

FAUNAL RELATIONSHIPS OF BIRDS IN THE ILIAMNA LAKE AREA, ALASKA

FRANCIS S. L. WILLIAMSON and LEONARD J. PEYTON



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ABSTRACT

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The authors studied animal-borne diseases and birds in the Iliamna Lake area, Alaska, for 86 man-days in May and June of 1958 and 1959. The ornithological history, climate, physiography, and major ecological characteristics of the area are discussed. Twelve ecological formations representing the Moist Coniferous Forest, Coniferous Forest, and Tundra Biomes are distinguished on the basis of plant life-form and geologic features and are used to analyze the distribution of birds. Eighty-one species of birds were observed and included in an annotated list of 103 species. Evidence of breeding and specimen data are presented. Other evidence indicates changes in abundance and range from earlier studies.

Populations of *Canachites canadensis*, *Parus hudsonicus*, *Vermicora celata*, *Dendroica petechia*, *Passerella iliaca* are intermediate between these species' interior and coastal races. *Passerella iliaca zaboria*, *P. i. unalaschensis*, and *P. i. sinuosa* all occur. Intermediates between *P. i. zaboria* and the two other races are apparently rare. These and other racial relationships are discussed.

The Iliamna avifauna is comprised of Sitkan (5 species), Hudsonian (38 species), and Eskimoan (20 species) avifaunal elements associated with the Moist Coniferous Forest, Coniferous Forest, and Tundra Biomes respectively. Nineteen widely distributed species were valueless in detecting faunal relationships. The data suggest that extreme southeastern Alaska, Prince William Sound, and probably Kodiak and Afognak Islands constitute distinct faunal districts. The Iliamna-Cook Inlet region has a mixed avifauna.

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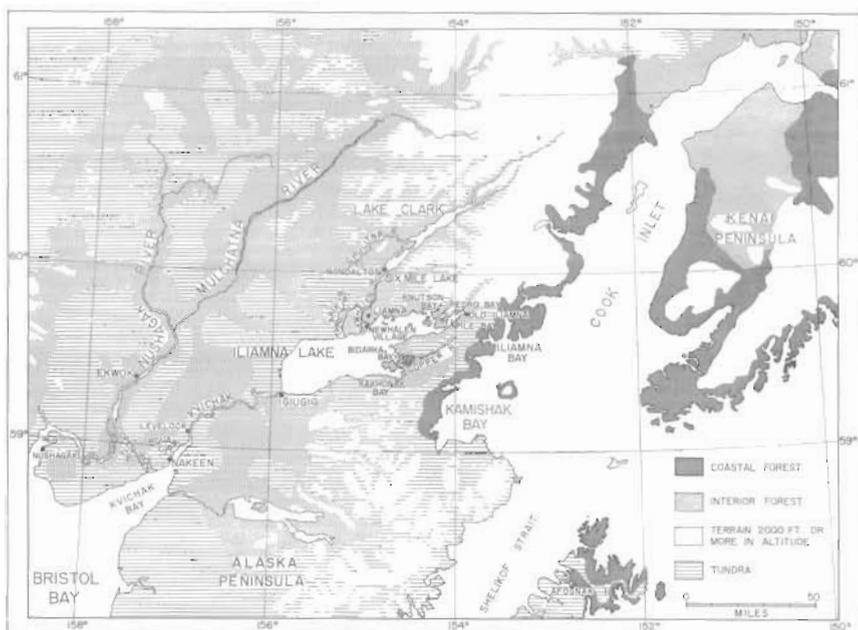


Figure 1. The approximate general distribution of vegetation types at the base of the Alaska Peninsula.

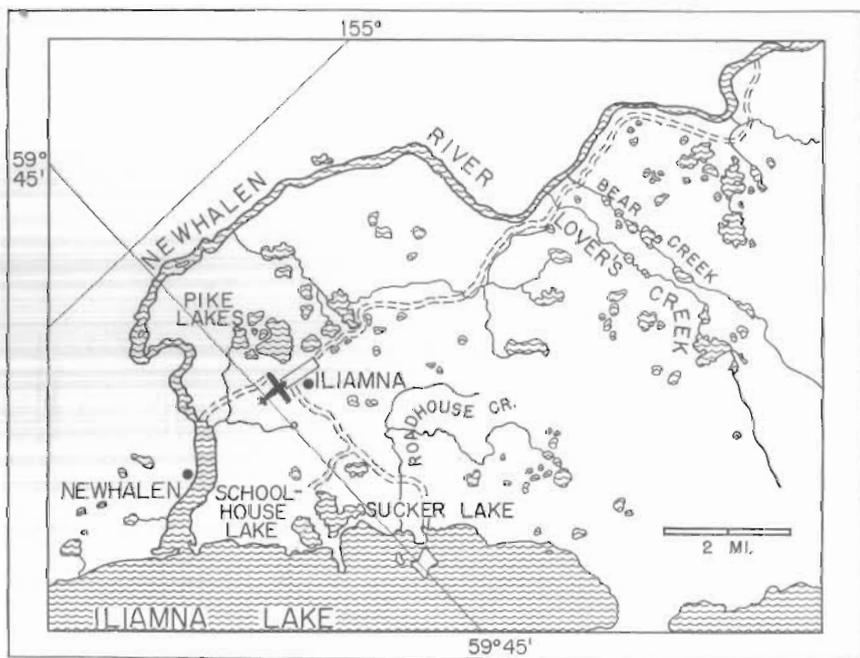


Figure 2. Outline map of the principal study area on Iliamna Lake.

FAUNAL RELATIONSHIPS OF BIRDS IN THE ILIAMNA LAKE AREA, ALASKA

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INTRODUCTION

The area about Iliamna Lake at the base of the Alaska Peninsula is of particular interest to ornithologists from the standpoint of the ecological distribution of birds, as well as their systematic and faunal relationships. This area is situated near the westernmost extent of the rich, moist, hemlock and Sitka spruce coastal forest, the dominant vegetation of the coastal regions of southeastern Alaska, at a point where the elements of this distinctive plant community are greatly reduced (Figure 1). The general lowness of the mountains of the Aleutian Range in this area is conducive to an intrusion of faunal and floral elements of the interior of Alaska and their intermixing with those of the coastal area. Additionally, the forest here interdigitates with the tundra of the Alaska Peninsula and Aleutian Islands to the west and south and, in fact, this forest is absent from much of the area and disappears completely only a relatively short distance farther west.

More or less centrally located in the area is the extensive Iliamna Lake, the largest body of fresh water in Alaska and an important consideration in understanding the distribution of certain species of birds. As implied above, the vegetational mosaic typically encountered in this area is of more than usual interest in that it is composed of markedly different plant communities often having sharp margins and sudden transitions to neighboring types. The avifauna is also diversified, and a few features of environment operative in influencing the distribution of birds were detected. This report presents such data as are available on the ecological distribution of the Iliamna birds, reviews briefly their systematic relationships, and brings into focus certain faunal shifts and characteristics of the area.

The area of our most intensive collecting and observation was about 50 square miles in extent and roughly the shape of a triangle with a base extending along the Newhalen River from Iliamna Lake inland for a distance of 12 miles and the apex falling on the lower slope of the conspicuous Roadhouse Mountain (Figure 2). Additional collecting and observations were made in nearby localities, including Bidarka Bay (local name) and the Copper River on the southern side of Iliamna Lake, and more distant, the area about Nondalton on Sixmile Lake, and the vicinity of Ekwok on

the Nushagak River. These localities and others mentioned later are all shown on Figures 1 and 2.

The Iliamna studies were developed as an adjunct to a similar but more intensive investigation begun by the authors in 1955 and still in progress in the upper Cook Inlet area. All of these studies were carried on in conjunction with investigations of animal-borne diseases, the primary function of our visits to the area. Joint visits were made during the periods May 23-June 13, 1958, and June 6-25, 1959; Peyton worked alone from June 2-5, 1959. A total of 86 man-days was spent in the area, and a fairly representative collection of specimens was made. This collection, together with field records and photographs, forms the basis for this report.

ACKNOWLEDGMENTS

We wish to express our gratitude to Oren Hudson, Anita and Collier Mize, and Doris and Robert Walker, all of Iliamna, for providing help in innumerable ways, including the facilities and transportation which made this work possible. Macy Hobson of the village of Nondalton on Sixmile Lake provided information on many species of birds including many of the less common ones based on his experience during many years of residence in the area. Our thanks go also to Calvin J. Lensink of the Alaska Department of Fish and Game for making available his records of birds observed in the upper Bristol Bay area and along the Kvichak River. Herbert Friedmann of the United States National Museum and Alden H. Miller of the Museum of Vertebrate Zoology made it possible for us to compare our specimens during visits to the collections under their care, and Dr. Miller very kindly examined a number of our specimens. Bernard Feinstein of the U. S. National Museum was very generous with his time and considerable taxonomic skill in aiding us during our work at that institution. Francis H. Fay and Robert L. Rausch have both read the manuscript and made many helpful suggestions. Finally, we should like to thank Reggie V. Rausch for preparing the maps and figures, and assisting with the preparation of the manuscript.

