

## ECOLOGICAL DISTRIBUTION OF BIRDS IN THE NAPASKIAK AREA OF THE KUSKOKWIM RIVER DELTA, ALASKA

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Few critical studies of the distribution of birds in Alaska have been made which are directed toward the accumulation of data on the effects of biotic and physical factors in controlling species occurrence. In this region, as in others at northern latitudes, the number of vegetational formations of a rank sufficient to influence the distribution of birds is relatively limited. Superimposed on this is a climate that is rigorous in many aspects. In such a region, it seems likely that field studies will be helpful in ascertaining the relative significance of biotic and physical factors in limiting abundance and providing barriers to distribution of birds.

Recent studies of avian distribution have revealed the importance of some aspects of the biotic environment. Pitelka (1941) emphasized the importance of biotic interrelations, especially responses to the physiognomy of vegetation, as controlling factors in the distribution of birds. Miller (1951) has demonstrated, in California, that climatic extremes usually do not affect the distributional pattern of a species when a suitable plant formation is present; the effects of climate are reflected, in an indirect way, by the ability of the plants to withstand the extremes. Local studies of bird distribution provide basic data from which an understanding of the relative role of biotic and climatic factors may be developed, and it is toward this end that this paper on the avifauna of a poorly known sector of southwestern Alaska has been prepared. Sufficient data have not yet been gathered to ascertain the importance of climate on the distribution of birds in the area under consideration, along the Kuskokwim River, but it is suspected that the direct action of climatic or other physical factors may be significant in a few instances.

The Napaskiak area, approximately 40 square miles in extent, is situated in the upper portion of the Kuskokwim River delta and includes the land adjacent to the south shore of the river as well as islands in the river itself. Its center is in the Eskimo village of Napaskiak about eight miles southwest of Bethel (fig. 1). The area is of particular biological interest because it lies along the western terminus of the vast, interior spruce forest where this plant community interdigitates with the broad, flat, coastal plain or tundra of the Yukon-Kuskokwim delta (fig. 2). Characterizing this overlap of markedly different vegetation types is an avifauna consisting of elements derived from each major community, along with those species common to both.

The Napaskiak area was visited by Robert Rausch and the writer during late May and early June of 1955. Return trips were made by the writer in August of the same year and again in May and June of 1956. The writer spent a total of 37 days in the area. The primary purpose of this work was the investigation of animal-borne diseases, an activity affording ample opportunity to obtain a fairly extensive and representative collection of birds. These specimens, in conjunction with field notes and photographs made in the area, constitute the basis for this report.

### ACKNOWLEDGMENTS

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Fig. 1. Outline map of the Napaskiak area showing the river, major sloughs, and lakes.

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#### PHYSICAL FEATURES AND CLIMATE

The Kuskokwim River delta consists almost entirely of a broad, flat plain underlain by unconsolidated gravels, sands, and silts of glacial, fluvial, lacustral, and marine origin (Smith and Maddren, 1915: plate 10). The soil is perpetually frozen except during the brief summer when a varying thickness of the upper stratum is ice-free. A few low hills mark the otherwise flat landscape. Bethel is 28 feet above sea level, and the altitude of the highest point in the Napaskiak area is only slightly higher. Numerous lakes and ponds dot the region, although these become more numerous to the south and west toward the coast of the Bering Sea. The Kuskokwim River is highly braided throughout the delta, and many sloughs border the main channel on either side. The tidal influence is marked, although its effects become less striking as the water level of the river subsides in late summer. In some years, including the two when the writer was present, the area is severely flooded following the spring breakup of ice. At such times the water rises well above the lower banks of the river and sloughs, depositing silt and debris in considerable quantity in the woodland. Parallel to the river, approximately 40 miles east and southeast, lie the conspicuous Kilbuck Mountains. This range is the westernmost extension of the Kuskokwim Mountains and separates the drainage of the Kuskokwim River from that of the Nushagak River. The general aspect of the area can be seen in figure 3.

The topographical features that affect the climate of the upper Kuskokwim River delta are the Bering Sea, 100 miles to the west and southwest, and the previously mentioned Kilbuck Mountains. The latter are oriented in a north-south direction with an average elevation of 4000 feet, and these, together with the Aleutian Range which runs southwest, provide a barrier to many of the storms originating in the Aleutian Islands

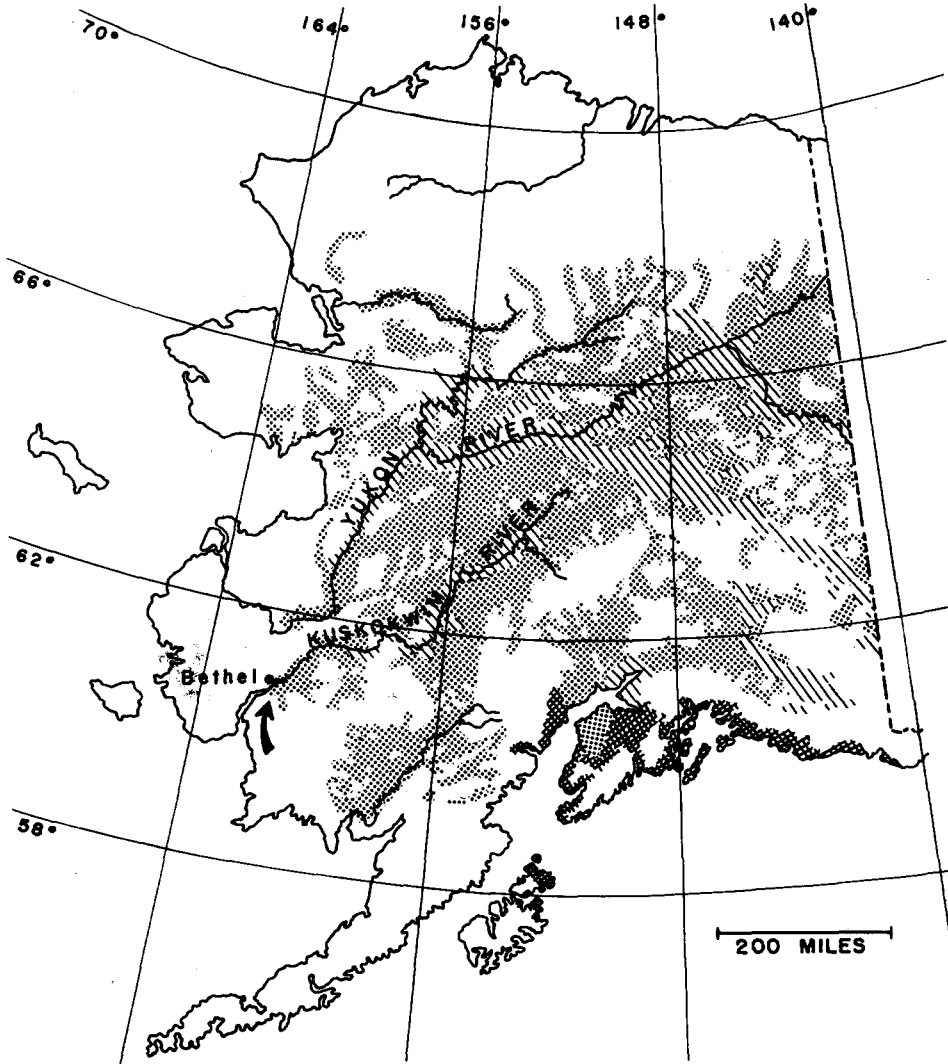


Fig. 2. Relationship of the Napaskiak area (at tip of arrow) to the forested regions of Alaska. The dots and diagonal lines indicate sparse spruce-birch interior forests, and normal spruce-birch interior forests, respectively; cross-hatching indicates hemlock-spruce coastal forests (after U. S. Dept. Agr., Forest Service, 1949, in Taylor and Little, 1950:30-31).

area. However, these mountains direct some storms into the delta region, and at such times the wind may reach or occasionally exceed 70 miles per hour. The prevailing winds, NE or NNE except during the early summer months when the origin is SE, have a mean annual velocity of 10.3 miles per hour.

The climate of the delta is more marine than continental and therefore somewhat cooler in summer and warmer in winter than interior Alaska. During December and early January the weather is dominated by clear, cold continental air. The same is true of June and July when mild temperatures and partly cloudy skies prevail. The rest of the

year is affected by marine air masses with the result that on the average 244 days of the year are cloudy, 66 partly cloudy, and only 55 clear. The average annual precipitation is 19 inches, with .01 inches or more falling on 154 days. The mean annual temperature is 30°F.; the monthly mean for July is 55°F. and for January, 6°F. There is an average growing season of 102 days (U. S. Weather Bureau, 1955).

