Glacier Lake (GM, MM, DG, JJ). Food carrying adults at the Chilkat, Unuk, and Chickamin rivers (JJ). An adult with at least four fledglings at the Chickamin River (MM).

Family Cinclidae

American Dipper (*Cinclus mexicanus*). Uncommon breeder. Fast flowing, clearwater streams and rivers. Only observed at the Chickamin River between late-August and April suggesting a shift from higher elevation streams to the river valley after the breeding season (MM). During the breeding season seen at the Antler (JJ), Whiting (JJ), Stikine (W, GM), Unuk (GM, JJ), Chickamin (MM, JJ), and Salmon (GM, DG) rivers. Adults carrying food at the Stikine (W), Unuk (JJ), and Salmon (DG) rivers. An adult was observed feeding young at the Antler River (JJ).

Family Regulidae

Golden-crowned Kinglet (*Regulus satrapa*). Fairly common resident and breeder. (Rare probable breeder at the Alsek River). Coniferous forests and mixed forests. Like the chestnut-backed chickadee and winter wren, also observed in single spruce trees amidst deciduous riparian thickets. Observed throughout the year at the Chickamin River

(MM). During the breeding season at all rivers (GM, MM, DG, JJ). Only two observations of Golden-crowned Kinglets at the Alsek River; one singing male in a spruce stand at Muddy Creek and another singing male in a spruce stand near Grand Plateau Glacier Lake (JJ). The only confirmed breeding evidence consists of four juveniles in montane alder thickets at Shakes Lake, Stikine River (GM).

Ruby-crowned Kinglet (*Regulus calendula*). Common breeder. Mixed forests but also in coniferous forests and deciduous riparian thickets with scattered spruce. The first spring record at the Chickamin River is a singing male on 1 April (MM). Frequently observed foraging in deciduous vegetation but nests primarily in conifers. Confirmed breeding at all rivers (GM, MM, JJ) except for probable at the Salmon River, where, interestingly, this species was considered uncommon (DG).

Family Turdidae

Gray-cheeked Thrush (*Catharus minimus*). Uncommon probable breeder. (Fairly common breeder at the Alsek River). Deciduous tall shrubland with scattered tall trees. Singing males at all rivers (GM, MM, JJ) except for the Salmon River (GM, DG). Considerably more common at the Alsek River where several food-carrying adults and nests with young were found in early-successional deciduous forest and deciduous shrubland (JJ). No records at the Chickamin River in 1973-4 (MM) suggesting that this species has undergone a recent range expansion. Breeding confirmed in southeastern Alaska (Wik and Streveler 1968).

Swainson's Thrush (*Catharus ustulatus*). Fairly common to common breeder. Deciduous and mixed forests and deciduous riparian thickets. Arriving later than other

thrushes, the first spring record at the Chickamin River is of a calling bird on 29 May (MM). Observed during the breeding season at all rivers except for the Alsek River (GM, MM, DG, JJ). Nests with eggs and young in deciduous shrubs at the Chilkat, Taku, Stikine, Unuk, and Chickamin rivers (JJ).

Hermit Thrush (*Catharus guttatus*). Fairly common breeder. (Common to abundant breeder at the Alsek River). Coniferous forests and to a lesser degree mixed forests. First observed at the Chickamin River on 7 May (MM). During the breeding season at all rivers (GM, MM, DG, JJ). The most common passerine species at the Dry Bay/Alsek River area and ubiquitous in deciduous shrubland with scattered small spruces. Numerous nests with eggs and young found in 1-3 m tall spruce that seemingly offered protection from both predators and inclement weather (pers. obs.). Evidence of breeding at the other rivers include food-carrying adults at the Chilkat River (JJ), fledglings at the Taku River (JJ), and singing males at the Stikine (GM, JJ), Unuk (GM, JJ), Chickamin (MM, JJ), and Salmon (GM, DG) rivers.

American Robin (*Turdus migratorius*). Common breeder. Recorded in a variety of habitats including coniferous, deciduous, and mixed forests, deciduous shrubland with scattered tall trees, townsites, and buildings. Observed during the breeding season at all of the rivers (SJ, GM, MM, DG, JJ). Breeding confirmed at all rivers except for probable at the Salmon River (MM, JJ).

Varied Thrush (*Ixoreus naevius*). Common breeder. Coniferous and mixed forest and deciduous shrubland. First heard at the Chickamin River on 30 March and by mid-April in flocks of up to 100; still fairly common at the Chickamin River in mid-October

(MM). During the breeding season one of the most prevalent species in coniferous forests at all rivers (GM, MM, DG, JJ). However, adults with fledglings frequently observed foraging in deciduous shrubland. At the Alsek River, primarily in deciduous shrubland with scattered short tree spruce (JJ). Breeding confirmed at all rivers except for probable at the Salmon River (G, GM, MM, DG, JJ).

Family Sturnidae

European Starling (*Sturnus vulgaris*). Rare resident and breeder. Primarily associated with townsites and estuarine meadows in southeastern Alaska. Seen foraging in small flocks at the Chilkat (Demartini, pers. comm.), Stikine, Chickamin (MM) and Salmon (DG) rivers. Nesting recorded at Sergief Island at the mouth of the Stikine River (GM) and at the mouth of the Salmon River (DG).

Family Motacillidae

American Pipit (*Anthus rubescens*). Rare summer visitant. Small flocks on alluvial bars at the Taku River in late-May (JJ) and a single bird at the Unuk River on 23 June (GM). Breeds above treeline in southeastern Alaska.

Family Bombycillidae

Bohemian Waxwing (*Bobycilla garrulus*). Rare probable breeder. Coniferous forest. Pairs in flight over or perched in coniferous forest at the Chilkat (JJ), Taku (JJ), and Stikine (JJ) rivers. The only indication that Bohemian Waxwings breed at the major mainland rivers of southeastern Alaska is based on a female with an enlarged oviduct and varied-sized ova collected at the Salmon River (GM). However, due to the proximity of the Canadian border, this female might not have bred in southeastern Alaska.

Cedar Waxwing (*Bombycilla cedorum*). Uncommon breeder. Mixed forests and deciduous shrubland. During the breeding season at the Antler (JJ), Chilkat (JJ), Taku (GM, JJ), Stikine (GM), Unuk (TS), Chickamin (HS, MM) and Salmon (GM, DG) rivers. A female that had recently laid (distended oviduct, one collapsed follicle, and varied-sized ova) was collected at the Salmon River (GM).

Family Parulidae

Tennessee Warbler (*Vermivora peregrina*). Rare breeder. Mixed forest and deciduous shrubland. During the breeding season a singing male and a brood of three fledglings with adults in riparian willows at Shakes Slough, Stikine River (GM). Another pair of agitated adults seen in similar habitat two miles east of Shakes Slough (GM). A pair of food-carrying adults in second-growth deciduous trees at the edge of coniferous forest in the town of Hyder (GM). In addition, an individual at the Chilkat River (Demartini, pers. comm.) and a single singing male in red alder woodland with open understory and few scattered young spruce at the Chickamin River (JJ).