HISTORICAL NOTE

Gabrielson and Lincoln (1959) have indicated that Charles L. McKay may have been the first ornithologist to visit Iliamna Lake, most probably during the years 1881-1883, when McKay was actively collecting in the vicinity of Nushagak on Bristol Bay. However, Wilfred H. Osgood apparently has been the only ornithologist to attempt a survey of the avifauna prior to the present time; this was of necessity brief, and was conducted well after the breeding season for most of the species had been

completed. In July of 1902, Osgood traveled from Iliamna Bay on Cook Inlet through Iliamna Pass to Iliamna Village, now deserted and called Old Iliamna on U. S. Geological Survey maps, on around the eastern end of Iliamna Lake and up the Nogheling (= Newhalen) River to Sixmile Lake and Lake Clark. From there he eventually reached Bristol Bay, traveling by way of Chulitna, Mulchatna, and Nushagak Rivers (see Figure 1). The results of his trip were published in 1904 as Number 24 of the North American Fauna Series.

More recently, in 1930, John B. Hurley (1931, 1932) worked in the Bristol Bay area to the south and west of Iliamna Lake, extending his observations up the Kvichak River which drains this lake. Ira N. Gabrielson (1944) traveled by boat from Bristol Bay up the Kvichak River to Iliamna Lake and thence up the lake to the present settlement of Iliamna on July 23, 1940, remaining there two days, July 24-26. On July 27 he continued to the eastern end of the lake and traveled over Iliamna Pass to Cook Inlet. Calvin J. Lensink worked along the Kvichak River and upper Bristol Bay during the periods of May 17 through June 20 and September 4 through October 3, 1959, and May 15 through June 19, 1960. Although Lensink's investigation was concerned primarily with the white whale, his valuable notes on birds have contributed much to this study.

* Additional work has been carried out by Hine (1919) and Cahalane (1944, 1959) in the Katmai National Monument, only a short distance south and west of Iliamna Lake. Olaus Murie's recent publication on the fauna of the Aleutian Islands and Alaska Peninsula (1959) includes little original information for the Iliamna Lake area, since his report deals almost exclusively with the Aleutian Islands.

All of these investigations together with our own studies make it possible to draw up a fairly comprehensive picture of avian distribution at the base of the Alaska Peninsula.

DESCRIPTION OF THE REGION

The following comments relate primarily to the immediate vicinity of Iliamna Lake, but include as well information on the physiography and climate of the general region at the base of the Alaska Peninsula.

PHYSIOGRAPHY

The Iliamna area is situated at the base or northern end of the Alaska Peninsula and includes all of the country adjacent to Iliamna Lake. It does not include Sixmile Lake, Lake Clark, or the Nushagak River areas. Iliamna Lake measures, at its points of greatest length and width, approximately 80 and 20 miles, respectively (Martin and Katz, 1912), and it has a surface area of approximately 1,226 square miles (Mertie, 1938). The bulk of the southern and western parts of the lake lies at a place where the principal physical features of the peninsula, a mountain axis on the south, the Aleutian Range, and a coastal plain on the north, first become evident. These mountains serve in a general way to separate the Iliamna area from the low, coastal borders of Cook Inlet. However, there is a low and narrow pass from the Cook Inlet to Iliamna Lake at the head of Iliamna Bay, where a scant 3 miles separates the lake from salt water (Smith, 1917). There is also a relatively broad expanse of low, rolling country heavily dotted with lakes between the vicinity of Bruin Bay and the head of Kamishak Bay on Cook Inlet, and the head of Khakonak Bay on Iliamna Lake.

The northeastern end of the lake is surrounded by mountains 4,000 to 5,000 feet in elevation, and a short distance to the northeast the volcanic cone of Mt. Iliamna rises conspicuously to a height of 10,016 feet. These mountains, the Chigmit portion of the Aleutian Range, are composed primarily of granitic rocks, although they include a great variety of sedimentary, metamorphic, intrusive, and volcanic types (Martin and Katz, 1912). The shore line of Iliamna Lake in this vicinity is characterized by the presence of fjord-like indentations such as Khakonak, Knutson, and Pile Bays, and these are often choked with rocky islands, many supporting lush vegetation.

The lower, or southwestern, half of the lake is surrounded essentially with low, flat country containing abundant lakes, ponds, and streams; the shore line is free of bays and there are few islands. Extending westward along the north shore of the lake, from a point near the mouth of Knutson Bay to the Kvichak River, this expanse of low flats is covered with gravel terraces, and is bordered to the north and west by more or less detached low mountains and hills of volcanic rock. These form a plateau loosely separating the Iliamna area, or Kvichak River drainage, from the valley of the Mulchatna and Nushagak Rivers. This is the area, including the

broad valley of the Newhalen River, where our work was concentrated. The Newhalen valley is marked by rolling, glacial deposits, including numerous large and conspicuous moraines. In the study area, the elevation on Iliamna Lake is approximately 50 to 100 feet above sea level, while at the FAA airfield it is 145 feet. There is an additional further rise to about 200 feet in the rolling country along the Newhalen River, although the bulk of the area is between 100 and 200 feet in elevation.

CLIMATE

The Iliamna area lies in a zone of gradual transition from maritime to continental climatic influences. There are no major mountains barring the path of moisture-laden air as it moves from Bristol Bay and the Bering Sea toward the interior; thus, the climate is typically cool, humid, and windy. Since winds are such a dominant feature of the climate, it is unfortunate that we have no data on average velocities at different seasons. In the low, flat, coastal areas to the west, wind speed may average as high as 25 to 30 miles per hour for an entire month, and intense lows moving toward the coast may produce strong winds of 60 to 70 miles per hour which persist for two or three days at a time. These strong winds sweep over Iliamna Lake only moderately abated and may extend their effectiveness well into the interior (Watson, 1959).

In summer a northward flow of air dominates the climate; temperatures are mild, fog is not uncommon, and roughly 40 per cent of the annual mean precipitation of 25.7 inches falls as rain during July, August, and September (Muller, 1955:131 *vide* Hopkins *et al.*). The mean temperature of the warmest month, July, is 54.5° F.

The winter is characterized by a southward flow of air with consequent modification of the climate to a more continental nature. The average annual snowfall is 64.7 inches and the monthly mean temperature for the coldest month, January, is 14.6° F.

The mean annual temperature is 33.7° F., and there is an average growing season of 124 days. The area lies in a zone of sporadic permafrost (Hopkins, Karlstrom *et al.*, 1955:136, Figure 11).

The above information, relating to climate, except where otherwise cited, was derived from the U. S. Weather Bureau, Climatological Data, annual summary for Alaska for 1958.

GENERAL ECOLOGICAL CONSIDERATIONS

The interesting and significant ecological setting of the base of the Alaska Peninsula, and the Iliamna area (Figure 3), was apparently first alluded to by Osgood (1904), who mentioned "... the importance of the region as a meeting ground of some of the life areas of Alaska." It seems obvious that Nelson (1887) was keenly aware of this also when he described his Alaskan Faunal Districts. Three of these districts, the Sitkan, Aleutian, and Alaskan Arctic, merge on the Alaska Peninsula, while the fourth, the Alaskan-Canadian, reaches a southwestern terminus at the head of Bristol Bay. The limits of Nelson's faunal districts in this area coincide very closely with those of the biotic provinces of Dice (1943) and the biomes of Shelford (1945). The latter two systems, however, include the Alaska Peninsula and the Aleutian Islands as parts of the Arctic-Alpine Zone and *Cladonia*-Caribou Biome, respectively, rather than as a distinct ecologic unit. Similarly, Osgood (1904) believed the Aleutian Faunal District hardly merited distinction as other than a subdivision of subordinate rank and felt (Osgood and Bishop, 1900) that the coastal region from the Lynn Canal north to Kodiak Island is biologically so similar to the interior of Alaska that it could not be considered part of the Sitkan Faunal District.

Nonetheless, Grinnell's studies (1910) led him to consider as distinctive the Prince William Sound region in his discussion of faunal districts at the northern terminus of the coastal forest, and he predicted that the Cook Inlet region, of which the area about Iliamna Lake is a part, would merit subordinate status when sufficient knowledge was available.

It should be pointed out that the tundra region of western Alaska extends into the Bristol Bay area only as a narrow coastal belt variously mixed with forested areas and is certainly not necessarily characteristic of the same formation to the north and west. Dice's comment (1943:10) that "Several biotic districts can probably be recognized in the Eskimoan Province." seems quite correct and probably applies equally well to the other provinces, or larger units of classification mentioned here. This subject is discussed somewhat further later on, and a thorough discussion of Alaska's avifauna with reference to biotic districts will be presented in a separate publication.