#### GENERAL ECOLOGICAL CONSIDERATIONS

The previously mentioned overlap of spruce forest and tundra in the Napaskiak area represents but one small contact of these vegetation types in Alaska. According to Dice (1943:9) this area constitutes a portion of the broad transition between the Eskimoan biotic province, or northern treeless zone, and the Hudsonian biotic province, or spruce



Fig. 3. A view west over the Napaskiak area from near Bethel showing general nature of terrain. Photograph taken at the time of the spring flood of 1955 by Hermann N. Kurriger, Civil Aeronautics Administration.

zone, to the south. Miller (1951:531) pointed out the inadequacies of the biotic province system as a basis for grouping distributional information. This criticism is based on two points: no adequate definition of a biotic province has been offered, and the units in it are, in general, subjectively determined. Anyone familiar with the vegetation in Alaska is likely to agree with this interpretation. Further, Peters (1955:28) believes it unlikely that biotic provinces can be defined by percentage distinctiveness of a biota due to stepwise, or clinal, loss of taxa from the fauna.

Another general system is that offered by Pitelka (1941:114, 115), who regards the subarctic coniferous forest of interior Alaska as an ecotone between the tundra biome of the west and north of Alaska and the coniferous forest biome to the south in Canada and the United States. This system has been utilized for study of the distribution of birds, and it has been shown to express certain general truths. It should be mentioned, however, that in the interior of Alaska, primarily contiguous with the major watersheds,

are stands of dense white spruce, *Picea canadensis* (Stoekeler, 1949:1) that may represent intrusions, or "arms," of the coniferous forest biome. Separating these and the tundra biome is coniferous forest comprised in large part of extensive bogs supporting large stands of stunted black spruce (*Picea mariana*).

A check-list of birds made in the central Kuskokwim region 300 miles north and east of Bethel (Cady, Wallace, Hoare, and Webber, 1955:14-16), and observations reported by Dice (1920a) from the head of the north fork of the Kuskokwim to Bethel, aid in understanding the effect this ecotone has on the distribution of birds. These records, in conjunction with those from Napaskiak, show that many species characteristic of one or both of the coniferous forest communities become uncommon, or disappear from the fauna entirely, as the lowlands of the delta are approached.

Study at any locality throughout this vegetational and climatic gradient would reveal pertinent information relating to the distribution of birds, although the westernmost portion, where the spruce forest disappears completely, is perhaps the most significant in this regard.

#### ECOLOGIC FORMATIONS

Following the method of Dice (1920b) and Miller (1951), ecologic formations have been selected for purposes of analyzing the distribution of birds. In making these selections first consideration has been given the life-form of the vegetation. Consistent correlations between the presence of certain bird species and vegetation has been shown to relate to the life-form of the plants rather than to specific dominants or groups of dominants (Pitelka, 1941:131, 135). Of equal importance to a smaller group of species are certain conspicuous topographic features, and these are also emphasized. In the Napaskiak area the number of such ecologic units characterized by distinctive plant formations or topography is relatively small. Some of these are subdivisible, and all are not of equal rank, but as Miller (1951:540) has indicated, restriction of the total number is necessary to serve the general purpose and must not descend to the level of particular plant associations.

The number of species of birds to be found in each formation is indicated in the discussion of the units that follows; preference for one or more particular formations is shown in table 1. All the species collected or observed in the area are included, although some of these are not believed to be breeding birds. These latter species are listed as questionable summer residents in table 1. The formations selected here (fig. 4) are in part similar to those defined by Dice (1920b) and are as follows:

Lacustrine waters	Riparian woodland
Fluviatile waters	Spruce woodland
Fresh-water marsh	Dwarf birch-alder thickets
Wet tundra	<i>Equisetum-Carex</i> stream margin
Heath tundra	Cut-banks

*Lacustrine waters*.—Included here are all non-flowing waters of the area (fig. 7). These consist of tundra lakes of various sizes but do not include the small shallow ponds of the wet tundra or fresh-water marsh. Some of the sloughs might be included here, but even the smallest of these is under the influence of the tide and in most there is flow of water. A total of 14 species was recorded in this formation.

*Fluviatile waters*.—All flowing waters including the main river, sloughs, and small tundra streams are parts of this formation (fig. 6). Also grouped here are the mud flats and sand bars, devoid of vegetation, that are exposed along the river and sloughs at low tide. Twenty species were recorded in this formation.

*Fresh-water marsh*.—The marshes considered here are actually of two types: those

Table 1  
Occurrence of Birds in Ecologic Formations

	Ecologic Formations									
	Lacustrine Waters	Fluviatile Waters	Fresh-water Marsh	Wet Tundra	Heath Tundra	Riparian Woodland	Spruce Woodland	Dwarf Birch-Alder Thickets	<i>Equisetum-Carex</i> Stream Margin	Cut-banks
Red-throated Loon	X	o								
Arctic Loon	X	o								
Red-necked Grebe	X									
Horned Grebe*		X								
Whistling Swan				o	o					
Canada Goose*		o			X					
White-fronted Goose*									X	
Mallard	o	X							o	
Pintail	o	X				o			o	
Green-winged Teal		X				o	o	o		
Baldpate		X								
Greater Scaup Duck	X	o								
Lesser Scaup Duck*	?	?								
Buffle-head*		X								
Old-squaw*		X								
White-winged Scoter*	o	o								
Black Scoter	o	X								
Goshawk						X				
Rough-legged Hawk						X				?
Marsh Hawk			X			o				
Willow Ptarmigan					X		o			
Sandhill Crane				X	o				o	
Semipalmated Plover									X	
Golden Plover					X		o			
Surf-bird*									X	
Wilson Snipe			o			X			o	
Hudsonian Curlew					X					
Solitary Sandpiper			X							
Least Sandpiper*				X						
Western Sandpiper					X				o	
Northern Phalarope	o		o	X					o	
Parasitic Jaeger		o			X					
Long-tailed Jaeger	o	o			X					
Glaucous Gull	X	o	o							
Common Gull	X	o	o							
Bonaparte Gull	X	o					o			
Arctic Tern	X	o	o							
Horned Owl			o			X				
Short-eared Owl					X					
Traill Flycatcher						X				
Tree Swallow			o			X				
Bank Swallow		o								X
Barn Swallow*										
(recorded at village)										
Canada Jay						X				
Raven					o	X				
Black-capped Chickadee						X	o			
Robin						X	o	o		

X, primary preference; o, secondary preference; \* = not believed to breed in area; ? = doubtful record.

Table 1 (continued)

	Ecologic Formations									
	Lacustrine Waters	Fluviatile Waters	Fresh-water Marsh	Wet Tundra	Heath Tundra	Riparian Woodland	Spruce Woodland	Dwarf Birch-Alder Thickets	<i>Equisetum-Carex</i> Stream Margin	Cut-banks
Varied Thrush						X		o		
Gray-cheeked Thrush						X		o		
Orange-crowned Warbler						X				
Yellow Warbler						X				
Myrtle Warbler						X				
Black-poll'd Warbler						X				
Northern Water-thrush			o			X				
Pileolated Warbler						X				
Rusty Blackbird			o			X				
Redpoll						X				
Savannah Sparrow			X	o				o		
Tree Sparrow						X	o	o		
Golden-crowned Sparrow*						X				
Fox Sparrow						X				
Lapland Longspur					X			o		

within the riparian woodland that are shaded by trees and are usually old sloughs, and those in more open situations consisting of old sloughs, lakes or ponds (fig. 5). Open water is usually absent in this successional vegetation, although a floating mat of *Sphagnum*, *Equisetum*, *Carex*, and forbs may cover water that is several feet deep. These plants are intermixed with grasses, the latter attaining a considerable height and density in the open, tree-fringed marshes. Nine species were recorded in this formation.

*Wet tundra*.—Surrounding many of the tundra lakes is a limited expanse of low, flat tundra covered with *Sphagnum* and *Carex* (fig. 7). Frequently small ponds dot this formation, and the vegetation may form floating mats. It also occurs in a limited fashion

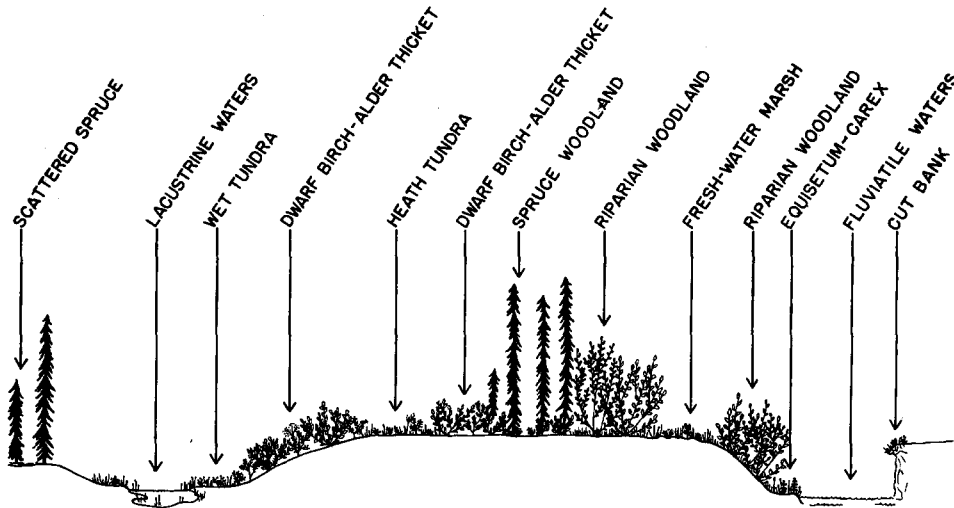


Fig. 4. Diagrammatic profile of the Napaskiak area showing topography and ecologic formations.

on the higher, heath tundra, usually in depressions with or without patches of open water. Eight species were recorded here.