Orange-crowned Warbler (*Vermivora celata*). Common to uncommon breeder. Dense deciduous shrubland and ecotones between deciduous shrubland and freshwater marshes. The first spring records at the Chickamin River is of a silent bird in a willow thicket on 9 May and 6-12 singing males heard in cottonwoods on 11-13 May (MM). Breeding confirmed at the Alsek, Chilkat, Taku, and Stikine rivers (JJ). Singing males at the Unuk (JJ), Chickamin (JJ), and Salmon (GM, DG) rivers. Considered common at all mainland river systems in 1974 (GM) and at the Chilkat, Taku, and Stikine Rivers during the 2000 breeding season (JJ). However, considered uncommon to rare at the Stikine by

Swarth (1911) and during the 2001 breeding season at the Unuk and Chickamin Rivers (JJ). Similarly, only two observations of Orange-crowned Warblers recorded at the Chickamin River and no observations from the Unuk River (TS), yet considered fairly common in 1974 at the Chickamin River (MM). Considered a common breeder at the Alsek River (JJ). Continued monitoring of population trends is suggested to determine whether this species has marked inter-annual population fluctuations or is experiencing a negative population trend in the southern mainland river systems.

Yellow Warbler (*Dendroica petechia*). Common breeder. Deciduous shrubland and mid-successional deciduous forests. At all rivers during the breeding season (GM, MM, DG, JJ). First seen on 17 May and heard singing on 24 May at the Chickamin River (MM). Confirmed breeding at the Alsek (JJ), Taku (JJ), Stikine (JJ), Unuk (JJ), and Chickamin (MM, JJ) rivers. Pairs and singing males at the Chilkat River (JJ).

Magnolia Warbler (*Dendroica magnolia*). Rare breeder. Mixed forest and deciduous shrubland. Singing males in mixed forest at the Unuk, Chickamin, and Salmon rivers (DG, JJ). A female collected in riparian alder thicket at the Chickamin River (MM). A family group was observed at Crescent Lake, Whiting River in June 1989 (Demartini, pers. comm.) and a nest with four young in mixed forest at the Stikine River (JJ) are the first known confirmed breeding records of this species in Alaska.

Yellow-rumped Warbler (*Dendroica coronata*). Fairly common breeder. Primarily in deciduous and mixed forests. During the breeding season both the northern and interior "myrtle" subspecies and the western "Audubon's" subspecies recorded at the major mainland river systems. Only "myrtles" seen at the Alsek River (JJ). Similarly, all

Yellow-rumped Warblers at the Taiya (JJ), Katzehin (JJ), Antler (JJ), Chilkat (GM, JJ), Taku (JJ), and Whiting (JJ) rivers were "myrtles". At the Stikine, the majority were "myrtles" but several male and female "Audubon's" seen (JJ). Both subspecies seen in small numbers at the Unuk (GM). During the 2000-2001 field seasons both subspecies seen at the Unuk and Chickamin (JJ) rivers, although the majority were "Audubon's". MacDonald and MacDonald (1975) observed both subspecies occasionally at the Chickamin River during the breeding season, but during May only 10-25% seen were "Audubon's". In addition, a singing male "myrtle-Audubon" intergrade was collected at the Chickamin River (MM). At the Salmon River all Yellow-rumped Warblers seen were "Audubon's" (GM). However, during a later visit to this river one male "myrtle" was detected (DG). Seen in late-April and late-September at the Chickamin River (MM). Breeding confirmed at all rivers (GM, MM, JJ).

Townsend's Warbler (*Dendroica townsendi*). Fairly common breeder. (Rare possible breeder at the Alsek River). Coniferous forest and frequently detected in mixed forests and deciduous shrubland with a few scattered mature spruce. First and last recorded at the Chickamin River on 25 April and 24 September, respectively. Singing males, food-carrying adults, and/or immatures recorded at all rivers (GM, MM, DG, JJ). However, at the Alsek River, a singing male heard in a spruce stand near the Grand Plateau Glacier Lake (JJ).

Blackpoll Warbler (*Dendroica striata*). Rare possible breeder. A singing male with a female at the Chickamin River in mid-June (MM). The only other records during the breeding season consists of an individual along the Chilkat River in June (Andres,

pers. comm.), and single male in deciduous shrubland at the Taku River (JJ), and one adult in a large migrant flock of warblers at the Chickamin River (TS). Breeding confirmed in Juneau area (R. Gordon, pers. comm.).

Black-and-White Warbler (*Mniotilta varia*). Rare probable breeder. A singing male with a female closely observed in dense deciduous tall shrub with few scattered pacific willow and spruce on 17 June 2001 at the Chickamin River (JJ). This pair was not relocated when I returned in late-July. However, behavior indicates that the pair was territorial and suggests that this species may breed in southeastern Alaska. This is the second documented record of Black-and-White Warbler in Alaska and the first record for this species in southeastern Alaska.

American Redstart (*Setophaga ruticilla*). Fairly common breeder. Well-developed shrub understory of deciduous forests. Arrives later to southeastern Alaska than other warbler species; first observed on 9 June at the Chickamin River (MM) and between 5-10 June at the Taku and Chickamin rivers (JJ). Recorded during the breeding season at all rivers except for the Alsek (W, GM, MM, DG, JJ). Evidence of confirmed breeding at the Taiya (JJ), Chilkat (JJ), Taku (GM, JJ), Stikine (JJ), Unuk (GM, JJ), and Chickamin (JJ) rivers. First year males often seen singing and paired with females (pers. obs.).

Northern Waterthrush (*Seiurus noveboracensis*). Uncommon breeder. In habitats with a developed deciduous shrub understory and high soil moisture levels. Also, observed in deciduous shrublands bordering freshwater marshes. Singing males at all rivers except for the Alsek (GM, MM, DG, JJ). Food-carrying adults seen at the Chilkat

(JJ), Unuk (JJ), and Chickamin (JJ) rivers.

MacGillivray's Warbler (*Oporonis tolmiei*). Fairly common breeder. Always in dense shrub habitats in mixed and deciduous forest and at the edge of wet meadows and freshwater marshes. Singing males at the Chilkat (JJ), Taku (GM, JJ), Stikine (W, GM, JJ), Unuk (GM, JJ), Chickamin (HS, MM, JJ), and Salmon (GM, DG) rivers. Nests located in salmonberry and alder shrub thickets at the Chilkat (JJ), Taku (JJ), Unuk (JJ), and Chickamin (MM, JJ) rivers.

Common Yellowthroat (*Geothlypis trichas*). Fairly common breeder. Primarily observed in freshwater marshes, sedges bordering lakes and ponds and to a lesser degree in estuarine meadows. First and last seen at the Chickamin River on 17 May and 3 September, respectively (MM). During the breeding season at all rivers except for the Alsek and Taiya rivers (HS, W, GM, MM, DG, JJ). Evidence of confirmed breeding at the Chilkat (JJ), Taku (JJ), Stikine (JJ), Unuk (JJ), and Chickamin (MM, JJ) rivers.

Wilson's Warbler (*Wilsonia pusilla*). Fairly common breeder. (Common to abundant breeder at the Alsek River). Usually observed in deciduous shrublands, and to a lesser degree, dense shrub layer in mature mixed and deciduous forests. First and last seen at the Chickamin River on 13 May and 3 September, respectively (MM). During the breeding season at all rivers (GM, MM, DG, JJ). Regarded as fairly common during the 2000 breeding season at the Chilkat, Taku, and Stikine rivers (JJ). However, during 2001, considered rare to uncommon at the Unuk and Chickamin Rivers (JJ). Common to abundant breeders in deciduous shrubland, especially willow at the Alsek River (JJ). Evidence of confirmed breeding at the Alsek, Chilkat, Taku, and Stikine rivers (JJ).

Singing males and pairs at the Unuk and Chickamin rivers (JJ).