It can be seen in Figures 1 and 3 that the Iliamna area lies in a zone of transition between those units of major ecological classification in which coniferous forest is the dominant ecologic association (Sitkan Biotic Province or Moist Coniferous Forest Biome, Hudsonian Biotic Province or Coniferous Forest Biome) and those in which tundra (Eskimoan Biotic

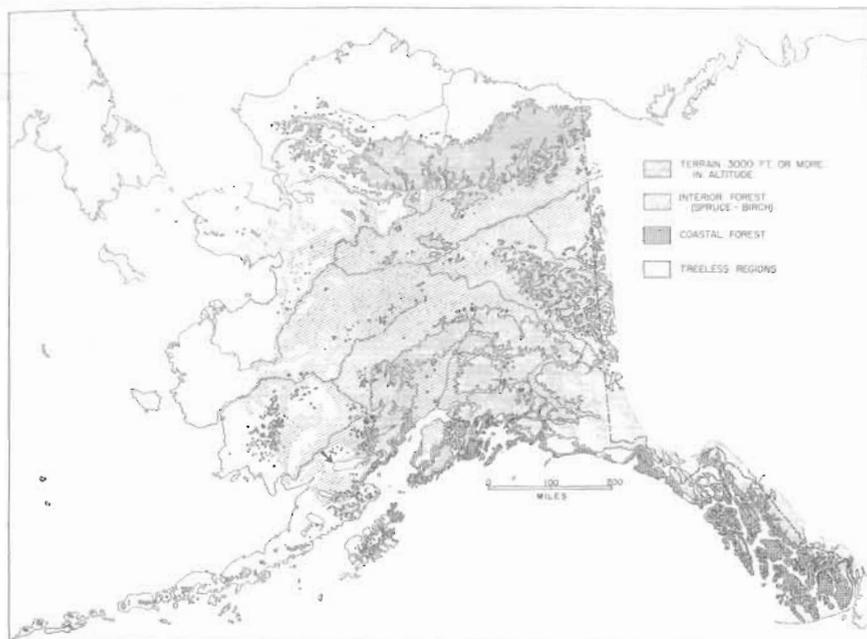


Figure 3. A general vegetation map showing the relationship of the Iliamna area to the forested and treeless regions of Alaska.

Province or Tundra Biome) predominates. An idea of how these units interdigitate may be aided by the following comments. As indicated earlier the coastal areas along Cook Inlet are, in a general way, separated from the Iliamna area by mountains. These uplands do not, however, constitute an effective barrier to the distribution of birds due to the low forested regions in the vicinity of Bruin and Kamishak Bays. The treeless regions (tundra) are continuous with the same regions to the north and west while the most effective connection between the interior of Alaska and the Iliamna area lies along the shores of the Newhalen River, Sixmile Lake, and Lake Clark, an area of continuous forest.

ECOLOGIC FORMATIONS

As in an earlier paper (Williamson, 1957), an attempt has been made to characterize certain ecologic formations and utilize these to analyze the distribution of birds. This was essentially the method of Dice (1920), who was apparently the first to use it in relation to Alaskan birds, and Miller (1951), and brings into focus the importance of the life-form of the plants rather than specific dominants or groups of dominants in making correlations between the presence of certain species of birds and vegetation (Pitelka, 1941). Distinctive features of topography or geology found to influence avian distribution are also discussed and utilized here. The shortcomings of this procedure are at once apparent and have been outlined by Miller (1951), but certain observations regarding our data and the particular region in question seem relevant.

It should be stressed that these formations serve the general purpose of denoting habitat preferences with only a varying degree of success and that they are, at least to some extent, subjectively determined. No fine line of distinction exists between many of them, as each may include a variety of plant associations. For example, in the Iliamna area the vegetation classed as riparian woodland grades from relatively simple stands of low willows through complex riparian assemblages of willow, alder, birch, and cottonwood. The coniferous forest ranges from the loosely spaced spruce woodland to the scattered stands of dense spruce and climax spruce-birch forest. From the standpoint of either the vegetation or the avifauna, realistic points of division often do not exist. The same remark applies equally well in some instances to fresh-water marsh and wet tundra, and for the heath tundra which varies from a formation with a low, mat-like aspect to one with relatively lush vegetation and plants of a shrubby nature. Also in doubt here is the accuracy with which we can report on the habitat preferences of many species of birds, especially those with any tendency to be eurytopic. We were unable to conduct a census program and so could record only in a general way the numbers of individuals of a given species utilizing particular situations.

With these qualifications in mind, we feel that our selection of both ecologic formations, and of the species having an affinity for one or more of these, is reasonably meaningful and useful.

In the following discussion of particular formations, an attempt has been made to indicate the form and species composition (dominants) of the characteristic plant associations and also to mention the distinctive features of topography. The number of species of birds we found in each formation is stated and where possible is followed in parentheses by the number

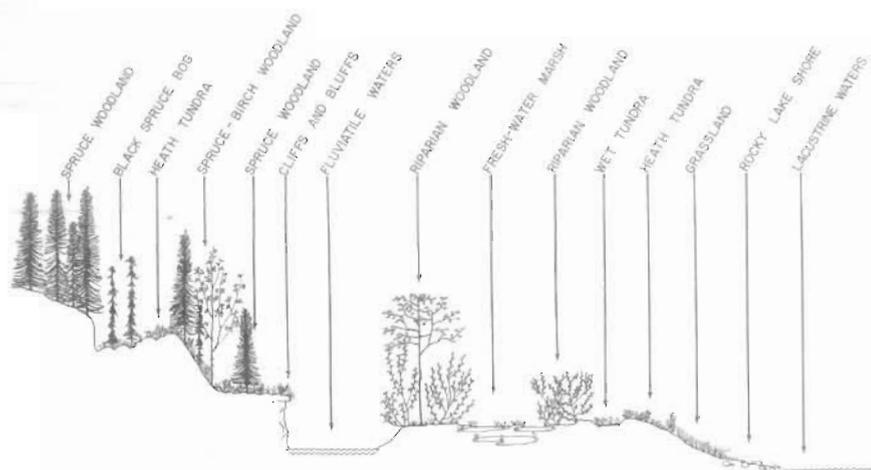


Figure 4. Diagrammatic profile of the Iliamna area showing topography and ecologic formations.

representing the total found by ourselves and others in these formations in the general vicinity of Iliamna Lake. For some formations it was not possible to derive a second total using the previously published accounts. The formations selected (Figure 4) are in part similar to those defined by Dice (1920) and Williamson (1957) and are as follows:

Lacustrine waters	Spruce-birch woodland
Fluviatile waters	Spruce woodland
Fresh-water marsh	Black spruce bog
Wet tundra	Grassland
Heath tundra	Rocky lake shore
Riparian woodland	Cliffs and bluffs

Lacustrine waters: Included here are all non-flowing waters of the area (Figure 5). All of these, Iliamna Lake and the numerous other lakes occurring on the tundra and in the wooded areas, have open surfaces which are essentially free of vegetation. Emergent plants may or may not be prominent along the shore lines. Not included are the many small ponds of the wet tundra or the fresh-water marsh. A total of 31 (33) species of birds was recorded in this formation.

Fluviatile waters: All flowing surface waters are considered parts of this formation (Figure 6). These include the Newhalen River, the many tundra and woodland streams, and the stream margins of sand, gravel, or mud which are usually, if not typically, devoid of vegetation. Fifteen (26) species of birds were recorded in this formation.



Figure 5. Lacustrine water of Iliamna Lake in Bidarka Bay.



Figure 6. Fluvatile water of Newhalen River near Lover's Creek showing border of riparian woodland on the right.

Fresh-water marsh: The marshland of the Iliamna area is very much restricted in extent and cannot be considered an important habitat for many species of birds. It is characterized by standing water with lush emergent vegetation, and seems to consist primarily of old lakes with exposed water in the form of scattered small ponds or openings. Marshy areas were found in the riparian woodland, low places in the heath tundra, and between or bordering tundra lakes of various sizes. The emergent plants of these marshes consist of species of *Carex*, *Equisetum*, and grasses, and in some areas the vegetation forms floating mats. We found only six species of birds in the marsh formation.

Wet tundra: This formation consists of low, generally flat expanses with a variable plant cover, usually less than ankle-high. Small ponds with associated plants such as *Carex* spp., *Eriophorum* spp., and *Juncus* spp., frequently dot this formation, and everywhere it is essentially wet underfoot. The lower areas are often covered with dense moss, while sedges of the genus *Eriophorum* and the heath, *Andromeda polifolia*, are conspicuous. Higher areas or mounds occur in this formation, and on these, woody plants such as *Ledum decumbens*, dwarf birch (*Betula nana*), and *Salix* spp. occur. Wet tundra was found about some of the lakes and was quite generally widespread in the lower country of the area (Figure 7). A total of 12 (13) species of birds was recorded in this formation.

Heath tundra: Heath tundra is widespread in the areas adjacent to Iliamna Lake where it occurs on nearly all the higher, better drained, open areas (Figure 8). The plant cover is, in general, comprised of low, ankle- to knee-high, predominately ericaceous plants. *Ledum decumbens* and *Betula nana* are the taller elements, with *Empetrum nigrum*, species of *Vaccinium*, lichens, mosses, some *Carex* spp., and numerous forbs such as *Pedicularis* spp. Patches of low, shrubby willows occur and occasionally cover a sizable area and reach a height of 4 to 6 feet. White spruce, usually greatly dwarfed or actually prostrate, occurs as scattered individuals. On the higher and better drained areas the vegetation changes markedly, generally to a low mat consisting essentially of *Empetrum nigrum*, mosses, and lichens (Figure 9). The latter actually constitutes a separate plant community, xeric dry tundra, but is so generally scarce, and so consistently associated with heath tundra, that it is included here. Heath tundra broadly interdigitates with spruce woodland (Figure 8) where it becomes decidedly lower in stature and forms the understory vegetation. Fifteen (16) species of birds were found in this formation.