*Heath tundra*.—The higher, better drained open areas all belong in this formation (fig. 7). The plant cover varies within certain limits in accordance with exposure, sub-

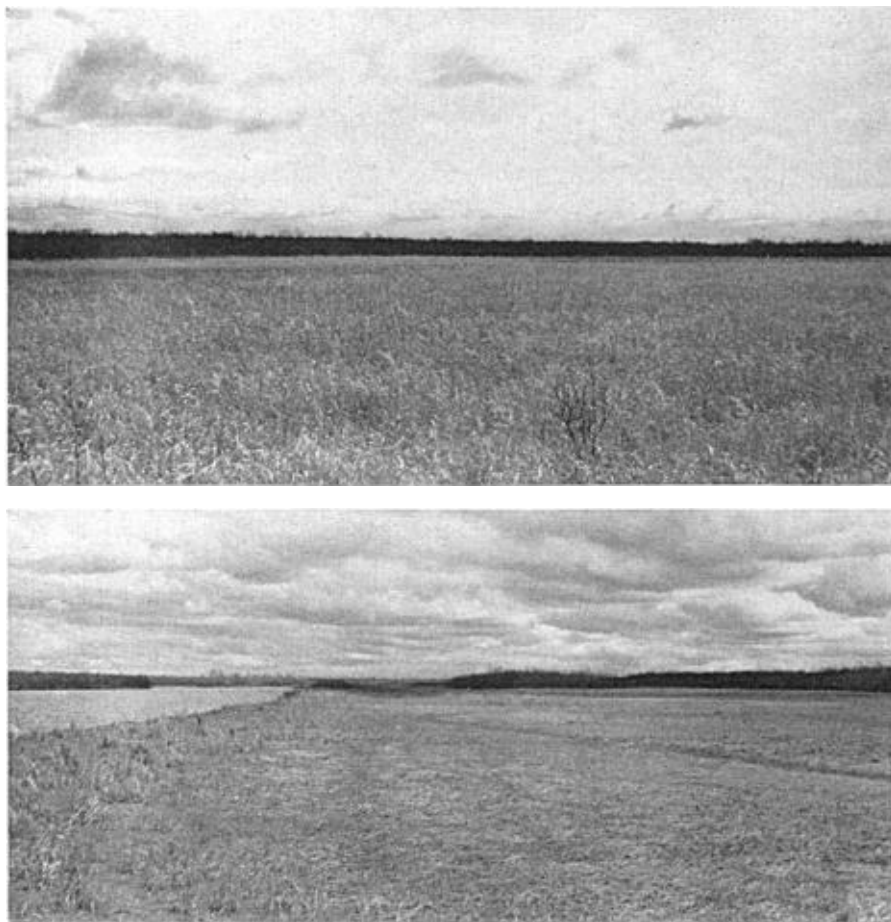


Fig. 5. Above: fresh-water marsh showing dense grass cover and bordering riparian woodland. Below: *Equisetum-Carex* formation bordering slough; this flat area, extending to the woodland, was completely inundated during periods of high tide; the taller trees on the horizon are poplars. Photographs taken in May, 1956, near Napaskiak.

strate, and drainage. In general the vegetation is low, ankle-high or less, and includes one or more species of *Cladonia*, *Cetraria*, *Sphagnum*, *Carex*, *Eriophorum*, *Ledum*, *Vaccinium*, *Empetrum*, and *Rubus*, and numerous grasses and forbs. In the lower areas the mosses and lichens are dominant, and on the higher ground surrounding some of the tundra lakes, woody plants, such as *Ledum* and *Vaccinium*, are dominant. Twelve species of birds were recorded in this formation.

*Riparian woodland*.—This formation, the most important in number of recorded bird species, is the characteristic border of nearly all the sloughs and the main river, and it completely covers the higher, more permanent islands. Abundant ground water and



sandy soils support this successional vegetation. Dominants include species of *Salix* and *Alnus* and, in some areas, scattered stands of poplars, *Populus tacamahaca*. Small willows, shrub-like in appearance and 10 to 15 feet high, are the most widespread and conspicuous features (fig. 6). The alders vary in abundance but are more prominent on the better drained sites away from the open water. The poplars are scattered in nearby pure stands, rarely larger than an acre or two, and reach heights of 40 to 50 feet. The willows, too, attain a size far greater than that indicated above. On higher ground, such as above cut-banks, many were found to be 3 to 5 inches in diameter and to reach a height of 20 to 25 feet. The understory of this formation is variable. Shrubby willows are underlain by dense grass (*Calamagrostis*), but the denser, more arborescent stands frequently are nearly bare beneath. On wetter ground a carpet of moss may occur.

Of interest is the fact that most of the birds of the riparian woodland have young, or incubated eggs, at the time the foliage is fully developed in early June. Twenty-six species of birds were recorded in this formation.

*Spruce woodland.*—The spruce woodland of the area is sparse, and no continuous closely-spaced stands were seen. The widely separated trees occur as a loose border of the riparian woodland, intermixed with such understory subdominants as *Alnus* and *Betula* (fig. 7). Occasional trees, or groups of trees, occur on the higher ground surrounding some of the tundra lakes, usually in close proximity to riparian woodland. A few may even occur in the latter formation. Spruce woodland apparently has little or no influence on the distribution of birds in the area. Four species were recorded here, and only one of these, the Bonaparte Gull, seemed to show any dependence on these trees.

*Dwarf birch-alder thickets.*—Bordering the riparian woodland at the edge of the tundra are thickets of intermixed *Betula* and *Alnus* (fig. 7). As mentioned above, these form an understory in the spruce, but in many places this vegetation extends out on to the heath tundra. It is also found on the higher ground adjacent to tundra lakes. In such places an understory of dense grass is often present. The shrubs are nearly uniformly 5 to 10 feet high and are densely spaced near the riparian woodland and scattered on the tundra. Nine species of birds were recorded in this formation.

*Cut-banks.*—These banks are produced by current action along some portions of the river and nearly all the sloughs. Some are penetrated with tangles of roots, and large blocks of substrate and vegetation fall into the channel at such points. Some are comprised of silt and sand with a minimum of roots. Only one species, *Riparia riparia*, was seen to utilize this formation, and its occurrence is dependent on banks of the second type.

*Equisetum-Carex stream margin.*—Scattered along the river and sloughs, frequently opposite cut-banks, are expanses of this formation (fig. 5). Dependent on abundant moisture, this vegetation appears to be rapidly invaded by willows as the bank is elevated above the influence of the tide. During the breeding season this formation is flooded at high tide, and the species utilizing it during wet periods are partly different from those utilizing it when it is dry. Ten species were listed in this formation.

#### ANNOTATED LIST OF SPECIES

A total of 62 species of birds was recorded from the Napaskiak area. Fifty-one of these species were believed to be nesting although evidence of breeding was not obtained for all. The eleven species of questionable status, as well as several others that the Eskimos claim to be summer residents, are included in the following list. Adequate data for abundance ratings are not available, but available field records permit the use of three categories, namely, abundant, common, and uncommon. Some clarification of this terminology will make it more meaningful both to the reader and to future, more de-