Family Thraupidae

Western Tanager (*Piranga ludoviciana*). Uncommon probable breeder. At the edges of mature coniferous forests and mixed forests and occasionally in deciduous riparian thickets where there were patches of tall spruce. Singing males and pairs at all rivers except for the Alsek and Katzehin (W, GM, MM, DG, JJ).

Family Emberizidae

Chipping Sparrow (*Spizella passerina*). Rare to uncommon breeder. Willow/herb glacial outwashes and gravel bars with scattered shrubs. Singing males at all rivers except for the Alsek, Katzehin, and Taiya rivers (GM, MM, DG, JJ). Food-carrying adults at the Chilkat River (JJ) and Whiting River (JJ) and adults feeding juveniles at the Taku River (GM).

Savannah Sparrow (*Passerculus sandwichensis*). Uncommon breeder. (Fairly common breeder at the Alsek River). Estuarine meadows and sedge meadows at the edge of freshwater marshes except for the Alsek River where encountered in willow dominated shrubland interspersed with open meadow and grass meadows bordering dunes. Singing males at all rivers (HS, W, GM, MM, DG, JJ). Food-carrying adults and juveniles at the Alsek and Chickamin rivers (JJ).

Fox Sparrow (*Passerella iliaca*). Fairly common breeder. Primarily in habitats with a dense shrub understory and a deciduous or mixed tree canopy layer. Observed at all rivers except for the Taiya, Katzehin, and Whiting rivers (HS, W, GM, MM, DG, JJ). Regarded as uncommon at the Salmon River in 1986 (DG) where numbers of observed

birds were distinctly lower in the same area than in 1974 (GM). Common to abundant breeder at the Alsek River in shrubland and deciduous short tree habitats with scattered short spruce. Evidence of confirmed breeding at all rivers (JJ) except for the Salmon River (GM, DG).

Song Sparrow (*Melospiza melodia*). Uncommon breeder. Dense shrub layer in deciduous forests and deciduous tall shrubland at the edge of freshwater marshes, sloughs, and other areas containing standing water. At all rivers except for the Alsek and Taiya rivers (HSb, W, GM, MM, DG, JJ). Confirmed breeding at the Chilkat, Taku, and Chickamin rivers (JJ). Considered a common breeder only 75 km to the north at Yakutat Bay by Gabrielson (1959), Song Sparrows were not seen at the Dry Bay/Alsek River area (JJ).

Lincoln's Sparrow (*Melospiza lincolnii*). Fairly common breeder. Freshwater marshes, willow shrubs at the edge of freshwater marshes, and estuarine meadows. At all rivers during the breeding season (GM, MM, DG, JJ). Evidence of confirmed breeding at all rivers except for probable at the Salmon River (GM, MM, JJ).

Golden-crowned Sparrow (*Zonotrichia atricapilla*). Uncommon probable breeder at the Alsek River. Deciduous shrubland. The only records of this species during the breeding season are of two males singing in early July from an alder thicket at the edge of Alsek Lake in late June 2001 (JJ), several on moraine in front of Norris Glacier, Taku River on June 27-28 1920 (AB), and a singing male on 24 May 1973 at the Chickamin River (MM).

Dark-eyed Junco (*Junco hyemalis*). Uncommon to fairly common breeder.

Mixed forests with fairly open shrub understory, the edge of coniferous forests, and to a lesser degree in deciduous shrubland. Also, prefers areas with a developed but patchy herbaceous ground layer (pers. obs.). Singing males at all rivers except for the Katzehin (GM, MM, DG, JJ). All records were of the "Oregon" *J. h. oreganus* subspecies. A nest with eggs at the Chilkat and the Unuk rivers (JJ) and fledglings seen at the Stikine (JJ) and Chickamin (MM) rivers.

Family Icteridae

Red-winged Blackbird (*Agelaius phoeniceus*). Uncommon breeder. Freshwater marshes and in sedges surrounding beaver ponds. Egg-laying was observed at the Chickamin River on 21 May (MM). Pairs and singing males at the Antler (JJ), Chilkat (JJ), Taku (JJ), Stikine (JJ), Unuk (JJ), Chickamin (MM, JJ), and Salmon (DG) rivers. An individual of unknown sex collected at Sergief Island, Stikine River (W). Several nests at the Chickamin River (MM) and an adult feeding fledglings at the Salmon River (DG).

Rusty Blackbird (*Euphagus carolinus*). Uncommon breeder. In similar habitats as Red-winged Blackbird and often the two species observed in close proximity. Recorded during the breeding season at all rivers except for the Alsek, Taiya, Katzehin, Antler and Salmon (GM, MM, JJ). A nest with eggs found in an alder overhanging the Chilkat River (JJ), young of the year observed at the Taku River (GM), and a food carrying adult recorded at the Chickamin River (MM).

Brown-headed Cowbird (*Molothrus ater*). Rare probable breeder. A single singing male at the Antler River in mid-June 2002 (JJ), a pair seen in an estuarine

meadow at the Chickamin River on 28 May 1973 (MM), an adult male with Red-winged Blackbirds and Rusty Blackbirds at the Chickamin River on 17 May 1974, and a pair along the Klehini River, a tributary of the Chilkat (date unknown) (Andres). The only known breeding record of Brown-headed Cowbird is of a nestling being fed by a Pine Grosbeak in the Chilkat River valley in 1996 (Demartini, pers. comm.).

Family Fringilidae

Pine Grosbeak (*Pinicola enucleator*). Uncommon resident and probable breeder. Coniferous forest. During the breeding season at the Alsek (JJ), Taiya (JJ), Chilkat (GM, JJ), Taku (GM), and Chickamin (HS, MM) rivers. Pairs seen at the Alsek (JJ) and the Chickamin (MM) rivers. Breeding confirmed in southeastern Alaska (Wik and Streveler 1968).

Red Crossbill (*Loxia curvirostra*). Common resident and probable breeder. Coniferous and mixed forests. During the 2001 breeding season, flocks of 10-15 individuals frequently observed in mature spruce at the Unuk (JJ), Chickamin (JJ), and Salmon rivers (GM, DG) Rivers. Recorded in smaller numbers at the Chilkat (JJ), Taku (GM, JJ), Stikine (JJ), and Unuk (GM) rivers. An adult female incubating eggs, evidenced by brood patch and condition of her oviduct, was collected at Sergief Island, Stikine River on 28 August (HSb). Breeding confirmed in southeastern Alaska (Wik and Streveler 1968).

White-winged Crossbill (*Loxia leucoptera*). Uncommon resident and probable breeder. In mixed forests at the Taiya (GM), Chilkat (JJ), Taku (JJ), Stikine (JJ), and Chickamin (MM) rivers. Less frequently observed than Red Crossbills (pers. obs.). The

only evidence of breeding consisted of singing males (JJ).

Common Redpoll (*Carduelis flammea*). Fairly common probable breeder at Alsek River. Several flocks of 5-10 recorded flying over deciduous shrubland at Dry Bay, Alsek River (JJ). Several males in courtship flights and pairs observed in montane alder thickets on a slope above Alsek Lake (JJ).

Pine Siskin (*Carduelis pinus*). Common resident and probable breeder. Coniferous, deciduous, and mixed forests, riparian alder thickets, and willow/herb glacial outwashes. Small flocks of 5-20 and large flocks of up to 100 frequently seen and heard at all rivers except for the Alsek River (HS, GM, MM, DG, JJ). Breeding confirmed in southeastern Alaska (Wik and Streveler 1968).