Riparian woodland: As interpreted here, the riparian woodland is of quite variable structure. Along the tundra streams entering Iliamna Lake it is typically composed of willows (*Salix* spp.) up to about 10 feet in



Figure 7. Wet tundra near Iliamna. Cotton sedge (*Eriophorum* spp.) in center, and heath tundra beyond.



Figure 8. Edge of the heath tundra and spruce woodland. Roadhouse Mountain is on the horizon to the left.



Figure 9. Low, mat-like heath tundra with a least sandpiper in foreground.



Figure 10. Dense riparian woodland, principally *Salix* spp.,
bordering Roadhouse Creek.

height, but with small stands consisting of trees several inches in diameter and up to 25 feet high (Figure 10). These willows are frequently underlain with dense grass. A second type of riparian woodland exists in some areas near the shore of Iliamna Lake, where it occurs on moist slopes with numerous rivulets. These stands are also composed essentially of willows but contain as well numerous alders (*Alnus* spp.), cottonwoods (*Populus* sp.), and paper birches (*Betula papyrifera*). This vegetation reaches a greater height generally than the purer stands of *Salix*, is more open beneath, and has a lush understory of grasses. A third and more complex riparian woodland is found along the shores of the Newhalen River and also along Bear Creek and Lover's Creek and other small streams that flow into this large river. Here, willows, alders, and cottonwoods occur mixed with scattered spruces (*Picea glauca*) and birches (*Betula papyrifera*) (Figures 11 and 12). Low willows and alders, mixed with dwarf birch, form a dense understory along many of these stream margins. Frequently the valleys broaden at the mouths of these streams and there *Salix* spp. and *Populus* spp. predominate with an understory of dense grass. It will be noted in the species accounts that some species of birds are found in one, two, or all three of these types of riparian woodland. Twenty-eight species of birds were found utilizing this formation.

Spruce-birch woodland: A dense spruce-birch woodland, in which birch predominates, typically covers the sun-drenched, south-facing hillsides above the stream courses and lowlands (Figures 12 and 13). Here, even in such favorable locations, the forest does not approach in stature that of most stands of the same type in the upper Cook Inlet area or in some parts of the interior of Alaska. The white spruces may exceed 12 to 15 inches in diameter and 30 to 40 feet in height in some stands, but they are usually smaller. The paper birches are generally small, but attain 6 to 10 inches in diameter and as much as 30 to 40 feet in height. They greatly outnumber the spruce component of these mixed woodlands. Understory plants, such as willows and alders, are relatively common in contrast to their general scarcity in a mature forest of this type. In addition to merging with typically riparian elements in the stream valleys, this formation also merges with spruce woodland in the open, exposed flat and rolling areas where both formations may occur, depending on exposure, drainage, and other factors. We recorded 25 (27) species of birds in the spruce-birch woodland.

Spruce woodland: This formation is generally widespread and common on the drier uplands of the area, and consists primarily of white spruce in loosely-spaced, open stands (Figure 8). The understory is a heath-lichen complex with *Ledum decumbens* and dwarf birch abundant and wide-



Figure 11. Riparian woodland mixed with elements of the spruce-birch woodland on Bear Creek. Large trees in the center are cottonwoods.



Figure 12. Aerial view of Lover's Creek, showing heath tundra on the right, riparian woodland in center, and dense spruce-birch woodland on the south-facing hillside to the left.



Figure 13. Aerial view of spruce-birch woodland near Iliamna showing the general, low stature of this formation.



Figure 14. Grassland bordering Schoolhouse Lake.

spread. In some areas, such as along a few of the stream bottoms, and also on some of the uplands, the white spruces occur in fairly compact, dense stands. Along the watercourses, a common understory plant is *Potentilla fruticosa*, while on the uplands an intermixture with birch occurs, often to the extent that an open spruce-birch woodland condition is approached. Nineteen (20) species of birds were recorded in this formation.

Black spruce bog: In two places in canyon bottoms small black spruce (*Picea mariana*) bogs were found, and these were characteristic of at least one type of black spruce bog in a late stage of succession. The trees surround a more or less circular expanse of dense, moist moss and grade in size from the very small innermost ones a few feet in height to larger trees several inches in diameter and up to perhaps 30 feet in height at the periphery. This formation is widespread and significant over much of Alaska, but in our experience is so restricted in amount in the Iliamna area as to be of little or no consequence in influencing the distribution of birds. It is included here for the sake of completeness. We found only one species of bird in the bogs, although others must occasionally occur there.

Grassland: There are no large expanses of what could be properly termed grassland in this area. However, grasses occur in nearly pure stands of limited extent on some of the ridges paralleling Iliamna Lake, along the shores of the Newhalen River, and also beside many of the streams (Figure 14). As already mentioned, grasses also form a lush understory in the riparian woodland, and in those areas where there are widely-spaced cottonwoods or willows, birds with an affinity for grassland may occur abundantly. Grass in these stands may be low in stature although it is commonly knee-high, and not infrequently waist-high. A total of eight species of birds was recorded in the grassland.

Rocky lake shore: In the study area the shore of Iliamna Lake is typically fringed with a relatively broad expanse of rocky shore, variously comprised of large rounded rocks, coarse gravel, or both, and mixed to a varying degree with sand (Figure 15). Intrusions of bedrock are not infrequent and in some places these outcroppings constitute an appreciable amount of the shore line. The lake shores are generally best included with their associated aquatic formation, as has been done with the shores of the lacustrine and fluvial waters discussed earlier. In this case, however, since the rocky shore attracts a wider range of species, primarily for foraging, than is usually associated with other lake margins, we feel that it is best treated separately. We found 23 species of birds utilizing this formation.

Cliffs and bluffs: As parts of this formation we have included all the earth and rock bluffs and cliffs, regardless of their height. They are scattered through the area but occur with the greatest frequency in the form



Figure 15. Expanse of rocky shore of Iliamna Lake in the study area.
Mountains on the horizon are on the opposite shore of the lake.

of low rock outcroppings along the shores of Iliamna Lake and the rapids of the Newhalen River. High earth bluffs with a much reduced plant cover found along the Newhalen River are included here. Only two species of birds were recorded from this formation.

Preferences for one or more formations are shown in Table 1. In the table, primary preference is based on our own observations, although here records from the literature, as cited in the annotated list, also have been used in analyzing ecologic distribution.

TABLE 1. *Continued*

	Lacustrine waters	Fluviatile waters	Fresh-water marsh	Wet tundra	Heath tundra	Riparian woodland	Spruce-birch woodland	Spruce woodland	Black spruce bog	Grassland	Rocky lake shore	Cliffs and bluffs
Greater yellowlegs	++	++			+++	+					++	
Least sandpiper	+			+++		+					++	
Short-billed dowitcher			+++								++	
Northern phalarope	+++			++							++	
Parasitic jaeger		+			+++						++	
Long-tailed jaeger	0	0			0							
Glaucous-winged gull	+++	++			++					++	+	
Herring gull	0	0									0	
Mew gull	+++	++		+	+							
Bonaparte's gull	+++	++						+			++	
Arctic tern	+++	++									+	
Marbled murrelet*	+++											
Great horned owl*						?	?	?				
Hawk owl*							+++					
Great gray owl							?	?				
*Short-eared owl									0			
Boreal owl*							?	?				
Saw-whet owl*						?	?	?				
Belted kingfisher	0											
Hairy woodpecker*							?	?				
Downy woodpecker*							?	?				
Black-backed three-toed woodpecker*							?	?				
Northern three-toed woodpecker								0				
Traill's flycatcher						+++						
Violet-green swallow							++	+				+++
Tree swallow						0		0				
Bank swallow*												?
Barn swallow					0							?
Cliff swallow												+++
Gray jay							+++	++				
Black-billed magpie						0		0				
Common raven						?	?	?				
Black-capped chickadee						0	0					
Boreal chickadee						++	+++					
Robin				0	0	0	0	0			0	
Varied thrush							+++	++				
Hermit thrush						+	++	+++				
Swainson's thrush						+	+++	++				
Gray-cheeked thrush						+++	++					
Arctic warbler*						?						