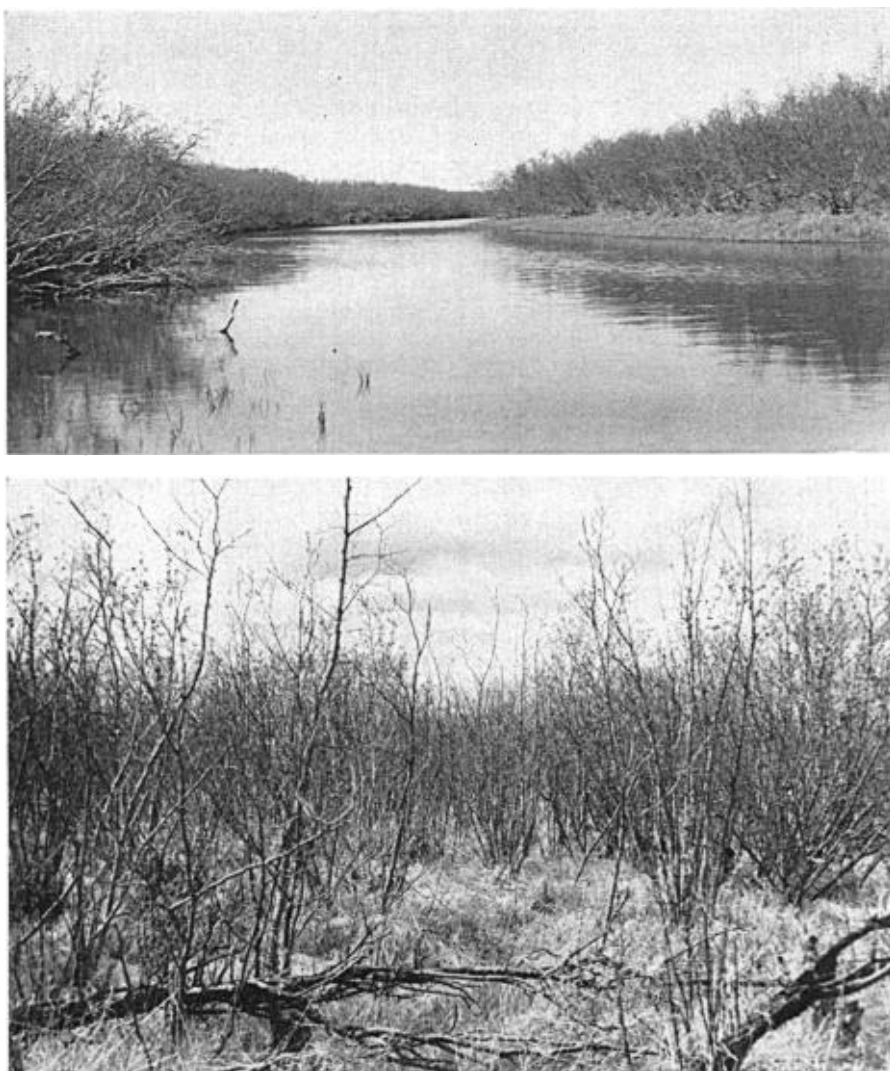


Fig. 6. Above: fluvial water of a slough showing bordering riparian woodland.  
Below: riparian woodland showing spacing of trees and the dense understory of grass.  
Photographs taken in May, 1956, near Napaskiak.

tailed investigations in the same area. The category "abundant" indicates that the species in question was repeatedly observed or heard in the inhabited formations, with indications that its available habitat was being nearly fully utilized. The term "common" denotes that the species was observed on all or nearly all the trips into the field, but that some apparently suitable habitat, or at least areas like the ones occupied, were vacant. "Uncommon" indicates that the species was seen on only a small number of trips and that large areas were evidently not being utilized. These terms were applied according to characteristic numbers and habitat requirements of individual species; for example, the Horned Owl was considered common although it was seen only on five occasions.



Fig. 7. Above: extensive open heath tundra on the left, wet tundra and lacustrine water on the right.

Below: spruce woodland and dwarf birch-alder thickets at the edge of the tundra; note spacing of conifers and the heath understory. Photographs taken in May, 1956, near Napaskiak.

*Gavia stellata*. Red-throated Loon. This species was uncommon and was observed infrequently along some of the sloughs and on the larger tundra lakes, where it presumably breeds. A female taken on June 2, 1955, had ova up to 7 mm. in diameter, no discernible collapsed follicles, and an enlarged oviduct; weight 1396 gm.

*Gavia arctica*. Arctic Loon. This species is believed to breed on the larger tundra lakes, where it was common in 1955. It proved to be a rare bird in 1956 and was seen only once, along a large slough. A male taken on June 15, 1955, weighed 1900 gm.

*Podiceps grisegena holböllii*. Red-necked Grebe. These grebes were moderately common on the tundra lakes, the only situation where they were seen. A male taken on May 28, 1955, weighed 1082 gm.

*Podiceps auritus cornutus*. Horned Grebe. On June 10, 1955, a male was collected on a small slough near the village; weight 442.5 gm. This is the only record of this species, and it is not believed to breed in the area.

*Olor columbianus*. Whistling Swan. This swan was common and was frequently seen flying over-

head or foraging on the ground on heath tundra. No specimens were obtained, but the Eskimos collected eggs from the tundra during the writer's stay in 1956.

*Branta canadensis*. Canada Goose. This species was observed over the river and the tundra several times. It appears to be uncommon, and no specimens were taken. Eskimos know this species well and brought in eggs from the tundra farther west. Breeding in the Napaskiak area is questionable.

*Anser albifrons*. White-fronted Goose. On June 4, 1955, a group of three was observed foraging in the *Equisetum-Carex* formation along the main river. Apparently these birds were migrants.

*Anas platyrhynchos*. Mallard. Common along the sloughs and on the tundra lakes. The birds foraged in the *Equisetum-Carex* formation at high tide and often loafed there at low water. A male taken on June 1, 1955, weighed 1117 gm.

*Anas acuta*. Pintail. Common throughout the region, foraging with Mallards along the slough margins and on the tundra lakes. A nest was found in dense grass of the riparian woodland near the village in May, 1955. A male was taken on May 28, 1955; testis 56 mm., weight 810.0 gm.

*Anas carolinensis*. Green-winged Teal. Probably the most common duck in the area; seen repeatedly on every trip. It was observed on the river and tundra lakes, and while foraging with the Mallards and Pintails in the *Equisetum-Carex* margin of the sloughs and river. Nests were found in the dry heath understorey of the dwarf birch-alder thickets and in the grassy riparian woodland. Specimens taken in 1955 included a female; June 1, incubating 10 eggs, weight 336.2 gm.; a male, June 2, testis 7 mm., weight 326.3 gm.

*Mareca americana*. Baldpate. Uncommon and seen only along some of the sloughs. Occasionally a pair was observed. A specimen of each sex was taken on June 15, 1955: male, weight 762.2 gm.; female, an egg in the oviduct, weight 776.2 gm.

*Spatula clypeata*. Shoveller. This duck was not recorded, but the Eskimos attest to its presence on the tundra lakes. It is not believed to breed in the area.

*Aythya marila*. Greater Scaup Duck. Abundant on the tundra lakes where it is believed to breed. It was also recorded along some of the sloughs and the main river. No specimens were obtained.

*Aythya affinis*. Lesser Scaup Duck. In a large group of Greater Scaup Ducks obtained by Eskimos was a female of this species. It was taken farther west on the tundra. No other records were obtained although it is possible this species was occasionally mistaken in the field for *A. marila*. Scaups examined at close range with binoculars and determined carefully were found to be *A. marila*, but some identifications at greater distances must necessarily be discounted.

*Bucephala albeola*. Buffle-head. On May 30, 1955, a pair was seen on the river near Bethel. No others were seen, and these are presumed to have been migrants.

*Clangula hyemalis*. Old-squaw. Five birds of this species were observed on the river near the village on May 28, 1956. I examined a group of breeding birds brought in by an Eskimo from the vicinity of Lomavik, to the southwest, and he informed me that Old-squaws are common on the tundra in that area. No evidence to indicate that this species breeds in the Napaskiak area was obtained.

*Melanitta deglandi*. White-winged Scoter. Recorded only in 1955, when it was seen twice on June 1. A group of ten was counted over the river, and two were on a large tundra lake. It is believed these birds were transients.

*Oidemia nigra americana*. Black Scoter. This scoter was abundant and was observed on nearly all the tundra lakes, usually in pairs, and one pair was seen on the river. Larger lakes, an acre or more in area, supported several pairs. The birds nested in the lake fringes. A male was taken on May 31, 1955; testis 25 mm., weight 1077 gm.

*Accipiter gentilis*. Goshawk. Seen on nearly every trip afield in 1955, and most frequently along the margins of the riparian woodland but also occasionally over the river. In 1956 none was seen. No specimens were obtained but it seems reasonable to assume a few of this species must nest in the riparian woodland.

*Buteo lagopus*. Rough-legged Hawk. This species was recorded only in 1956 when a pair was found attending a nest built in a tall poplar on a large island south of the village. Eskimos informed me of another nest on a high bluff farther down the river. According to Cade (1955:344), the birds nesting in this area, as in others contiguous with the Bering Sea, should not be designated trinominally; this area is part of a zone of intergradation of Alaskan and Siberian forms.

*Circus cyaneus hudsonicus*. Marsh Hawk. Not recorded in 1955 but found at two widely sepa-

rated localities in 1956. In both instances the birds were hunting over the extensive, open grassy marshes in the riparian woodland and often alighting in the willows. On May 26, 1956, a pair, apparently with a nest, was observed near the village and the male was collected; testis 15 mm., weight 353.0 gm.

*Canachites canadensis*. Spruce Grouse. I found no evidence to indicate the presence of this species, although the Eskimos contend it is present in the willows in the fall. It seems quite possible that a few of this species find a favorable food supply in this area and move in following the breeding season.