Appendix B-1. Common Name, Scientific Name, Primary Nesting Guild, and Migratory Guilds of 52 Species Recorded During 326 100 m Point Counts at Six Major Mainland Rivers.

Species	Scientific name	Species Code	Nesting Guild	Migratory Guild
Alder Flycatcher	Empidonax alnorum	ALFL	SHRUB	LONG-DISTANCE
American Redstart	Setophaga ruticilla	AMRE	SHRUB	LONG-DISTANCE
American Robin	Turdus migratorius	AMRO	TREE	LONG-DISTANCE
Black-capped Chickadee	Poecile atricapilla	BCCH	CAVITY	RESIDENT
Brown Creeper	Certhia americana	BRCR	TREE	RESIDENT
Black-and-White Warbler	Mniotilta varia	BWWA	GROUND	LONG-DISTANCE
Bohemian Waxwing	Bombycilla garrulus	BOWA	TREE	SHORT-DISTANCE
Cassin's Vireo	Vireo cassinii	CAVI	TREE	LONG-DISTANCE
Chestnut-backed Chickadee	Poecile rufescens	CBCH	CAVITY	RESIDENT
Chipping Sparrow	Spizella passerina	CHSP	SHRUB	LONG-DISTANCE
Common Yellowthroat	Geothlypis trichas	COYE	SHRUB	LONG-DISTANCE
Dark-eyed Junco	Junco hyemalis	DEJU	GROUND	SHORT-DISTANCE
Downy Woodpecker	Picoides pubescens	DOWO	CAVITY	RESIDENT
Fox Sparrow	Passerella iliaca	FOSP	GROUND	RESIDENT
Golden-crowned Kinglet	Regulus satrapa	GCKI	TREE	RESIDENT
Gray-cheeked Thrush	Catharus minimus	GCTH	SHRUB	LONG-DISTANCE
Hammond's Flycatcher	Empidonax hammondii	HAFL	TREE	LONG-DISTANCE
Hairy Woodpecker	Picoides villosus	HAWO	CAVITY	RESIDENT
Hermit Thrush	Catharus guttatus	HETH	GROUND	LONG-DISTANCE
Least Flycatcher	Empidonax minimus	LEFL	TREE	LONG-DISTANCE
Lincoln's Sparrow	Melospiza lincolnii	LISP	GROUND	LONG-DISTANCE
MacGillivray's Warbler	Oporonis tolmiei	MACW	SHRUB	LONG-DISTANCE
Magnolia Warbler	Dendroica magnolia	MAGW	TREE	LONG-DISTANCE
Northern Flicker	Colaptes auratus	NOFL	CAVITY	SHORT-DISTANCE

Species	Scientific name	Species Code	Nesting Guild	Migratory Guild
Northern Waterthrush	Seiurus noveboracensis	NWTH	GROUND	LONG-DISTANCE
Orange-crowned Warbler	Vermivora celata	OCWA	GROUND	LONG-DISTANCE
Olive-sided Flycatcher	Contopus cooperi	OSFL	TREE	LONG-DISTANCE
Pine Siskin	Carduelis pinus	PISI	TREE	RESIDENT
Pacific-slope Flycatcher	Empidonax difficilis	PSFL	TREE	LONG-DISTANCE
Red-breasted Nuthatch	Sitta Canadensis	RBNU	CAVITY	RESIDENT
Red-breasted Sapsucker	Sphyrapicus rubber	RBSS	CAVITY	SHORT-DISTANCE
Ruby-crowned Kinglet	Regulus calendula	RCKI	TREE	LONG-DISTANCE
Red Crossbill	Loxia curvirostra	RECR	TREE	RESIDENT
Red-eyed Vireo	Vireo olivaceus	REVI	SHRUB	LONG-DISTANCE
Red-winged Blackbird	Agelaius phoeniceus	RWBL	GROUND	LONG-DISTANCE
Rusty Blackbird	Euphagus carolinus	RUBL	SHRUB	SHORT-DISTANCE
Rufous Hummingbird	Selasphorus rufus	RUHU	TREE	LONG-DISTANCE
Savannah Sparrow	Passerculus sandwichensis	SAVS	GROUND	LONG-DISTANCE
Song Sparrow	Melospiza melodia	SOSP	GROUND	RESIDENT
Steller's Jay	Cyanocitta stelleri	STJA	TREE	RESIDENT
Swainson's Thrush	Catharus ustulatus	SWTH	SHRUB	SHORT-DISTANCE
Tennessee Warbler	Vermivora peregrina	TEWA	GROUND	LONG-DISTANCE
Townsend's Warbler	Dendroica townsendi	TOWA	TREE	LONG-DISTANCE
Varied Thrush	Ixoreus naevius	VATH	TREE	SHORT-DISTANCE
Warbling Vireo	Vireo gilvus	WAVI	TREE	LONG-DISTANCE
Western Tanager	Piranga ludoviciana	WETA	TREE	LONG-DISTANCE
Wilson's Warbler	Wilsonia pusilla	WIWA	GROUND	LONG-DISTANCE
Winter Wren	Troglodytes troglodytes	WIWR	GROUND	SHORT-DISTANCE
Western Wood-Pewee	Contopus sordidulus	WWPE	TREE	LONG-DISTANCE
Yellow-rumped Warbler	Dendroica coronata	YRWA	TREE	LONG-DISTANCE
Yellow Warbler	Dendroica petechia	YWAR	SHRUB	LONG-DISTANCE

Appendix B-2. Relative Frequency (Relative Abundance) of Bird Species Recorded in 326 100 m Radius Point Counts among Six Major Mainland Rivers of Southeastern Alaska. Species That Are Significantly Different among Rivers Are Shown in Bold.

Species	No. of rivers recorded	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin	Indicator Value[a]	P^b
ALFL	4	0.00 (0)	0.13 (7)	0.00 (0)	0.06 (3)	0.02 (1)	0.03 (2)	3.1	0.13
AMRE	**5**	**0.00 (0)**	**0.75 (40)**	**0.19 (12)**	**0.78 (42)**	**0.12 (6)**	**0.84 (53)**	**17.9**	**0.0002**
AMRO	**6**	**0.18 (8)**	**0.81 (43)**	**0.73 (45)**	**0.41 (22)**	**1.18 (59)**	**0.59 (37)**	**20.6**	**0.0002**
BCCH	3	0.02 (1)	0.04 (2)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	1.1	0.69
BOWA	1	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.00 (0)	0.00 (0)	1.6	0.8
BRCR	4	0.00 (0)	0.02 (1)	0.03 (2)	0.00 (0)	0.04 (2)	0.02 (1)	1.5	0.54
BWWA	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
CAVI	1	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.00 (0)	0.00 (0)	1.6	0.8
CBCH	**4**	**0.00 (0)**	**0.11 (6)**	**0.03 (2)**	**0.07 (4)**	**0.70 (35)**	**0.00 (0)**	**30.5**	**0.0002**
CHSP	3	0.00 (0)	0.02 (1)	0.05 (3)	0.02 (1)	0.00 (0)	0.00 (0)	2.7	0.14
COYE	**4**	**0.00 (0)**	**0.45 (24)**	**0.03 (2)**	**0.11 (6)**	**0.00 (0)**	**0.08 (5)**	**12.6**	**0.0002**
DEJU	**5**	**0.00 (0)**	**0.13 (7)**	**0.02 (1)**	**0.31 (17)**	**0.38 (19)**	**0.10 (6)**	**10.5**	**0.002**
DOWO	2	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	0.02 (1)	1.1	0.46
FOSP	**6**	**1.48 (65)**	**0.96 (51)**	**0.55 (34)**	**0.41 (22)**	**0.26 (13)**	**0.25 (16)**	**29.2**	**0.0002**
GCKI	**4**	**0.00 (0)**	**0.02 (1)**	**0.02 (1)**	**0.00 (0)**	**0.20 (10)**	**0.16 (10)**	**10.2**	**0.0004**
GCTH	**6**	**0.95 (42)**	**0.17 (9)**	**0.08 (5)**	**0.04 (2)**	**0.04 (2)**	**0.17 (11)**	**44.7**	**0.0002**
HAWO	**5**	**0.14 (6)**	**0.02 (1)**	**0.00 (0)**	**0.04 (2)**	**0.14 (7)**	**0.03 (2)**	**5.4**	**0.04**
HAFL	**5**	**0.00 (0)**	**1.0 (53)**	**0.24 (15)**	**0.31 (17)**	**0.42 (21)**	**0.32 (20)**	**32.1**	**0.0002**
HETH	**6**	**1.14 (50**	**0.55 (29)**	**0.63 (39)**	**0.43 (23)**	**0.06 (3)**	**0.08 (5)**	**29.6**	**0.0002**