TABLE 1. *Continued*

	Lacustrine waters	Fluviatile waters	Fresh-water marsh	Wet tundra	Heath tundra	Riparian woodland	Spruce-birch woodland	Spruce woodland	Black spruce bog	Grassland	Rocky lake shore	Cliffs and bluffs
Ruby-crowned kinglet							+++	++				
Water pipit											0	
Bohemian waxwing							+++	+	++			
Northern shrike								+++				
Orange-crowned warbler						+++	++					
Yellow warbler						+++						
Myrtle warbler						+	+++	++				
Blackpoll warbler						+++	++					
Northern waterthrush						+++	++					
Wilson's warbler						+++	++					
Rusty blackbird			0	0		0	0	0			0	
Common redpoll				+		+++	++	++		+	+	
Pine grosbeak*							?	?				
Pine siskin*							?	?				
White-winged crossbill*							?	?				
Savannah sparrow			+	+	++	+				+++	+	
Slate-colored junco							+++	++				
Tree sparrow				+	+++	+	+	+		++	+	
White-crowned sparrow					+++	++	+					
Golden-crowned sparrow					++	+++	+	+		++	+	
Fox sparrow						+++	++					
Lincoln's sparrow						+++		++				
Lapland longspur				++	+++						+	

+++ primary preference

++ secondary preference

+ tertiary preference

0 no preference could be determined

* not observed in 1958-59

ANNOTATED LIST OF SPECIES

The following list includes all of the species we recorded in the area as well as records of occurrence from the literature. Most of the birds we observed are members of the breeding avifauna, although a few were classed as migrants and others are of questionable status. We consider that 81 species were breeding in the area during the time of our study, and that 22 additional species occurring there probably also were breeding birds. Macy Hobson provided useful information on a number of species in this last group which we did not encounter in the area. Neither Hobson nor Osgood made any distinction between the main body of Lake Clark and the lower, constricted portion now known as Sixmile Lake. In the accounts to follow their references to Lake Clark include both lakes. We have included the data from our specimens, all of which were collected in the immediate vicinity of the present settlement of Iliamna unless otherwise indicated. Comments on the taxonomy of these birds are presented below. Subspecific names are provided when identifications could be made from specimens, and both common and scientific names follow the A. O. U. Check-list (1957).

We were not able to conduct censuses and so have little data on abundance. Where possible we made direct counts of individuals seen and, in the case of a number of the less common species, such as the common loon and parasitic jaeger, we believe that our counts were accurate, or nearly so, for the total population in the study area. For other species our records allow the use of a system of rating as to relative abundance using the categories abundant, common, uncommon, and rare. These terms were defined earlier (Williamson, 1957) and are used here with only slight modification. The term "abundant" indicates that the species in question was repeatedly observed or heard in the inhabited formations, with evidence that the available habitat was being heavily, or perhaps fully, utilized. The term "common" denotes that the species was observed on all or nearly all daily field trips, but that some areas of presumed suitable habitat were occupied sparsely or not at all. "Uncommon" indicates merely that the species was not often observed and areas of presumed suitable habitat were not being utilized. The term "rare" indicates that the species normally inhabits the area in extremely small numbers and is not meant to apply to vagrants or seldom-observed migrants. Although this rating system is admittedly unsatisfactory, it is believed to be better than no system at all. Remarks concerning abundance apply to both 1958 and 1959 unless otherwise stated.

COMMON LOON, *Gavia immer*

Considering the small number of common loons seen, in contrast to the

large number of apparently suitable lakes with abundant fishes, this species has been classed as uncommon in the Iliamna area. In 1958, it was not seen in the study area, but in June of that year, several were seen among the islands of Bidarka Bay and the species was considered to be common there. The secluded nature of Bidarka Bay, with heavy forest bordering the many inlets and covering the many islands, seemed to provide the most acceptable nesting area. In 1959, two birds, apparently a pair, were observed repeatedly on a large lake (Pike Lakes) in the spruce forest, and it is believed the birds nested there. Single birds were seen on three other occasions, twice on lakes of moderate size and once on the Newhalen River. Osgood (1904) did not report this species; neither did Hurley (1931) along the Kvichak River, nor Cahalane (1959) in the Katmai Region. On the other hand, Gabrielson (1944) observed that the species was very common along the Kvichak River in 1940, when pairs were seen throughout the day. The same was reported by Lensink for 1959 and 1960. These observations seem to indicate striking fluctuations in the numbers of common loons in the region, as well as local differences. In general, although there are numerous records for the common loon in western Alaska, the evidence indicates that it is an uncommon breeding species west of the spruce forest (Gabrielson and Lincoln, 1959). We obtained no specimens.

ARCTIC LOON, *Gavia arctica pacifica*

The arctic loon was abundant throughout the area on lakes, usually in pairs, and although we observed displaying and other indications of breeding we were unable to locate any nests. Loons were frequently observed foraging in the waters of Iliamna Lake adjacent to smaller lakes where their nests were probably located. Osgood (1904) considered arctic loons to be abundant on the rivers and lakes of the area, as did Gabrielson (1944), while the latter author, Hurley (1931), and Lensink all found it abundant in the Kvichak River and environs. The data for a female taken in the study area in a small bay of Iliamna Lake on June 20, 1959, are: largest ovum 25 mm, one collapsed follicle, light fat, weight 2,152.7 gm.

RED-THROATED LOON, *Gavia stellata*

Recorded only in 1959, when one pair of red-throated loons with two downy young was found on a small pond on the wet tundra. This is the first record for the red-throated loon from the Iliamna area, although Hurley (1931) found one nest on a tundra lake near Bristol Bay, Lensink found it to be a common species on the clear-water portion of the Kvichak

River, and Osgood (1904) saw a few along the Chulitna River. There are scattered records of breeding farther south and east, but the center of the breeding distribution lies far to the north and west.

DOUBLE-CRESTED CORMORANT, *Phalacrocorax auritus cincinatus*

Double-crested cormorants were considered to be common on Iliamna Lake and adjoining smaller lakes, and individuals traveling between Six-mile Lake and Iliamna Lake were frequently observed flying low over the Newhalen River. Osgood (1904) and Gabrielson and Lincoln (1959) reported small nesting colonies on rocky islets in Iliamna Lake. We examined islands of this sort where cormorants were observed and did not find any nests, although one small nesting colony was seen from the air on a rocky island in the rapids of the lower Newhalen River. Lensink saw a few in passage going down the Kvichak River and assumed these were moving from the Iliamna colonies to the Bering Sea. Data for a male taken on July 9, 1959, are: testis 24 mm, no fat, weight 3,206.0 gm.

WHISTLING SWAN, *Olor columbianus* and/or TRUMPETER SWAN, *O. buccinator*.

Whistling and/or trumpeter swans were common nesting birds about the tundra lakes along the northern shore of Iliamna Lake in areas away from sites of human habitation. Groups were seen on two occasions resting on grassy islets at the mouth of the Copper River, in Bidarka Bay. Pairs were seen flying along the shore of Iliamna Lake near our quarters on a few occasions, and a lone individual was reported a number of times on Schoolhouse Lake. Swans have not previously been reported in the Iliamna area, although there are numerous records of occurrence in the surrounding regions. We collected no specimens and so must recognize the possibility that either one or both species were present. The few we saw at close range seemed to us to be *O. columbianus* based on size alone. *O. buccinator* is now known to nest as nearby as the Kenai Peninsula.

CANADA GOOSE, *Branta canadensis*

A special effort was made to find geese, but none were seen. Nonetheless, Macy Hobson assured us that Canada geese have nested on islands in Iliamna Lake. There are no records of Canada geese for this area and Hurley (1931) failed to find them about the head of Bristol Bay or along the Kvichak River. In contrast, Lensink reported that he saw flocks commonly along the Kvichak River in summer; there was no evidence of nesting. We assume that *B. c. taverneri* would be the race nesting in this area since it nests in the upper Cook Inlet region, where it intergrades with *B. c. occidentalis*, the race of Prince William Sound.

MALLARD, *Anas platyrhynchos*

The mallard was considered to be an uncommon breeding species, and was seen principally on tundra lakes and ponds; females were seen on the wet tundra where limited nesting probably takes place. Pairs were seen both years, and females with broods of young were found on two occasions in 1959. The first was a female with an undetermined number of young, seen as they worked their way along a grassy island in the Copper River. Some of these ducklings were seen to ride on the back of the female. The second brood was seen on a small tundra lake where Peyton observed a peregrine falcon capture one of the young. Mallards have not previously been reported in this area; Hurley (1931) and Lensink found them to be uncommon along the Kvichak River.

PINTAIL, *Anas acuta*

Even less abundant than the mallard, the pintail was considered to be uncommon. In 1958, a total of five was seen on three days, and one female appeared to be nesting in a marshy area with dense emergent vegetation. More were seen in 1959, including two females with five young each. With the one exception mentioned above, pintails were seen only on lakes. This is the first record of the species for this area, although Hurley (1931) and Lensink found them to be common to abundant nesting birds along the Kvichak River.

GREEN-WINGED TEAL, *Anas carolinensis*

Only three green-winged teal were seen, two in 1958 and one in 1959. Two were on lakes and one was on the Newhalen River. Breeding probably occurs here, although we found no evidence for this. Osgood (1904) saw only one in the area, on the Newhalen River, but both Gabrielson (1944) and Hurley (1931) reported teal as abundant along the Kvichak River. They are known to breed commonly farther west on the Alaska Peninsula (Cahalane, 1959; Gianini, 1917; Gabrielson and Lincoln, 1959).

AMERICAN WIDGEON, *Mareca americana*

We found only three widgeon, one lone male and one pair, all on lakes in the study area in 1959. If this duck breeds here, it does so very uncommonly. This is the first record for the area and other reports indicate that this species is rare to the west of Iliamna Lake.

SHOVELER, *Spatula clypeata*

We observed shovelers only on June 8, 1958, when possibly eight or ten were seen about the mouth of Copper River, Bidarka Bay. There are no

other records for this area or for the Kvichak River, and other reports indicate that the species is rare to the west of Iliamna Lake. Macy Hobson informed us that the shoveler has been appearing regularly along the Chulitna River only in recent years, indicating a possible range extension or decided change in local abundance.