*Lagopus lagopus alascensis*. Willow Ptarmigan. Observed or heard on nearly every trip to the tundra; considered to be common. Ptarmigan, usually in pairs, restricted their activities to the heath tundra, either in, or adjacent to, the scattered dwarf birch-alder thickets. On June 4, 1955, a female was flushed from a nest containing 10 eggs in the low vegetation of the heath tundra. Data for specimens, all males, are: May 28, 1955, testis 13 mm., weight 630.7 gm.; June 1, 1955, weight 620.0 gm.; June 2, 1956, testis 17 mm., weight 594.8 gm.

*Grus canadensis*. Sandhill Crane. Abundant and conspicuous throughout the area. This was especially true in August, 1955, when hundreds could be seen scattered over the tundra feeding on berries. Flocks passed overhead throughout the day. While common on both the wet and dry tundra, they were also seen foraging in the *Equisetum-Carex* association along the sloughs. No breeding areas were located but Eskimos know of local ones on the tundra. A male was taken on June 8, 1955; testis 25 mm., weight 3500 gm.

*Charadrius semipalmatus*. Semipalmated Plover. Uncommon in the area and not recorded in 1955 although Eskimos attested to its presence. In 1956 pairs were found on two occasions; they were foraging in sparse *Equisetum-Carex* that was broken with patches of open sandy ground. One of these pairs, apparently with a nest nearby, was collected on May 29, 1956; male, testis 9 mm., weight 41.3 gm.; female, largest ovum 8 mm., one collapsed follicle, weight 41.3 gm.

*Pluvialis dominica fulva*. Golden Plover. Pairs of this uncommon species were widely separated over the open heath tundra. Compared to numbers recorded on the Johnson River (Walkinshaw and Stophlet, 1949:31), this species was uncommon in the Napaskiak area. On June 2, 1956, an otherwise wary male was collected while driving an intruding Long-tailed Jaeger from its territory; testis 14 mm., weight 133.5 gm.

*Aphriza virgata*. Surf-bird. On June 4, 1956, a male was taken as he foraged in the *Equisetum-Carex* formation along the slough at the village; testis 11 mm., light fat, weight 123.7 gm. This bird proved to be unknown to local Eskimos and was judged to be a transient.

*Capella gallinago delicata*. Wilson Snipe. This species was very abundant, and its winnowing, during late May and early June, was nearly continuous throughout the day and night. Nests were found in the dense grass of the riparian woodland, and the birds were seen foraging in the *Equisetum-Carex* formation and in both types of fresh-water marsh. Specimens taken include a female on May 27, 1955, weight 129.1 gm., and a male, June 1, 1956, testis 15 mm., weight 100.9 gm.

*Numenius phaeopus*. Hudsonian Curlew. Even scarcer than the Golden Plover, and like that species it was seen only on the open heath tundra. In 1955, five were seen and only two of these seemed to be established breeding birds. In 1956, a pair was located 6 miles northeast of the village in the same area as the birds of 1955. No specimens were obtained and a concerted effort to find the nest failed.

*Tringa solitaria cinnamomea*. Solitary Sandpiper. These birds were restricted to fresh-water marshes of the closed type where they could be found foraging on floating mats of vegetation. This type of marsh, a late stage in succession to woodland, is relatively uncommon in the area, and the sandpipers were likewise. A male was collected both years; 1955, June 9, testis 8 mm., weight 62.1 gm.; 1956, June 6, testis 9 mm., weight 55.8 gm.

*Erolia minutilla*. Least Sandpiper. Found only once, in 1955, when a male was collected foraging about a small pond on the wet tundra on May 31; testis 6 mm., weight 20.0 gm. Apparently this bird was a transient.

*Ereunetes mauri*. Western Sandpiper. This species was always present foraging in the *Equisetum-Carex* formation at low tide and was undoubtedly the most abundant shorebird in the area. Occasionally it was seen loafing or feeding on mud bars. The heath tundra was utilized for nesting, and displaying birds were nearly always in sight or hearing. Specimen data for 1955: male, May 31, testis 7 mm., weight 26.9 gm.; male, June 2, testis 6 mm., weight 25.5 gm.; female, June 2, egg in the

oviduct, one collapsed follicle, weight 36.8 gm. For 1956: male, May 30, testis 9 mm., weight 26.4 gm.; male, May 30, testis 7 mm., 27.0 gm.; male, May 31, testis 7 mm., weight 24.8 gm.; female, May 30, ova to 3 mm. in diameter, three collapsed follicles, weight 29.5 gm.

*Lobipes lobatus*. Northern Phalarope. This species was very abundant and was recorded every day in pools in one or all of the following formations: lacustrine water, wet tundra, fresh-water marsh, and *Equisetum-Carex*, the latter on incoming or outgoing tides. In 1955 two specimens were taken: female, May 26, one collapsed follicle, weight 34.5 gm.; male, June 6, testis 13 mm., weight 32.0 gm. In 1956 a male was taken from a pair, apparently with a nest, on the wet tundra adjacent to a lake; testis 10 mm., brood patch, weight 31.0 gm.

*Stercorarius parasiticus*. Parasitic Jaeger. This jaeger was moderately common in 1955 and it was recorded on the heath tundra and along the river and sloughs on most of the trips. Only one, a melanistic bird, was seen in 1956, and this along the river. Two specimens were collected in 1955; a female, June 1, two collapsed follicles, weight 486.9 gm.; male, June 4, testis 13 mm., weight 416.4 gm.

*Stercorarius longicaudus*. Long-tailed Jaeger. Abundant both years and seen most frequently on the heath tundra where scattered pairs occupied breeding territories. It was also recorded on the tundra lakes and river, often loafing on mud bars with the gulls and terns. Specimen data for 1955: male, June 1, testis 18 mm., weight 289.7 gm.; male, June 4, testis 11 mm., weight 246.6 gm.; female, June 1, two collapsed follicles, weight 295.5 gm. For 1956: male, June 6, testis 12 mm., weight 256.9 gm.; female, May 31, largest ovum 3 mm., weight 303.1 gm.

Gulls. Relatively large numbers of two of the three species of gulls present were collected in both years. These specimens were autopsied for helminths and data on gonads, age, and weight were recorded. The skins of most were not saved. These data are presented in table 2.

*Larus hyperboreus barrovianus*. Glaucous Gull. Abundant throughout the area; these large gulls were recorded on every trip into the field. Along the river and sloughs during the breeding season adult, third-year, and second-year birds were collected. First-year birds were collected in August, 1955. The criteria for age determination were taken from Johnston (1955:204). On the tundra lakes and bordering wet tundra the adults were numerous, and they are believed to breed in this area.

Table 2

Data on Age, Gonads, and Weight for Gulls Collected in the Napaskiak Area, 1955-56

Species	Locality/relation to Napaskiak	Date	Testis/largest ovum (mm.)	Weight (grams)
<b>Glaucous Gull:</b>				
Males, 1st year:	5 mi. N	August 24, 1955	Minute	1269.4
	5 mi. N	August 24, 1955	Minute	1148.2
	5 mi. N	August 24, 1955	Minute	937.1
	5 mi. N	August 24, 1955	Minute	1225.1
Males, 2nd year:	3 mi. N	June 8, 1956	8	1316.5
	3 mi. N	June 8, 1956	4	1353.7
	3 mi. N	June 8, 1956	4	1278.2
Males, 3rd year:	Napaskiak	August 27, 1955	3	1383.6
	Napaskiak	August 27, 1955	1	1547.7
	3 mi. N	June 8, 1956	18	1485.4
	3 mi. N	June 8, 1956	5	1603.9
Males, adult:	Napaskiak	August 27, 1955	4	1499.1
	2 mi. NE	June 8, 1956	12	1750.0
Females, 1st year:	5 mi. N	August 24, 1955	Minute	887.0
	5 mi. N	August 24, 1955	Minute	1087.8
	5 mi. N	August 24, 1955	Minute	869.0
	5 mi. N	August 24, 1955	Minute	961.0

Table 2 (continued)