Species	No. of rivers recorded	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin	Indicator Value[a]	P^b
LEFL	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
LISP	**5**	**0.05 (2)**	**0.36 (19)**	**0.10 (6)**	**0.19 (10)**	**0.00 (0)**	**0.05 (3)**	**8.3**	**0.005**
MACW	**5**	**0.00 (0)**	**0.06 (3)**	**0.05 (3)**	**0.13 (7)**	**0.10 (5)**	**0.25 (16)**	**9.6**	**0.002**
MAGW	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
NOFL	1	0.00 (0)	0.02 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	1.9	0.44
NWTH	**5**	**0.00 (0)**	**0.30 (16)**	**0.05 (3)**	**0.11 (6)**	**0.08 (4)**	**0.14 (9)**	**11.7**	**0.001**
OCWA	**6**	**1.36 (60)**	**1.21 (64)**	**0.98 (61)**	**0.83 (45)**	**0.04 (2)**	**0.38 (24)**	**21.9**	**0.0002**
OSFL	2	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.02 (1)	1.0	0.8
PISI	**4**	**0.00 (0)**	**0.09 (5)**	**0.00 (0)**	**0.02 (1)**	**0.30 (15)**	**0.16 (10)**	**7.3**	**0.008**
PSFL	**4**	**0.00 (0)**	**0.00 (0)**	**0.11 (7)**	**0.63 (34)**	**0.86 (43)**	**0.59 (37)**	**24.3**	**0.0002**
RBNU	**3**	**0.00 (0)**	**0.00 (0)**	**0.18 (11)**	**0.06 (3)**	**0.02 (1)**	**0.00 (0)**	**11.3**	**0.0002**
RBSS	**5**	**0.00 (0)**	**0.32 (17)**	**0.06 (4)**	**0.09 (5)**	**0.12 (6)**	**0.14 (9)**	**11.4**	**0.001**
RCKI	**6**	**0.32 (14)**	**0.42 (22)**	**0.79 (49)**	**0.39 (21)**	**1.34 (67)**	**1.16 (73)**	**22.5**	**0.0002**
RECR	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (3)	3.2	0.16
REVI	2	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (4)	0.00 (0)	0.05 (3)	3.4	0.09
RUBL	1	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	3.8	0.07
RUGR	2	0.00 (0)	0.00 (0)	0.05 (3)	0.02 (1)	0.00 (0)	0.00 (0)	3.5	0.06
RUHU	**5**	**0.00 (0)**	**0.02 (1)**	**0.34 (21)**	**0.24 (13)**	**0.20 (10)**	**0.02 (1)**	**11.4**	**0.001**
RWBL	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
SAVS	**1**	**0.16 (7)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**0.00 (0)**	**11.4**	**0.0002**
SOSP	**5**	**0.00 (0)**	**0.26 (14)**	**0.10 (6)**	**0.13 (7)**	**0.48 (24)**	**0.27 (17)**	**14.7**	**0.0004**
STJA	3	0.00 (0)	0.00 (0)	0.00 (0)	0.11 (6)	0.02 (1)	0.10 (6)	4.0	0.09
SWTH	**5**	**0.00 (0)**	**0.64 (34)**	**0.03 (2)**	**0.74 (40)**	**0.88 (44)**	**1.14 (72)**	**26.4**	**0.0002**

Species	No. of rivers recorded	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin	Indicator Value[a]	P^b
TEWA	2	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.02 (1)	1.0	0.81
TOWA	**5**	**0.00 (0)**	**0.04 (2)**	**0.05 (3)**	**0.07 (4)**	**0.48 (24)**	**0.76 (48)**	**25.9**	**0.0002**
VATH	**6**	**0.30 (13)**	**0.09 (5)**	**0.11 (7)**	**0.22 (12)**	**0.78 (39)**	**0.35 (22)**	**19.4**	**0.0002**
WAVI	**5**	**0.00 (0)**	**1.17 (62)**	**0.92 (57)**	**1.37 (74)**	**1.56 (78)**	**1.17 (74)**	**23.2**	**0.0002**
WETA	**5**	**0.00 (0)**	**0.02 (1)**	**0.03 (2)**	**0.11 (6)**	**0.22 (11)**	**0.13 (8)**	**6.9**	**0.02**
WIWA	**6**	**1.80 (79)**	**1.68 (89)**	**1.29 (80)**	**0.69 (37)**	**0.54 (27)**	**0.03 (2)**	**23.7**	**0.0002**
WIWR	**5**	**0.00 (0)**	**0.06 (3)**	**0.05 (3)**	**0.15 (8)**	**0.54 (27)**	**0.59 (37)**	**20.9**	**0.0002**
WWPE	3	0.00 (0)	0.04 (2)	0.00 (0)	0.06 (3)	0.02 (1)	0.00 (0)	1.8	0.43
YRWA	6	0.84 (37)	1.09 (58)	1.18 (73)	1.00 (54)	0.88 (44)	0.59 (37)	14.0	0.27
YWAR	**6**	**0.80 (35)**	**1.15 (61)**	**2.00 (124)**	**1.57 (85)**	**2.12 (106)**	**1.95 (123)**	**19.4**	**0.007**

[a]Indicator value was calculated from indicator species analysis (McCune and Mefford 1999). Species with greater abundance and occurrence in a group are given higher indicator values. [b]Alpha value is based on a Monte Carlo permutation procedure that tests whether a random assignment of group memberships produced a higher indicator value for each species (Dufrene and Legendre 1997).

Appendix B-3. Relative Frequency (Relative Abundance) of Bird Species Recorded in 326 100 m Radius Point Counts at Three Trans-Mountain and Three Coastal Rivers of Southeastern Alaska.