GREATER SCAUP, *Aythya marila nearctica*

The greater scaup was considered common, and singles, or more usually pairs, were seen on many of the lakes and on the grassy shores of the rocky islands in Iliamna Lake. No nests were found, but some eggs collected by one of the local people were believed to belong to this species. The nest was located in the grassy margin of an island. Osgood did not mention scaup, but Hurley (1931), Gabrielson (1944), and Lensink all found this duck breeding commonly along the Kvichak River, and they are also common farther west on the Alaska Peninsula (Gabrielson and Lincoln, 1959). A male was taken on June 3, 1959; testis 30 mm, moderate fat, weight 955.5 gm.

COMMON GOLDENEYE, *Bucephala clangula*

The common goldeneye was seen on lakes once in 1958 and twice in 1959 and was regarded as uncommon. All of these birds were females and identification, based on bill color alone, must be considered tentative. There are no other records for the Iliamna area, although Macy Hobson claims familiarity with this species.

BARROW'S GOLDENEYE, *Bucephala islandica*

One pair of Barrow's goldeneyes was seen about a small island in Iliamna Lake in 1959. Osgood (1904) reported this species from the Newhalen River and saw it commonly later in his trip on the Nushagak River drainage.

HARLEQUIN DUCK, *Histrionicus histrionicus*

Harlequin ducks were common along the Newhalen River from Iliamna Lake to Sixmile Lake, and one occasionally was seen on Iliamna Lake. We often saw small assemblages of mixed sexes, and only rarely solitary birds or pairs. Osgood (1904) did not find the harlequin duck, although there can be no doubt that this is a common breeding species in the area at the present time. Even though Hurley (1931) failed to find them, Lensink saw harlequin ducks occasionally along the Kvichak River and frequently along the small clear-water streams throughout the Bristol Bay area. They are abundant to the west on the Alaska Peninsula (Gianini, 1917) and Aleutian Islands (Murie, 1959).

WHITE-WINGED SCOTER, *Melanitta deglandi dixonii*

White-winged scoters were common on the lakes and were frequently seen in pairs. Even though there are no other records of this species for this area, we believe that the birds were breeding there. Lensink found them to be common on the Kvichak in small flocks, but there was no evidence to indicate breeding, and Hurley (1931) did not see white-winged scoters at all. Cahalane (1959) reported a female and one young in Katmai National Monument, and there are numerous other records for nearby areas, especially for the coastal waters. These records, with the exception of Cahalane's, relate to non-breeding and migrant birds. Data for a male collected on June 14, 1959, are: testis 16 mm, light fat, weight 1,436.9 gm.

SURF SCOTER, *Melanitta perspicillata*

The surf scoter was considered uncommon since it was seen only on June 18, 1959, when two pairs were found on Sucker Lake. The birds were foraging, and both of the males were heard whistling and observed displaying before their respective females. The nearest known breeding locality is slightly north of Bristol Bay on Lynx Lake (Gabrielson and Lincoln, 1959). Osgood (1904) did not find this scoter, but individuals have been seen in nearby localities; Gabrielson saw four males on the Kvichak River on July 23 (1944), and Lensink reported them as the least common of the three species of scoters present along the Kvichak River and believed them to be non-breeding birds.

COMMON SCOTER, *Oidemia nigra americana*

Common scoters were seen only twice in 1958, although they were commonly observed in 1959, usually in pairs. They were seen most frequently on small lakes adjacent to Iliamna Lake and were occasionally seen on the larger lake. It seems quite certain that this scoter breeds in the area, as Osgood (1904) reported females with young on small lakes near Lake Clark and also on the Chulitna River. Hurley (1931), Gabrielson (1944), and Lensink found them to be common along the Kvichak River where Gabrielson, at least, saw several broods of young. A male was collected on June 14, 1959; testis 34 mm, moderate fat, weight 1,446.6 gm.

RED-BREASTED MERGANSER, *Mergus serrator serrator*

The red-breasted merganser was abundant in the area and was the most commonly observed anatid. They occurred usually in pairs but often in small flocks on Iliamna Lake, on smaller lakes, and were seen somewhat less frequently on the Newhalen River and other large streams. A female was found incubating nine eggs in a nest hidden in dense grass beneath

a willow beside Iliamna Lake on May 30, 1958. A female with a brood of young was observed on a nearby swift, rushing stream, Talarik Creek, on June 20, 1959. Osgood (1904) also found red-breasted mergansers in abundance in the area, and Gabrielson (1944) saw over 50 broods along the Kvichak River on July 23. In the same area Lensink found the species to be common and located four nests containing eight, nine, ten, and ten eggs, respectively, on Kaskanak Flats on June 19. These eggs were judged to be in middle and late stages of incubation. This is a somewhat changed situation since 1930, when Hurley (1931) reported the species as uncommon and found no evidence of breeding. Data for a male taken on June 3, 1959, are: testis 49 mm, heavy fat, weight 1,099.2 gm.

GOSHAWK, *Accipiter gentilis*

We did not observe goshawks in the study area, although they probably occur there in small numbers. Osgood (1904) observed one at Iliamna Pass and several at the mouth of the Chulitna River on Lake Clark. Macy Hobson reported that goshawks occur about Lake Clark, and Lensink saw one along the upper Kvichak River. We observed one flying over the Nushagak River and adjacent riparian woodland at the village of Ekwok. We regard this hawk as rare in the Iliamna area.

SHARP-SHINNED HAWK, *Accipiter striatus*

Macy Hobson reported that the sharp-shinned hawk occurs in the vicinity of Lake Clark. There are no other records for the Iliamna Lake area, although it has been recorded as far west as Brooks Lake in the Katmai National Monument (Cahalane, 1959).

ROUGH-LEGGED HAWK, *Buteo lagopus*

Single rough-legged hawks were seen on two occasions at Iliamna and once at Ekwok, all in 1958. Osgood (1904) found a pair and two young able to fly on an islet in Lake Clark; he also saw this species at the mouth of the Chulitna River. It should be classed as an uncommon to rare breeding species in this area, although it occurs commonly farther to the west (Murie, 1959).

BALD EAGLE, *Haliaeetus leucocephalus*

The bald eagle was common and we saw nearly as many juveniles as adults. They were seen most frequently along the Newhalen River, although they foraged about the margins of the lakes as well. One pair had a nest located in a tall spruce tree on a hillside above a bay in Iliamna Lake near the mouth of the Copper River. One young bird was seen

near Sixmile Lake. Surprisingly, Osgood (1904) found bald eagles to be uncommon; only one was seen about Iliamna Lake and only five on his entire journey through the base of the Alaska Peninsula. Gabrielson (1944), Hurley (1931), and Lensink all reported this species as common in the Kvichak River-Bristol Bay region.

MARSH HAWK, *Circus cyaneus*

Marsh hawks were seen only in 1959 when they were observed on four different occasions over both wet and heath tundra. Possible indications of nesting include observations of a pair foraging together and one of a female chasing a peregrine falcon (See below.) over the tundra, returning to the starting location, and circling and calling loudly for an extended period of time. There are no other records for the Iliamna area, although Osgood (1904) observed them commonly along the Chulitna River, and Lensink reported them as common about Bristol Bay.

OSPREY, *Pandion haliaetus*

In 1958, a single osprey was seen soaring overhead near the mouth of the Newhalen River. In 1959, one other was seen foraging at a small lake near Iliamna, and a much alarmed bird was seen at a nest near Nondalton on Sixmile Lake. The nest, situated about 25 feet above the ground, was in a spruce tree in a grove of cottonwoods (*Populus* sp.). These were generally taller than the nest-tree. The contents of this nest were not determined. Osgood (1904) found ospreys more common, occurring along all the stream courses he visited. He found one nest on the Newhalen and several on the Chulitna River; all of these nests were in the tops of live spruce trees near the banks of the streams. Gabrielson (1944) saw only one of these hawks about Iliamna Lake, and Hurley (1931) and Lensink did not observe any along the Kvichak River or about Bristol Bay. Osgood's report seems to indicate that the population density fluctuates, although his route along the watercourses would have increased the probability of observing ospreys. Gabrielson and Lincoln (1959) have remarked that they believe the Bristol Bay region is the center of distribution for ospreys in Alaska.

GYRFALCON, *Falco rusticolus*

Cade (1960) indicated that the Iliamna area is well within the known breeding range of the gyrfalcon, and he listed a breeding station on Iliamna Lake. We have been unable to find any other reference to this record. We did not observe gyrfalcons in the area, and Macy Hobson told us he was not familiar with this species. There are records of occurrence for the Bristol

Bay region, Kodiak, and the Alaska Peninsula (Gabrielson and Lincoln, 1959).

PEREGRINE FALCON, *Falco peregrinus*

A peregrine falcon was seen only on June 25, 1959, when Peyton observed one making a succession of dives over a small pond in the wet tundra. This activity was terminated when the falcon, over the loud protestations of a female mallard, took a young duck from the water and flew from view over the tundra into an area of tundra and spruce woodland. There are no other records of peregrine falcons for the Iliamna area, although Lensink saw one on Kvichak Bay at Copenhagen Creek. The species is common to abundant to the south and west.