Species	Locality/relation to Napaskiak	Date	Testis/largest ovum (mm.)	Weight (grams)	
Females, adult:	Napaskiak	June 13, 1955	....	1278.6	
	Napaskiak	June 13, 1955	....	1620.0	
	Napaskiak	June 13, 1955	....	1297.2	
	3 mi. N	June 8, 1956	4	1271.8	
	3 mi. N	June 8, 1956	Minute	1317.2	
	3 mi. N	June 8, 1956	10	1195.8	
	5 mi. N	June 10, 1956	5	1371.4	
	5 mi. N	June 10, 1956	5	1255.2	
	5 mi. N	June 10, 1956	5	1234.9	
	5 mi. N	June 10, 1956	10	1381.6	
	Common Gull:				
Males, 1st year:	5 mi. N	August 24, 1955	Minute	360.0	
	5 mi. N	August 24, 1955	Minute	450.6	
Males, 3rd year:	6 mi. NE	June 4, 1956	18	435.9	
	6 mi. NE	June 4, 1956	18	461.0	
	3 mi. W	June 7, 1956	10	440.0	
	3 mi. W	June 7, 1956	17	446.7	
	3 mi. N	June 8, 1956	12	495.5	
Males, adult:	Napaskiak	May 27, 1955	....	415.0	
	6 mi. NE	May 31, 1955	25	424.0	
	3½ mi. SE	June 1, 1955	18	390.8	
	3½ mi. SE	June 1, 1955	12	453.1	
	3½ mi. SE	June 1, 1955	12	406.9	
	3½ mi. SE	June 1, 1955	15	415.1	
	3½ mi. SE	June 4, 1955	18	493.0	
	Napaskiak	June 6, 1955	20	462.4	
	Napaskiak	June 6, 1955	23	535.1	
	Napaskiak	June 6, 1955	24	462.5	
	Napaskiak	June 7, 1955	19	507.1	
	Napaskiak	June 8, 1955	....	486.4	
	Napaskiak	June 13, 1955	12	474.5	
	Napaskiak	June 13, 1955	11	392.8	
	Napaskiak	June 13, 1955	17	499.8	
	3 mi. W	June 7, 1956	19	465.3	
	3 mi. W	June 7, 1956	22	428.7	
	3 mi. W	June 7, 1956	15	497.8	
	3 mi. N	June 8, 1956	12	461.9	
	Females, adult:	6 mi. NE	May 31, 1955	5	325.9
		6 mi. NE	May 31, 1955	Two large	517.0
3½ mi. SE		June 1, 1955	4	403.7	
3½ mi. SE		June 1, 1955	4	379.9	
3½ mi. SE		June 4, 1955	9	342.0	
Napaskiak		June 6, 1955	10	388.3	
Napaskiak		June 6, 1955	Two large	551.5	
Napaskiak		June 7, 1955	3	433.2	
6 mi. NE		June 4, 1956	5	394.2	
3 mi. W		June 7, 1956	3	396.5	
3 mi. W		June 7, 1956	3	320.6	
3 mi. W		June 7, 1956	4	398.8	
3 mi. N		June 8, 1956	5	385.9	
Bonaparte Gull:					
Males, adult:	3½ mi. SE	June 4, 1955	12	202.3	
	Napaskiak	June 12, 1955	....	182.0	
	3½ mi. SE	June 2, 1956	10	182.5	
	3½ mi. SE	June 2, 1956	14	188.9	
Female, adult:	Napaskiak	June 6, 1955	Had laid	169.6	

*Larus glaucescens*. Glaucous-winged Gull. No positive identification was made of this species and it is unlikely that it occurs in the area. Dice (1920a:176; 1920b:8) recorded only *L. hyperboreus* along the Kuskokwim from the interior to Bethel, and Walkinshaw and Stophlet (1949:31) list only Glaucous Gulls from the Johnson River. The report by Cady, Wallace, Hoare, and Webber (1955:14) that *glaucescens* nests on sand bars in the river in the central Kuskokwim region is evidently an error.

*Larus canus brachyrhynchus*. Common Gull. This gull was very abundant in the area and was found in the same formations as *L. hyperboreus*. Adults and a few third-year birds were taken. Those showing black spots or barring on the rectrices and black and white-tipped primaries were judged to be in their third year. Johnston (1956:141, 142) has reported that in the California Gull (*Larus californicus*) the third-year plumage is quite variable, and birds of this age may show no black in the rectrices. Further, adults may possess tail spots. This variation might be expected in *L. canus* and consequently some of the birds in table 2 may be incorrectly placed regarding age. Nonetheless, it is apparent that no second-year birds, and only a few of those in their third year, reach these breeding grounds.

*Larus philadelphia*. Bonaparte Gull. This species was seen only occasionally along the river and sloughs, usually in company with the larger gulls. Breeding territories, which were vigorously defended, were found at widely separated localities on the tundra where scattered spruces occurred adjacent to tundra lakes. This arrangement was uncommon in the area and the gulls were likewise.

*Sterna paradisaea*. Arctic Tern. Terns were abundant about the tundra lakes and bordering wet tundra, where colonies of breeding birds could be found. They were seen every day foraging along the river and sloughs and loafing on the mud bars with the gulls. Data for two males taken on May 31, 1955, are: testis 7 mm., weight 110.3 gm.; testis 5 mm., weight 114.4 gm. A female was taken on June 10, 1956; enlarged oviduct, largest ovum 3 mm., weight 95.6 gm.

*Bubo virginianus algistus*. Horned Owl. This species was not recorded in 1955, but in 1956 single owls were observed on five different occasions. Four of these observations were in the riparian woodland bordering the sloughs, and one bird was observed foraging over an open grassy marsh near the village. No calling was noted, but the Eskimos say these owls can be heard earlier in the spring. A female was taken on May 24, 1956; largest ovum 2 mm., molting and incubation patch refeathering, moderate fat, weight 2000 gm.

*Nyctea scandiaca*. Snowy Owl. This owl was not recorded but Eskimos assured me that it occurs on the heath tundra in the breeding season and about the village in the fall. A marked paucity of microtine rodents was noted on the tundra in both years and it seems very likely this food shortage influences the presence and abundance of Snowy Owls as it does at Barrow (Pitelka, Tomich, and Treichel, 1955).

*Asio flammeus*. Short-eared Owl. This species was rare in the Napaskiak area and was recorded only twice, both times in 1955. On May 31 the remains of one were found on the heath tundra, and on June 4 one was seen flying over the same formation. As in the case of the Snowy Owl, the abundance of this species probably depends on the abundance of microtine rodents.

Woodpeckers. No members of this group were observed although their presence was indicated by diggings in the larger willows and poplars. The Eskimos believe there are two species present, one very small and another the size of a robin. The smaller one is most likely the Downy Woodpecker, and the larger one either *Colaptes* or *Picoides*. *Colaptes auratus* is a characteristic inhabitant of poplars in Alaska while members of the genus *Picoides* are usually found in spruce or burned spruce (Dice, 1920b). The cavities of woodpeckers are used for nesting in this area by Tree Swallows and possibly by Black-capped Chickadees, and the relative scarcity of these two species in the riparian woodland may be attributable to the scarcity of woodpeckers.

*Empidonax traillii traillii*. Traill Flycatcher. After the foliage was well developed in the riparian woodland in the second week in June, this species made its appearance. Singing males were common and were scattered through the area; one was almost always within hearing. A male taken on June 7, 1956, weighed 14.2 gm.; testis 4 mm.

*Iridoprocne bicolor*. Tree Swallow. The numbers of this abundant species were due, in large part, to the provision of nest boxes by the villagers. Nesting cavities were otherwise scarce and the species was found nesting at only two localities away from the village where there were large willows and poplars. The birds foraged over the woodland and the open grassy marshes. Data for three specimens



taken on June 6, 1955, are: male, testis 12 mm., weight 20.7 gm.; female, ova minute, weight 17.8 gm.; and female, largest ovum 8 mm., oviduct enlarged, weight 19.2 gm. Data for a pair taken May 29, 1956, are: male, testis 11 mm., weight 21.5 gm.; female, largest ovum 2 mm., weight 21.3 gm.

*Riparia riparia riparia*. Bank Swallow. Virtually every cut-bank of sandy soil along the sloughs and river supported a colony of this abundant species. They were never found far from these nesting sites as they foraged, often skimming the surface, over the water below the bank. A male weighing 14.7 gm. was taken on June 4, 1955; testis 7 mm. Data for two females, both with incubation patches, taken on June 6, 1955, are: largest ovum 2 mm., weight 16.3 gm.; and largest ovum 2 mm., weight 15.6 gm.

*Hirundo rustica*. Barn Swallow. Recorded only once, in 1955, when a lone bird flew over the grassy clearing which surrounds the village. It is not believed to nest in the region although Walkinshaw and Stopblet (1949:34) found two pairs with nests on the Johnson River 30 miles west of Bethel.

*Perisoreus canadensis pacificus*. Canada Jay. This jay was encountered only occasionally and always in the riparian woodland. Nesting seemed to be completed in late May. Data for five specimens taken in 1955 are: male, June 1, testis 3 mm., molting, weight 73.6 gm.; male, June 9, molting, weight 70.0 gm.; male, August 27, testis 2 mm., weight 73.4 gm.; male, August 27, testis 1 mm., weight 73.6 gm.; female, June 1, ova minute, molting, incubation patch refeathering, weight 64.8 gm.

*Corvus corax principalis*. Raven. Ravens were common and were seen nearly every day in the field, usually in the riparian woodland or over the open tundra. They frequently raided fish-drying racks near the village. A nest was found in riparian woodland on June 7, 1955. A male taken on June 4, 1956, weighed 1411 gm., testis 10 mm.

*Parus atricapillus turneri*. Black-capped Chickadee. On June 1, 1955, a pair of this species was seen in the riparian woodland near the village and also a lone bird in the spruces at the edge of the tundra. On June 4, 1955, a pair, presumably those seen on June 1, was collected at the village. This species was not recorded in 1956. Apparently the scarcity of nesting cavities limits the numbers of chickadees that can nest in the region. Data for the pair collected are: male, testis 6 mm., weight 12.0 gm.; female, enlarged ova, incubation patch, weight 11.8 gm.