Species	Trans-mountain rivers incuding Alsek	Trans-mountain rivers excluding Alsek	Coastal rivers	Indicator Value including Alsek[a]	*P* including Alsek[b]	Indicator Value excluding Alsek	*P* excluding Alsek
ALFL	0.02 (3)	0.02 (3)	0.06 (10)	2.3	0.26	2.1	0.53
AMRE	0.34 (54)	0.46 (54)	0.6 (99)	25.8	0.0008	22.7	0.13
AMRO	0.47 (75)	0.58 (67)	0.84 (139)	35.1	0.0002	32.4	0.03
BCCH	0.02 (3)	0.02 (2)	0.01 (2)	1.1	0.55	1.0	0.57
BOWA	0.006 (1)	0.01 (1)	0	0.6	0.5	0.9	0.41
BRCR	0.01 (2)	0.02 (2)	0.02 (4)	1.6	0.37	1.4	0.65
BWWA	0	0	0.006 (1)	0.6	1.0	0.6	1.0
CAVI	0.006 (1)	0.01 (1)	0	0.6	.5	0.9	0.41
CBCH	0.04 (6)	0.05 (6)	0.25 (41)	12.0	0.0002	11.5	0.007
CHSP	0.02 (4)	0.03 (4)	0.006 (1)	2.0	0.20	2.9	0.16
COYE	0.05 (8)	0.07 (8)	0.17 (29)	7.0	0.02	6.5	0.13
DEJU	0.11 (18)	0.15 (18)	0.19 (32)	8.4	0.15	7.3	0.67
DOWO	0	0	0.01 (2)	1.2	0.5	1.2	0.53
FOSP	0.76 (121)	0.48 (56)	0.48 (80)	27.9	0.006	16.8	0.85
GCKI	0.006 (1)	0.01 (1)	0.13 (21)	12.1	0.0002	11.8	0.0008
GCTH	0.31 (49)	0.06 (7)	0.13 (22)	14.8	0.003	7.5	0.08
HAFL	0.2 (32)	0.27 (32)	0.57 (94)	32.1	0.0002	29.2	0.0006
HAWO	0.05 (8)	0.02 (2)	0.06 (10)	3.3	0.62	4.7	0.13

Species	Trans-mountain rivers incuding Alsek	Trans-mountain rivers excluding Alsek	Coastal rivers	Indicator Value including Alsek[a]	*P* including Alsek[b]	Indicator Value excluding Alsek	*P* excluding Alsek
HETH	0.7 (112)	0.53 (62)	0.22 (37)	37.0	0.0002	27.4	0.0002
LEFL	0	0	0.006 (1)	0.6	1.0	0.6	1.0
LISP	0.11 (18)	0.14 (16)	0.13 (22)	3.4	0.95	4.4	0.6
MACW	0.06 (10)	0.09 (10)	0.14 (24)	9.3	0.02	8.3	0.2
MAGW	0	0	0.006 (1)	0.6	1.0	0.6	1.0
NOFL	0	0	0.006 (1)	0.6	1.0	0.6	1.0
NWTH	0.06 (9)	0.08 (9)	0.17 (29)	11.8	0.001	10.8	0.05
OCWA	1.04 (166)	0.91 (106)	0.54 (90)	39.8	0.0002	34.1	0.0006
OSFL	0.006 (1)	0.01 (1)	0.006 (1)	0.3	1.0	0.5	1.0
PISI	0.006 (1)	0.01 (1)	0.18 (30)	5.8	0.006	5.7	0.02
PSFL	0.26 (41)	0.35 (41)	0.48 (80)	24.4	0.0002	21.5	0.1
RBNU	0.09 (14)	0.12 (14)	0.006 (1)	7.6	0.002	10.7	0.0002
RBSS	0.06 (9)	0.08 (9)	0.19 (32)	11.7	0.003	10.7	0.04
RCKI	0.52 (84)	0.6 (70)	0.97 (162)	35.6	0.0004	33.9	0.01
RECR	0	0	0.02 (3)	1.2	0.5	1.2	0.51
REVI	0.02 (4)	0.03 (4)	0.02 (3)	1.1	0.83	1.7	0.56
RUBL	0	0	0.02 (3)	1.2	0.5	1.2	0.5
RUGR	0.02 (4)	0.03 (4)	0	2.5	0.05	3.4	0.02
RUHU	0.21 (34)	0.29 (34)	0.07 (12)	13.5	0.002	20.1	0.0002
RWBL	0	0	0.006 (1)	0.6	1.0	0.6	1.0
SAVS	0.04 (7)	0	0	3.1	0.03	0	0

Species	Trans-mountain rivers incuding Alsek	Trans-mountain rivers excluding Alsek	Coastal rivers	Indicator Value including Alsek[a]	*P* including Alsek[b]	Indicator Value excluding Alsek	*P* excluding Alsek
SOSP	0.08 (13)	0.11 (13)	0.33 (55)	21.3	0.0002	19.8	0.001
STJA	0.04 (6)	0.05 (6)	0.04 (7)	2.2	0.59	1.9	1.0
SWTH	0.26 (42)	0.36 (42)	0.90 (150)	45.7	0.0002	42.1	0.0002
TEWA	0.006 (1)	0.01 (1)	0.006 (1)	0.3	1.0	0.5	1.0
TOWA	0.04 (7)	0.06 (7)	0.44 (74)	25.8	0.0002	24.9	0.0002
VATH	0.2 (32)	0.16 (19)	0.4 (66)	16.8	0.013	17.9	0.007
WAVI	0.82 (131)	1.12 (131)	1.3 (214)	47.9	0.0002	41.7	0.18
WETA	0.05 (8)	0.07 (8)	0.12 (20)	6.8	0.07	6.1	0.28
WIWA	1.22 (196)	1.01 (117)	0.7 (118)	41.9	0.0002	35.9	0.002
WIWR	0.07 (11)	0.09 (11)	0.4 (67)	29.9	0.0002	28.3	0.0002
WWPE	0.02 (3)	0.26 (3)	0.02 (3)	0.9	1.0	1.0	1.0
YRWA	1.02 (164)	1.09 (127)	0.84 (139)	35.1	0.08	37.1	0.03
YWAR	1.5 (244)	1.8 (209)	1.75 (290)	43.1	0.13	41.6	0.73

[a]Indicator value was calculated from indicator species analysis (McCune and Mefford 1999). Species with greater abundance and occurrence in a group are given higher indicator values. [b]Alpha value is based on a Monte Carlo permutation procedure that tests whether a random assignment of group memberships produced a higher indicator value for each species (Dufrene and Legendre 1997).

Appendix C-1. Common Name, Scientific Name, Species Code, Nesting Guild, and Migratory Guild for 47 Species Recorded at 326 50 m Point Counts Conducted at Six Major Mainland Rivers of Southeastern Alaska.