PIGEON HAWK, *Falco columbarius bendirei*

Peyton observed a pigeon hawk on June 9, 1958, in spruce-birch woodland along the Copper River. This individual apparently was alarmed by the pair of bald eagles near the nest mentioned earlier, and dived on these birds. Osgood (1904) collected one (USNM 184053) and saw another along the Newhalen River, and he observed them commonly along the Chulitna River. There are no other records for this area, although the species occurs to the south and rarely to the west.

SPRUCE GROUSE, *Canachites canadensis atratus*, *C. c. atratus* × *osgoodi*

We did not observe spruce grouse although they are numerous in the area in some years. Osgood (1904) apparently passed through the Iliamna area when the grouse were at a cyclic high, and he found them to be common about Iliamna, the Newhalen River, and abundant at Lake Clark. Anita Mize has observed this species commonly and has sent us several specimens, and we had the opportunity of examining Osgood's specimens. They have not been seen in the Bristol Bay region, although they were found in Katmai National Monument in 1940, 1953, and 1954 by Cahalane (1959). Our specimens, all collected in the spruce-birch woodland a few miles north of Iliamna Lake, include three adult males, two taken in September of 1959, and one taken in September of 1960.

WILLOW PTARMIGAN, *Lagopus lagopus alexandrae*

We did not observe willow ptarmigan, and since local residents considered them to be common, we presumed them to be at a low point in numbers. Both Osgood (1904) and Gabrielson (1944) saw willow ptarmigan commonly in the tundra formations about Iliamna Lake, and they collected specimens which are in the National Museum. Gabrielson has identified

these birds as belonging to the race *alexandrae*. Hurley (1931) also found this species generally distributed on the tundra along the Kvichak River and found one nest on May 29. Lensink likewise regarded them as common about Kvichak Bay and found one nest at Copenhagen Creek on June 7.

ROCK PTARMIGAN, *Lagopus mutus*

We were unable to visit the mountains in the area and so had no opportunity to observe rock ptarmigan. Osgood (1904) found rock ptarmigan in the mountainous area near the head of the Chulitna River, and Macy Hobson stated that he had also seen them in the mountains about Lake Clark. They undoubtedly occur in this area wherever there is suitable habitat.

WHITE-TAILED PTARMIGAN, *Lagopus leucurus*

Osgood (1904) was informed by a native that white-tailed ptarmigan occur about Lake Clark, and we were told the same by Macy Hobson. Gabrielson and Lincoln (1959) also reported a sight record from this vicinity. As far as is known, this appears to constitute the westernmost occurrence of this species.

SEMPALMATED PLOVER, *Charadrius semipalmatus*

Sempalmated plovers were common in pairs found spaced out along the gravelly shores of Iliamna Lake. They were not seen along the margins of other lakes or along any of the streams. One nest with four eggs was found in a grassy area among rocks on June 3, 1959, and another with four eggs was found on the open beach of fine gravel on May 27, 1958. A pair with four downy young was seen on June 16, 1959. There are no other records from this area, although Hurley (1931) found them nesting at the head of Bristol Bay. The data for a pair collected on May 24, 1958, are: male, testis 9 mm, moderate fat, weight 42.6 gm; female, largest ovum 19 mm, heavy fat, weight 64.1 gm.

AMERICAN GOLDEN PLOVER, *Pluvialis dominica*

Golden plovers were seen on only one day, May 24, 1958, when three different individuals were observed foraging along the rocky lake shore. Gabrielson and Lincoln (1959) and the A.O.U. Check-list (1957) report the Kuskokwim River as the approximate southern extent of the breeding range of the golden plover, although Hurley (1931) found four pairs in close proximity and one nest on June 2 at the head of Bristol Bay. It seems likely that these plovers nest somewhere in the vicinity of Iliamna Lake.

BLACK-BELLIED PLOVER, *Squatarola squatarola*

We observed individual black-bellied plovers on three occasions in 1958 and once in 1959. They were foraging along the gravelly shore of Iliamna Lake, the sandy margin of Schoolhouse Lake, and at the edge of the wet tundra. Macy Hobson reported to us that he has been familiar with these birds for many years and that they nest very sparingly on the dry upland tundra near Iliamna Lake. The nearest known breeding locality is along the Johnson River, 30 miles west of Bethel (Walkinshaw, 1948). We collected one male on May 26, 1958: testis 12 mm, well developed incubation patches, light fat, weight 226.7 gm.

SURFBIRD, *Aphriza virgata*

Surfbirds were seen only along the rocky and gravelly shore of Iliamna Lake, and when flushed they would fly over the open heath tundra areas. The earliest seen were on May 30, 1958, and the latest on June 13, 1959. Three of the total of five observations made during the two years were of groups of birds of up to five in number. These records indicate that the birds were migrants, although it does seem to us very likely that surfbirds nest in the vicinity of Iliamna Lake. This assumption is borne out by the data for a male collected on May 30, 1958: testis 15 mm, well developed incubation patches, heavy fat, weight 176.5 gm.

BLACK TURNSTONE, *Arenaria melanocephala*

In 1958 single black turnstones were seen on three occasions between May 25 and June 4, foraging along the rocky lake shore. Osgood (1904) collected one and observed another on an islet in Lake Clark. Hurley (1931) did not report this species as occurring about the head of Bristol Bay or along the Kvichak River. Gabrielson (1944), on the other hand, reported it as common the length of that river, usually in groups of four to six. This last observation may indicate a migratory movement only, and the general opinion that this species nests only in coastal areas seems valid. Lensink found black turnstones abundant on the marshes and mud flats of Kvichak Bay, and he found a nest with two young on the upland tundra at Copenhagen Creek on June 16, and another with four young at Kaskanak Flats on June 19. The following data for our two specimens, taken in 1958, indicate breeding on Iliamna Lake: May 25, male, testis 11 mm, well developed incubation patches, moderate fat, weight 107.0 gm; June 4, female, largest ovum 3 mm, collapsed follicles, well developed incubation patches, moderate fat, weight 126.8 gm.

COMMON SNIPE, *Capella gallinago delicata*

Snipe were uncommon and were seen only three times (two pairs included) in 1958, and five times in 1959. In nearly all cases the birds were flushed from marshy areas in the heath tundra and riparian woodland, or from the lake margins. They were seen and heard winnowing overhead as well. Osgood (1904) did not report snipe from about Iliamna Lake, and both Hurley (1932) and Lensink report them to be uncommon about Bristol and Kvichak Bays, respectively. We believe that common snipe nest sparingly in the area. Data for a male collected at Iliamna on June 17, 1959, are: testis 17 mm, incubation patches, light fat, weight 98.4 gm.

SPOTTED SANDPIPER, *Actitis macularia*

The spotted sandpiper was common along the Newhalen River, where a nest containing four eggs was found on June 10, 1959. This nest was located fully 75 feet from the water on a partially grass-covered hillside at the edge of the open spruce woodland. Individual birds were also seen along the Copper River and the Nushagak River. This species has not been reported as occurring in the Bristol Bay or Kvichak River region, and ours is the only record of occurrence for the Iliamna area. Osgood (1904) reported a flock of about ten on the gravelly shore of Lake Clark on July 25; these were probably early fall migrants.

WANDERING TATTLER, *Heteroscelus incanum*

We saw tattlers only in 1958, when three different individuals were observed. On May 31, one was seen displaying and heard calling over the Kvichak River and associated gravel bars at Igiugig on Iliamna Lake; this observation indicates breeding. The other two were seen on May 28 and June 4 foraging on the rocky lake shore at Iliamna. Gabrielson reported seeing birds of this species on both June 24 and 26 on the shore of the lake, although Osgood (1904) did not see any along his route. There are numerous records of occurrence of wandering tattlers farther west on the Alaska Peninsula and Aleutian Islands. Data for a female collected at Iliamna on May 28, 1958, are: largest ovum 3 mm, heavy fat, weight 125.9 gm.

GREATER YELLOWLEGS, *Totanus melanoleucus*

This abundant shorebird was observed in a variety of habitats including heath tundra (overhead calling), foraging along the rocky lake shore, the borders of the Newhalen River, Copper River, and Lover's Creek. They were also seen on the marshy shores of several small lakes and in wet boggy areas with small trees. Nests were thought to be located in the latter habi-

tat. Osgood (1904) reported seeing the greater yellowlegs on two occasions near Iliamna Lake, and records from the Kvichak River and Alaska Peninsula are numerous. Data for two males collected in 1958 at Iliamna Lake and Bidarka Bay are, respectively: June 4, testis 14 mm, well developed incubation patches, moderate fat, weight 171.8 gm; June 11, testis 12 mm, moderate fat, weight 164.3 gm.