*Turdus migratorius migratorius*. Robin. Least numerous of the three species of thrushes present; nonetheless considered common. Robins were seen every day in the riparian woodland, where pairs were widely spaced, and they were frequently observed in the dwarf birch-alder thickets and spruces. A nest found on June 1, 1956, in a large willow near the village contained three eggs; the female was still laying. Data for the specimens are: male, June 4, 1955, testis 16 mm., weight 90.0 gm.; male, May 25, 1955, testis 12 mm., weight 78.3 gm.; male, May 30, 1955, testis 15 mm., weight 82.8 gm.

*Ixoreus naevius meruloides*. Varied Thrush. This species was common to abundant in the riparian woodland and dwarf birch-alder thickets. It was seen every day and was found to be especially numerous in the poplar stands. A female taken on May 26, 1955, weighed 91.6 gm., and had several collapsed follicles. The data for four specimens taken in 1956 are: male, May 29, testis 12 mm., weight 72.0 gm.; male, June 7, testis 12 mm., weight 74.7 gm.; female, May 24, egg in the oviduct, 2 large ova, weight 89.4 gm.; female, June 7, largest ovum 13 mm., weight 85.5 gm.

*Hylocichla minima minima*. Gray-cheeked Thrush. Abundant in the riparian woodland and also seen in the dwarf birch-alder thickets at the tundra edge. A female taken on June 6, 1955, weighed 30.7 gm.; largest ovum 5 mm. Data for specimens in 1956 are: male, May 24, testis 14 mm., weight 32.4 gm.; male, May 26, testis 14 mm., weight 30.5 gm.

*Vermivora celata celata*. Orange-crowned Warbler. Although seen or heard fairly frequently, this species was considered only a moderately common resident of the riparian woodland. The pairs were widely scattered, and usually only two or three birds were seen on an all-morning search. The data for two birds taken on June 1, 1955, are: male, testis 6 mm., weight 10.3 gm.; female, ova minute, weight 9.3 gm. For 1956: male, May 26, testis 7 mm., weight 10.1 gm.; male, May 26, testis 6 mm., weight 10.8 gm.

*Dendroica aestiva rubiginosa*. Yellow Warbler. This warbler arrived in large numbers in the riparian woodland in the first week in June, when the foliage was nearly mature. Singing males were constantly within hearing from this time on. Data for two males taken on June 7, 1956, are: testis 6 mm., weight 9.3 gm.; testis 7 mm., weight 9.7 gm.

*Dendroica coronata hooveri*. Myrtle Warbler. This species was less abundant than *V. celata*, and

was considered very uncommon. Found only in the riparian woodland, it was recorded twice in 1955, and three times in 1956. A total of five was seen of which four were collected. A female taken from a nest on June 1, 1955, weighed 14.6 gm.; incubation patch well developed. Data for three males taken in 1956 are: May 29, testis 8 mm., weight 13.3 gm.; May 29, testis 8 mm., weight 12.4 gm.; June 7, testis 8 mm., weight 13.2 gm.

*Dendroica striata*. Black-poll'd Warbler. Very abundant in the riparian woodland during both years, large numbers being present when I arrived. Specimen data for 1955: male, May 26, testis 8 mm., weight 12.9 gm.; male, June 1, testis 6 mm., weight 12.6 gm.; female, May 28, weight 10.9 gm.; female, June 1, ova minute, 11.3 gm. For 1956: male, May 24, testis 8 mm., weight 12.0 gm.; male, June 11, testis 7 mm., weight 13.8 gm.

*Seiurus noveboracensis notabilis*. Northern Water-thrush. Common in the riparian woodland and in the fresh-water marsh of the closed type. A male taken on May 28, 1955, weighed 15.0 gm.; testis 7 mm. Specimen data for 1956: male, May 24, testis 6 mm., weight 17.4 gm.; female, May 28, egg in the oviduct, three other large ova, weight 22.8 gm.

*Wilsonia pusilla pileolata*. Pileolated Warbler. Moderately common; pairs widely scattered in the riparian woodland. Data for three males taken in 1955 are: May 28, testis 5 mm., weight 7.4 gm.; June 1, 7.9 gm.; June 4, testis 7 mm., weight 7.6 gm. Two birds were taken on May 29, 1956: male, testis 8 mm., weight 7.6 gm.; female, largest ovum 2 mm., weight 7.8 gm.

Of the six species of warblers present only one, the Yellow Warbler, arrived after the foliage appeared in the woodland. The other five species were present in late May when the study began and, with the exception of the uncommon Myrtle Warbler and perhaps the already abundant Black-poll'd Warbler, increased markedly in numbers until the end of that month. Readily discernible differences in the foraging behavior of these birds were observed, and in very general terms were as follows.

Water-thrushes foraged primarily on the ground, commonly in boggy areas. Pileolated and Myrtle warblers were found in "edge" situations, along the slough margins in low willows, and in dense thickets about the poplar stands. Black-poll'd Warblers were most often observed in the larger willows, foraging along naked limbs under the canopy. Orange-crowned Warblers were also found in the larger trees but usually in the lower part of the canopy and often well out on the limbs. The Yellow Warblers foraged high up in the leafy canopy near or at the tops of the trees. There was, of course, some overlapping in these patterns of distribution.

Unfortunately, sufficient detailed quantitative data regarding the ecologic preferences of the warblers have not as yet been gathered for a comparison with the situation in an area of more heterogeneous vegetation, such as the Cook Inlet region. In the latter locality the same six species of warblers occur, but a greater range of vegetational formations is utilized and the ecological separation of the birds is, in some instances, strikingly different.

*Euphagus carolinus*. Rusty Blackbird. Seen only occasionally, usually in pairs, flying overhead or perched on the tops of willows in the riparian woodland. They were also seen about the grassy fresh-water marshes. Data for three males taken in 1955 are: May 26, testis 12 mm., weight 62.7 gm.; May 26, testis 14 mm., weight 66.8 gm.; June 2, testis 12 mm., weight 64.6 gm. A male taken on June 1, 1956, weighed 61.1 gm.; testis 12 mm.

*Pinicola enucleator*. Pine Grosbeak. This species was not recorded in the area but the Eskimos attest to its presence in the riparian woodland. Two females were taken on June 15, 1955, approximately eight miles northeast of the area, and the data for these are: enlarged oviduct, several collapsed follicles, weight 75.7 gm.; enlarged oviduct, incubation patch, weight 68.7 gm. In 1956 another female was seen in the same area.

*Acanthis flammea flammea*. Redpoll. Abundant throughout the area in the riparian woodland. A nest was found on May 27, 1955, and the data for three birds taken in that year are: male, May 27, testis 7 mm., weight 12.4 gm.; male, June 15, testis 6 mm., weight 13.6 gm.; female, May 26, weight 12.9 gm. For 1956: male, May 27, weight 12.4 gm.; female, May 26, largest ovum 2 mm., incubation patch, weight 12.9 gm.; female, May 26, largest ovum 2 mm., incubation patch, weight 13.6 gm.

*Passerculus sandwichensis anthinus*. Savannah Sparrow. Common to abundant in nearly all formations of open character where grasses were predominant. These included fresh-water marshes, dwarf birch-alder thickets, wet tundra, and the cleared areas about the village. The data for two males taken in 1955 are: May 27, testis 9 mm., weight 19.6 gm.; May 31, testis 8 mm., weight 18.6 gm.

The data for two males taken in 1956 are: May 18, testis 7 mm., weight 19.9 gm.; May 26, testis 11 mm., weight 19.4 gm.

*Spizella arborea ochracea*. Tree Sparrow. Abundant throughout the area in a variety of formations. It was found in the riparian woodland, in dwarf birch-alder thickets, and in the latter also where they occurred among the spruces. It was found well out on the dry tundra wherever the scattered birches and alders were present, including the margins of some of the tundra lakes. It was conspicuously absent where the ground was bare or the cover sparse, as under the dense poplars. A nest containing three eggs was found in the riparian woodland on May 27, 1955. Data for three specimens taken in 1955 are: male, May 26, testis 11 mm., weight 18.6 gm.; male, May 28, testis 13 mm., weight 18.0 gm.; female, June 1, egg in the oviduct, three collapsed follicles, weight 20.0 gm. Data for two males taken in 1956 are: May 24, testis 8 mm., weight 18.2 gm.; June 8, testis 11 mm., weight 19.4 gm.

*Zonotrichia atricapilla*. Golden-crowned Sparrow. This species was recorded on May 30, 1956, when a lone male, apparently a transient, was detected singing along the border of the riparian woodland at the village. This bird was stalked but not taken. Some of the Eskimos know this species from farther down the river where they say it occurs in the willows.