Species	Scientific name	Species Code	Nesting Guild	Migratory Guild
Alder Flycatcher	*Empidonax alnorum*	ALFL	SHRUB	LONG-DISTANCE
American Redstart	*Setophaga ruticilla*	AMRE	SHRUB	LONG-DISTANCE
American Robin	*Turdus migratorius*	AMRO	TREE	LONG-DISTANCE
Black-capped Chickadee	*Poecile atricapilla*	BCCH	CAVITY	RESIDENT
Brown Creeper	*Certhia americana*	BRCR	TREE	RESIDENT
Black-and-White Warbler	*Mniotilta varia*	BWWA	GROUND	LONG-DISTANCE
Chestnut-backed Chickadee	*Poecile rufescens*	CBCH	CAVITY	RESIDENT
Chipping Sparrow	*Spizella passerine*	CHSP	SHRUB	LONG-DISTANCE
Common Yellowthroat	*Geothlypis trichas*	COYE	SHRUB	LONG-DISTANCE
Dark-eyed Junco	*Junco hyemalis*	DEJU	GROUND	SHORT-DISTANCE
Downy Woodpecker	*Picoides pubescens*	DOWO	CAVITY	RESIDENT
Fox Sparrow	*Passerella iliaca*	FOSP	GROUND	RESIDENT
Golden-crowned Kinglet	*Regulus satrapa*	GCKI	TREE	RESIDENT
Gray-cheeked Thrush	*Catharus minimus*	GCTH	SHRUB	LONG-DISTANCE
Hammond's Flycatcher	*Empidonax hammondii*	HAFL	TREE	LONG-DISTANCE
Hairy Woodpecker	*Picoides villosus*	HAWO	CAVITY	RESIDENT
Hermit Thrush	*Catharus guttatus*	HETH	GROUND	LONG-DISTANCE
Lincoln's Sparrow	*Melospiza lincolnii*	LISP	GROUND	LONG-DISTANCE
MacGillivray's Warbler	*Oporonis tolmiei*	MACW	SHRUB	LONG-DISTANCE
Magnolia Warbler	*Dendroica magnolia*	MAWA	TREE	LONG-DISTANCE
Northern Flicker	*Colaptes auratus*	NOFL	CAVITY	SHORT-DISTANCE
Northern Waterthrush	*Seiurus noveboracensis*	NWTH	GROUND	LONG-DISTANCE
Orange-crowned Warbler	*Vermivora celata*	OCWA	GROUND	LONG-DISTANCE
Olive-sided Flycatcher	*Contopus cooperi*	OSFL	TREE	LONG-DISTANCE

Species	Scientific name	Species Code	Nesting Guild	Migratory Guild
Pine Siskin	*Carduelis pinus*	PISI	TREE	RESIDENT
Pacific-slope Flycatcher	*Empidonax difficilis*	PSFL	TREE	LONG-DISTANCE
Red-breasted Nuthatch	*Sitta canadensis*	RBNU	CAVITY	RESIDENT
Red-breasted Sapsucker	*Sphyrapicus ruber*	RBSS	CAVITY	SHORT-DISTANCE
Ruby-crowned Kinglet	*Regulus calendula*	RCKI	TREE	LONG-DISTANCE
Red Crossbill	*Loxia curvirostra*	RECR	TREE	RESIDENT
Red-eyed Vireo	*Vireo olivaceus*	REVI	SHRUB	LONG-DISTANCE
Rusty Blackbird	*Euphagus carolinus*	RUBL	SHRUB	SHORT-DISTANCE
Rufous Hummingbird	*Selasphorus rufus*	RUHU	TREE	LONG-DISTANCE
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	GROUND	LONG-DISTANCE
Song Sparrow	*Melospiza melodia*	SOSP	GROUND	RESIDENT
Steller's Jay	*Cyanocitta stelleri*	STJA	TREE	RESIDENT
Swainson's Thrush	*Catharus ustulatus*	SWTH	SHRUB	LONG-DISTANCE
Tennessee Warbler	*Vermivora peregrina*	TEWA	GROUND	LONG-DISTANCE
Townsend's Warbler	*Dendroica townsendi*	TOWA	TREE	LONG-DISTANCE
Varied Thrush	*Ixoreus naevius*	VATH	TREE	SHORT-DISTANCE
Warbling Vireo	*Vireo gilvus*	WAVI	TREE	LONG-DISTANCE
Western Tanager	*Piranga ludoviciana*	WETA	TREE	LONG-DISTANCE
Wilson's Warbler	*Wilsonia pusilla*	WIWA	GROUND	LONG-DISTANCE
Winter Wren	*Troglodytes troglodytes*	WIWR	GROUND	SHORT-DISTANCE
Western Wood-Pewee	*Contopus sordidulus*	WWPE	TREE	LONG-DISTANCE
Yellow-rumped Warbler	*Dendroica coronata*	YRWA	TREE	LONG-DISTANCE
Yellow Warbler	*Dendroica petechia*	YWAR	SHRUB	LONG-DISTANCE

Appendix C-2. Frequency of Individuals with Abundance in Parentheses from 326 50 m Radius Point Counts among Four Habitat Types. Species That Were Included in Statistical Analyses Are Listed in Boldface Type. Species That Are Significantly Different among Habitat Types Have P-Values Listed in Italics.

Species	Shrub	Young Forest	Mature Forest	Mixed Forest	Indicator Value[a]	P^b
Alder Flycatcher	**0.09 (5)**	**0**	**0**	**0**	**5.7**	***0.005***
American Redstart	**0.08 (4)**	**0.39 (35)**	**0.62 (57)**	**0.28 (25)**	**20.3**	***0.002***
American Robin	**0.4 (21)**	**0.39 (35)**	**0.4 (37)**	**0.47 (42)**	**9.4**	**0.89**
Black-capped Chickadee	0.04 (2)	0	0.01 (1)	0	1.5	0.31
Brown Creeper	**0**	**0**	**0**	**0.05 (5)**	**4.4**	***0.03***
Black-and-White Warbler	0.02 (1)	0	0	0	1.9	0.15
Chestnut-backed Chickadee	**0.02 (1)**	**0.004 (4)**	**0.1 (8)**	**0.39 (35)**	**15.2**	**0.001**
Chipping Sparrow	0.02 (1)	0.01 (1)	0.01 (1)	0	1.2	0.59
Common Yellowthroat	**0.2 (10)**	**0.02 (2)**	**0.07 (6)**	**0**	**6.4**	**0.009**
Dark-eyed Junco	**0.08 (4)**	**0.09 (8)**	**0.1 (9)**	**0.12 (11)**	**2.8**	**0.83**
Downy Woodpecker	0	0	0.01 (1)	0	1.1	0.71
Fox Sparrow	**0.8 (42)**	**0.43 (39)**	**0.24 (22)**	**0.16 (14)**	**25.8**	***0.001***
Golden-crowned Kinglet	**0**	**0**	**0.04 (4)**	**0.21 (19)**	**14.9**	***0.001***
Gray-cheeked Thrush	**0.3 (16)**	**0.12 (11)**	**0.05 (5)**	**0.01 (1)**	**15.1**	***0.001***
Hammond's Flycatcher	**0.04 (2)**	**0.23 (21)**	**0.62 (57)**	**0.17 (15)**	**26.8**	***0.001***
Hairy Woodpecker	**0**	**0.04 (4)**	**0**	**0.09 (8)**	**4.3**	***0.04***
Hermit Thrush	**0.5 (26)**	**0.28 (25)**	**0.16 (15)**	**0.14 (13)**	**16.3**	***0.001***
Lincoln's Sparrow	**0.41 (22)**	**0.1 (9)**	**0**	**0**	**15.2**	***0.001***
MacGillivray's Warbler	**0.07 (4)**	**0.03 (3)**	**0.1 (8)**	**0.06 (5)**	**3.0**	**0.62**
Magnolia Warbler	0	0	0	0.01 (1)	1.1	0.71
Northern Flicker	0.02 (1)	0	0	0	1.9	0.2
Northern Waterthrush	**0.04 (2)**	**0.08 (7)**	**0.1 (9)**	**0.03 (3)**	**3.9**	**0.26**
Orange-crowned Warbler	**1.02 (54)**	**0.48 (43)**	**0.31 (29)**	**0.19 (17)**	**34.6**	***0.001***

Species	Shrub	Young Forest	Mature Forest	Mixed Forest	Indicator Value[a]	P^b
Olive-sided Flycatcher	0.02 (1)	0	0	0	1.9	0.15
Pine Siskin	**0.06 (3)**	**0.01 (1)**	**0**	**0.13 (12)**	**3.7**	**0.08**
Pacific-slope Flycatcher	**0**	**0.03 (3)**	**0.29 (27)**	**0.69 (62)**	**36.2**	***0.001***
Red-breasted Nuthatch	**0**	**0**	**0.01 (1)**	**0.05 (5)**	**2.7**	**0.13**
Red-breasted Sapsucker	**0.06 (3)**	**0.07 (6)**	**0.13 (12)**	**0.1 (10)**	**3.5**	**0.56**
Ruby-crowned Kinglet	**0.17 (9)**	**0.18 (16)**	**0.14 (13)**	**0.93 (84)**	**44.5**	***0.001***
Red Crossbill	0	0	0	0.02 (2)	0.7	0.83
Red-eyed Vireo	**0**	**0.05 (5)**	**0**	**0**	**3.3**	***0.03***
Rusty Blackbird	0.01 (1)	0	0	0	1.1	0.71
Rufous Hummingbird	**0.06 (3)**	**0.14 (13)**	**0.13 (12)**	**0.2 (18)**	**7.1**	**0.13**
Savannah Sparrow	**0.09 (5)**	**0**	**0**	**0**	**5.7**	***0.007***
Song Sparrow	**0.2 (10)**	**0.08 (7)**	**0.1 (9)**	**0.07 (6)**	**7.4**	***0.03***
Steller's Jay	**0**	**0.01 (1)**	**0**	**0.05 (5)**	**2.2**	**0.24**
Swainson's Thrush	**0.15 (8)**	**0.2 (17)**	**0.42 (39)**	**0.52 (47)**	**17.6**	***0.005***
Tennessee Warbler	0	0.01 (1)	0	0	1.1	0.71
Townsend's Warbler	**0**	**0**	**0.03 (3)**	**0.43 (39)**	**26.9**	***0.001***
Varied Thrush	**0.08 (4)**	**0.07 (6)**	**0.09 (8)**	**0.28 (25)**	**13.4**	***0.002***
Warbling Vireo	**0.2 (10)**	**0.7 (63)**	**0.98 (90)**	**0.7 (64)**	**26.8**	***0.001***
Western Tanager	**0**	**0.02 (2)**	**0.02 (2)**	**0.12 (11)**	**7.4**	***0.01***
Wilson's Warbler	**1.06 (56)**	**0.73 (66)**	**0.42 (39)**	**0.32 (29)**	**24.4**	***0.001***
Winter Wren	**0.02 (1)**	**0.02 (2)**	**0.08 (7)**	**0.4 (37)**	**28.5**	***0.001***
Western Wood-Pewee	0	0.01 (1)	0	0	1.1	0.71
Yellow-rumped Warbler	**0.57 (30)**	**0.58 (52)**	**0.66 (61)**	**0.54 (49)**	**12.9**	**0.89**
Yellow Warbler	**1 (53)**	**0.9 (81)**	**1.1 (104)**	**0.9 (86)**	**20.3**	**0.24**

[a]Indicator value was calculated from indicator species analysis (McCune and Mefford 1999). Species with greater abundance and occurrence in a group are given higher indicator values. [b]Alpha value is based on a Monte Carlo permutation procedure that tests whether a random assignment of group memberships produced a higher indicator value for each species (Dufrene and Legendre 1997).

Appendix C-3. Relative Frequency (Relative Abundance) of Interior Associated Species, Species of Management Concern, and Rare Species Recorded at Major Mainland Rivers of Southeastern Alaska, 2000-2001. Species That Are Significantly Different among Rivers Are Shown in Bold.

Species	No. of rivers recorded	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin	Indicator Value	*P*
AMRE[1]	**5**	**0.00 (0)**	**0.75 (40)**	**0.19 (12)**	**0.78 (42)**	**0.12 (6)**	**0.84 (53)**	**17.9**	**0.0002**
BCCH[1]	3	0.02 (1)	0.04 (2)	0.03 (2)	0.00 (0)	0.00 (0)	0.00 (0)	1.1	0.69
BOWA[3]	1	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.00 (0)	0.00 (0)	1.6	0.8
BRCR[2]	4	0.00 (0)	0.02 (1)	0.03 (2)	0.00 (0)	0.04 (2)	0.02 (1)	1.5	0.54
BWWA[3]	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
CAVI[3]	1	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.00 (0)	0.00 (0)	1.6	0.8
CHSP[1,3]	3	0.00 (0)	0.02 (1)	0.05 (3)	0.02 (1)	0.00 (0)	0.00 (0)	2.7	0.14
COYE[1]	**4**	**0.00 (0)**	**0.45 (24)**	**0.03 (2)**	**0.11 (6)**	**0.00 (0)**	**0.08 (5)**	**12.6**	**0.0002**
HAFL[1]	**5**	**0.00 (0)**	**1.00 (53)**	**0.24 (15)**	**0.31(17)**	**0.42 (21)**	**0.32 (20)**	**32.1**	**0.0002**
HAWO[2]	**5**	**0.14 (6)**	**0.02 (1)**	**0.00 (0)**	**0.04 (2)**	**0.14 (7)**	**0.03 (2)**	**5.4**	**0.04**
LEFL[1,3]	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
MACW[2]	**5**	**0.00 (0)**	**0.06 (3)**	**0.05 (3)**	**0.13 (7)**	**0.10 (5)**	**0.25 (16)**	**9.6**	**0.002**
MAGW[3]	1	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	1.6	0.9
OSFL[3]	2	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.02 (1)	1.0	0.8
RBNU[2]	**3**	**0.00 (0)**	**0.00 (0)**	**0.18 (11)**	**0.06 (3)**	**0.02 (1)**	**0.00 (0)**	**11.3**	**0.0002**
RBSS[2]	**5**	**0.00 (0)**	**0.32 (17)**	**0.06 (4)**	**0.09 (5)**	**0.12 (6)**	**0.14 (9)**	**11.4**	**0.001**
REVI[1,3]	2	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (4)	0.00 (0)	0.05 (3)	3.4	0.09
RUBL[3]	1	0.00 (0)	0.06 (3)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	3.8	0.07

Species	No. of rivers recorded	Alsek	Chilkat	Taku	Stikine	Unuk	Chickamin	Indicator Value	*P*
RUGR[1,3]	2	0.00 (0)	0.00 (0)	0.05 (3)	0.02 (1)	0.00 (0)	0.00 (0)	3.5	0.06
TEWA[3]	2	0.00 (0)	0.00 (0)	0.00 (0)	0.02 (1)	0.00 (0)	0.02 (1)	1	0.81
WAVI[1]	**5**	**0.00 (0)**	**1.17 (62)**	**0.92 (57)**	**1.37 (74)**	**1.56 (78)**	**1.17 (74)**	**23.2**	**0.0002**
WETA[1]	**5**	**0.00 (0)**	**0.02 (1)**	**0.03 (2)**	**0.11 (6)**	**0.22 (11)**	**0.13 (8)**	**6.9**	**0.02**
WWPE[2]	3	0.00 (0)	0.04 (2)	0.00 (0)	0.06 (3)	0.02 (1)	0.00 (0)	1.8	0.43

[1] Interior associated species. [2] Species of management concern (BPIF 1999). [3] Rare and transient species (Armstrong 1995).

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