*Passerella iliaca zaboria*. Fox Sparrow. Abundant resident in the riparian woodland; heard and seen every day. Data for two specimens taken in 1955 are: male, May 27, testis 10 mm., weight 39.1 gm.; female, June 1, weight 39.4 gm. For 1956: male, May 24, testis 9 mm., weight 34.4 gm.; male, May 24, testis 8 mm., weight 34.8 gm.; male, May 24, testis 7 mm., weight 38.6 gm.; female, June 11, largest ovum 3 mm., incubation patch, weight 38.6 gm.

*Calcarius lapponicus alascensis*. Lapland Longspur. Abundant on the open heath tundra where it was the only nesting passerine bird. It was also found on the tundra fringe in the scattered dwarf birch-alder thickets. In 1956 a pair of longspurs occupied a cleared grassy area near my cabin and apparently had a nest nearby. Data for a pair collected on May 31, 1955, are: male, testis large (shot), weight 25.5 gm.; female, egg in the oviduct, three collapsed follicles, weight 29.6 gm. Data for a pair taken on May 31, 1956, are: male, testis 10 mm., weight 28.0 gm.; female, egg in the oviduct, two ova large, one collapsed follicle, weight 30.3 gm.

#### DISCUSSION

This preliminary survey of the birds of the Napaskiak region best serves to indicate that there exists an array of interesting problems relating to the distribution of birds in the spruce-tundra ecotone of western Alaska. The data gathered thus far are insufficient for a solution of any of these problems, but they justify the discussion of a selected few. This is best approached, perhaps, by briefly mentioning some of the factors that may be responsible for the scarcity, or apparent absence, in this region of species of birds normally found in one or the other of the two plant communities involved. These species, judging from the presence of seemingly suitable, continuous habitat, and from their occurrence in nearby localities, might be expected to be present, or at least more abundant.

As mentioned earlier, records are available from three localities in the vicinity of Napaskiak. The tundra vegetation at Johnson River (Walkinshaw and Stophlet, 1949:30) is nearly identical to that at Napaskiak, although the dwarf birch-alder thickets are more limited in occurrence at the former locality. Conspicuously missing at Johnson River is the dense riparian woodland with its accompanying marshes and spruce border. The aquatic formations are not adequately discussed, but fluvial water with its *Equisetum-Carex* margin is undoubtedly less prominent. Lacustrine waters are presumably more abundant. A list of 49 species was compiled in this area and can be compared with the list from Napaskiak. The most obvious difference is the absence at Johnson River of a large number of species characteristic of the riparian woodland. These include the Goshawk, Horned Owl, Traill Flycatcher, Canada Jay, Black-capped Chickadee, Varied Thrush, Orange-crowned Warbler, Myrtle Warbler, and Black-poll Warbler. Nevertheless, five species restricted to this formation in the Napaskiak area were present at Johnson River, usually in limited numbers. These are the Tree Swallow,

Yellow Warbler, Northern Water-thrush, Pileolated Warbler, and Rusty Blackbird. Their scarcity at Johnson River indicates they were in a marginal situation as regards their requirements. The riparian woodland birds of the Napaskiak area showing a secondary preference for dwarf birch-alder thickets were present at Johnson River, in many cases abundantly so. Two other species that are apparently dependent on trees, the Bonaparte Gull and the Solitary Sandpiper, were missing at Johnson River.

Many tundra species such as Canada Goose, White-fronted Goose, Old-squaw, Golden Plover, and Hudsonian Curlew were more abundant at Johnson River. Others such as the American Scoter and Glaucous Gull were less abundant. The scarcity of the latter at Johnson River, as well as that of the Mallard and Baldpate, and the complete absence of the Semipalmated Plover, might be attributable to the lack of extensive fluviatile water and bordering vegetation.

Of seven species recorded at Johnson River and not at Napaskiak, only three, the Shoveller, Black-bellied Plover, and Yellow Wagtail, were recorded in such numbers as to merit special attention. The Shoveller, according to Eskimos, occurs in the Napaskiak area, although it is evidently never common. It was recorded 23 times at Johnson River. The Yellow Wagtail (153 observed) and Black-bellied Plover (44 observed) were both abundant breeding birds on the tundra, and a number of nests of each was found (Wal-kinchaw, 1948a:64-66; 1948b:220), whereas they are absent in the Napaskiak area.

There are absent from the Napaskiak area several species of birds found farther inland in topographic and vegetational formations which continue down the Kuskokwim River well within the study area. Dice (1920a) and Cady, Wallace, Hoare, and Webber (1955) listed the Swainson Thrush (*Hylocichla ustulata*) and the White-crowned Sparrow (*Zonotrichia leucophrys*) as inhabitants of the riparian woodland and the Belted Kingfisher (*Megaceryle alcyon*) as inhabiting the river banks. Cady *et al.* (*op. cit.*: 14) reported the Violet-green Swallow (*Tachycineta thalassina*) as abundant along the river and its banks, and Dice (1920a:9) listed the same species as characteristic of streamside cut-banks in interior Alaska. Neither of these reports listed the Lincoln Sparrow (*Passerella lincolni*) as occurring along the Kuskokwim River, although Miller (1956:271) indicated the breeding range as extending to within a few miles of the study area. Grassy bogs and meadows are abundant west to the tundra, and even out on that formation, and this last species can be expected to occur.

Dilger (1956:173) indicated the Napaskiak area to be well within the breeding range of the Swainson Thrush but well out of that of the Gray-cheeked Thrush. The actual situation is the reverse; and the range maps he presented are inaccurate for other parts of Alaska. The apparent adaptation of the Swainson Thrush for arboreal foraging (Dilger, 1956:196) may account for its absence in the Napaskiak area. This would seem reasonable if this thrush is limited to foraging in coniferous forest, but otherwise the riparian woodland would seem to provide the essential requirements, as indeed it does, at least for nesting, in the central Kuskokwim region.

Oakeson (1954:352-353) has described the habitat occupied by White-crowned Sparrows at Mountain Village on the Yukon River, and this area appears very similar to much of the Napaskiak area. In addition she observed four passerine associates of the White-crowned Sparrow, and these are all found commonly in the riparian woodland at Napaskiak. Attention was called to the erratic distribution of this sparrow in the Yukon Territory by Rand (1946:64). The same situation exists along the Kuskokwim River, where it was recorded as far west as Bethel during the present study.

Nelson (1887:155) reported the Belted Kingfisher to be a regular summer resident on the lower Yukon River as far west as the Bering Sea. Suitable nesting banks and an

abundant food supply seem to be equally as available along the lower Kuskokwim, and the absence of this species is not readily explained.

Bishop (1900:88) found the Violet-green Swallow nesting in holes, similar to those of *Riparia*, along the Yukon River in interior Alaska. This was the most abundant of four species of swallows present in the central Kuskokwim region as observed by Cady *et al.*

In characterizing the associations of terrestrial vertebrates of interior Alaska, including the Kuskokwim River west to Bethel and the tundra, Dice (1920*b*) lists many additional species, not present in the Napaskiak area, as residents of the shore, *Equisetum*, sedge, and willow-alder habitats. The discrepancies in species-lists are great enough to indicate that, in most instances, the latter formations are not equivalent to their counterparts described in this report. The relationship of these formations to each other, especially as regards the presence of adjacent spruce, spruce-birch, and spruce-aspen woodland, is different significantly from one area to another.

In general, the presence or absence of particular vegetational and topographic formations seem to dictate the occurrence and abundance of birds in the Napaskiak area. For those species discussed above as possible exceptions, as well as others probably overlooked, additional and more detailed studies are needed. For instance, it seems unlikely that the variations in abundance and occurrence of birds from locality to locality on the tundra can be entirely attributed to the presence or absence of particular vegetational structures. I am not prepared to offer alternate hypotheses, but it seems probable that studies of certain aspects of the physical environment would be fruitful. These might include: exposure to wind, amount of insolation, variation of amount of tundra in relation to lacustrine waters, and amount of surface and soil moisture. It would also seem profitable to conduct studies at a number of localities along the river above Bethel, placing emphasis on the vegetation but also investigating the direct effects of climatic factors. In addition to providing information on distribution, such work would be helpful in understanding the marked year to year fluctuations in abundance of such species as the Goshawk and Arctic Loon.

#### SUMMARY

In conjunction with studies of animal-borne diseases, 37 days in May, June, and August of 1955 and 1956 were spent by the writer gathering information on birds of the Napaskiak area of the Kuskokwim River delta, Alaska. A brief discussion of the climate, topography, and general ecological setting of this area is presented.

Placing emphasis on the life-form of the vegetation, a list of ten ecologic formations is discussed and employed to analyze the distribution of birds. Sixty-two species of birds were recorded in the region. An annotated list, with data from specimens, is presented.

Two species, the Goshawk and the Arctic Loon, fluctuated markedly in abundance between the two years. In addition, several species were scarce or absent in the area, although they were present in nearby localities in similar vegetational and topographic formations.

The direct effects of climate, or other physical factors, are suggested as influencing at least some of these distributional patterns. Additional studies of habitat relations and climate as they influence each species at various localities in the area are needed.

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