LEAST SANDPIPER, *Erolia minutilla*

The abundant least sandpiper was commonly observed foraging along the rocky lake shore, the gravelly and sandy border of the Newhalen River, and once in a boggy area in the riparian woodland. Nesting seemed to be principally on the wet tundra, where spacing of pairs was evident and singing and display were observed. A nest containing four well-incubated eggs was found in this habitat on June 13, 1959. Apparently these sandpipers also nest occasionally in more upland areas, such as heath tundra mixed with scattered spruce. In such an area an alarmed pair was observed on June 15, 1959, and in open dry heath Peyton banded four downy young attended by their parents on June 24, 1959. Osgood (1904) saw one bird between Lakes Iliamna and Clark and a few others at Lake Clark. He was apparently too late to see them in abundance, although lateness of the season may not have been the reason, as Gabrielson (1944) failed to find them at all. Hurley (1932) found them widely distributed and nesting about the head of Bristol Bay, and the Alaska Peninsula is generally regarded as at or near the point of greatest breeding density in Alaska (Gabrielson and Lincoln, 1959). Nonetheless, Lensink failed to find this species. There is little doubt that there are striking year to year fluctuations in density of the breeding population of least sandpipers throughout the Iliamna-Alaska Peninsula-Bristol Bay region. Data for a male taken on May 25, 1958, are: testis 7 mm, incubation patches, moderate fat, weight 21.4 gm.

SHORT-BILLED DOWITCHER, *Limnodromus griseus caurinus*

We observed dowitchers on only three occasions: May 26, 1958, and June 4 and 15, 1959. The first two were foraging along the shore in a shady area where a small stream entered Iliamna Lake, and the last was flushed from a fresh-water marsh. Although short-billed dowitchers are very uncommon at the present time in the Iliamna Lake area, Hurley (1932) found them second in numbers only to the northern phalarope along the Kvichak River, where they nested in the marshes and about tundra pools. Lensink regarded them as the most common shorebirds nesting on the marshes of Kvichak Bay, and a specimen he collected was examined.

Data for our specimen, a female collected on June 15, 1959, yielded evidence of nesting: largest ovum 5 mm, four collapsed follicles, oviduct enlarged, incubation patches, light fat, weight 105.7 gm.

NORTHERN PHALAROPE, *Lobipes lobatus*

The northern phalarope was not seen in 1958, but in 1959 it was a common bird of the tundra and taiga pools; two pairs were also seen in a freshwater marsh surrounding one of the lakes. There is no other record for the Iliamna area, although Hurley (1932) and Lensink both found it commonly on tundra pools along the Kvichak River. We collected an adult and a downy young bird, both males, from a small pond on the wet tundra on June 25: testis 4 mm, incubation patches, light fat, weight 29.4 gm; testis minute, yolk sac present, no fat, weight 3.9 gm.

PARASITIC JAEGER, *Stercorarius parasiticus*

Parasitic jaegers were moderately common and individuals were seen flying over the heath tundra, the Newhalen River, and resting along the rocky shore of the lake. In 1959, four pairs were located and two nests were found. The first contained two fresh eggs on June 7 and was situated in a moist, mossy depression in the heath tundra near Schoolhouse Lake. The nest and the male were collected on June 9, and nine days later another pair, consisting of one melanistic and one light-colored individual, was present in the same area. A third pair and the second nest were found on June 25 in an area of low, wet tundra. The nest depression contained only fragments of shell. The adults were very much alarmed by our presence, but our search for young birds was not successful. There are no other breeding records for the Iliamna area, although Gabrielson (1944) found a pair with two young on a gravel bar in the Kvichak River, and both Hurley (1931) and Lensink considered the birds as abundant in the tundra areas bordering that river. The data for the male collected on June 9 are: testis 13 mm, incubation patches, moderate fat, weight 437.0 gm.

LONG-TAILED JAEGER, *Stercorarius longicaudus*

The long-tailed jaeger was seen only once, in 1959, when one was attracted to the disturbance created by nesting parasitic jaegers. Osgood (1904) saw a single bird on Iliamna Lake and Hurley (1931) reported a pair seen on June 6 along the Kvichak River. Hurley stated that the birds he saw were dark phase, a puzzling remark since no dark phase is known for this species. Possibly he observed dark immature birds, or perhaps there was some confusion with the parasitic jaeger. Long-tailed jaegers are apparently uncommon throughout the Bristol Bay area and there are

no records of nesting. Macy Hobson stated that they nest in the mountains of this region. Data for our specimen are: immature female, largest ovum 3 mm, oviduct enlarged, no incubation patches, no collapsed follicles, heavy fat, weight 306.4 gm.

GLAUCOUS-WINGED GULL, *Larus glaucescens*

Glaucois-winged gulls were abundant on Iliamna Lake and the Newhalen River. They were occasionally seen foraging along the rocky lake shore, and they nested in abundance on islands in Bidarka Bay. The nests were situated in grassy areas and in heath tundra, somewhat elevated above the usual rocky margins of these islands. The colonies are generally known and regularly visited by local people for purposes of egg collecting, and it seems doubtful that the birds are very successful in the breeding effort. Osgood (1904) found glaucois-winged gulls abundant in the area as did Gabrielson (1944). Data for a male taken on June 7, 1959, are: testis 18 mm, incubation patches, no fat, weight 1,390.2 gm.

HERRING GULL, *Larus argentatus*

In 1958 we saw two herring gulls resting on the lake shore and several along the Newhalen River. In 1959 several were seen on Sixmile Lake, and it is thought that they probably breed in this vicinity. Since there are no other records for this area, and since Hurley (1931) and Lensink failed to see any of these gulls about the Kvichak River or Bristol Bay, Gianini's (1917) report that this bird was abundant and nested on the Alaska Peninsula at Steповak Bay is puzzling. Other reports indicate only occasional straggling to the Aleutian Islands and Alaska Peninsula (Murie, 1959; Cahalane, 1959).

MEW GULL, *Larus canus brachyrhynchus*

We found mew gulls to be common on the Newhalen River, Iliamna Lake, Sixmile Lake, and numerous smaller lakes in the area. Osgood (1904) saw only one on Iliamna Lake and Gabrielson (1944) saw none. Lensink considered this to be the most common gull in the Bristol Bay region and along the Kvichak River. His interesting and valuable comments on this species are quoted below.

Adult birds were frequently seen with nesting material in their beaks on May 20 and by June 7 most of all clutches appeared to be completed. The first young were found on June 13 and the peak of the hatch occurred on June 16 and 17. A second, small series of eggs which may represent a re-nesting were [*sic*] a week or more behind the initial peak. The short-billed gull population on Kvichak River is believed by Archie Mossman to be considerably below that of previous years. The smaller number of birds this year was

particularly noticeable at Egg Island [,] where intensive egging by Igiugig natives may be destroying the colony, and in counts of birds passing along the river at Levelock.

Hurley also called this gull the most common one in the Bristol Bay region, and colonies of up to 100 pairs were found nesting on the small tundra lakes. We found no actual evidence of nesting in our study areas, although the presence of the nearby colonies makes this seem likely. Our only specimen, a female taken on May 30, 1958, judging from tail spotting, is a third-year bird: largest ovum 3 mm, oviduct little enlarged, light fat, weight 330.1 gm.

BONAPARTE'S GULL, *Larus philadelphia*

Immatures and adults of the uncommon Bonaparte's gull were seen on Iliamna Lake and its margins. We found no evidence of nesting, but Osgood (1904) saw two birds together, and Gabrielson (1944) saw two young just learning to fly on the lake on July 26. Hurley (1931) found small colonies of four pairs nesting on wooded islets of burned spruce in the upper Kvichak River, and Lensink saw only a few along that river. Data from a male collected on June 9, 1959, are: testis 13 mm, no fat, weight 200.1 gm.

ARCTIC TERN, *Sterna paradisaea*

Arctic terns were abundant on Iliamna Lake, along the Newhalen River, and on Sixmile Lake. They nested in large numbers on the gravelly shore of a small island near Iliamna in both years, and many eggs were found here on June 3, 1959. Lensink found the majority of eggs in the Kvichak River area were pipped on June 20. On July 16, Osgood (1904) found the birds to be uncommon on Iliamna Lake, but many other records indicate general abundance throughout this area. Data for a pair collected at Iliamna on June 3, 1959, are: male, testis 11 mm, incubation patch, light fat, weight 111.3 gm, and female, largest ovum 4 mm, two collapsed follicles, incubation patch, light fat, weight 116.8 gm.

MARBLED MURRELET, *Brachyramphus marmoratum marmoratum*

Gabrielson (1944) saw a number of marbled murrelets at the head of Iliamna Lake on July 27 and collected one of these in breeding plumage. This is an extremely interesting record, and this species should be looked for again in this area.

OWLS. The fact that we saw only one species of owl (*Asio flammeus*) in this area is probably due to our inability to visit heavily wooded areas dur-

ing periods of darkness, to the lateness of the season, and to the possible general scarcity of these birds. The following brief accounts based on the literature and on reports from Macy Hobson indicate that a number of species of owls occur regularly.

GREAT HORNED OWL, *Bubo virginianus*

Osgood (1904) heard a great horned owl at Old Iliamna, and Macy Hobson informed us that it occurs at Lake Clark. It is probably well distributed throughout the wooded country.

HAWK OWL, *Surnia ulula*

Osgood (1904) took an immature hawk owl in the thick woods at Lake Clark and Macy Hobson reported that he has seen birds of this species in the same area.

GREAT GRAY OWL, *Strix nebulosa*

Macy Hobson stated that he has seen the great gray owl at Lake Clark.

SHORT-EARED OWL, *Asio flammeus*

On June 8, 1959, we saw one short-eared owl flying over an open grassy area at the edge of the riparian woodland at Iliamna. This is the only record for the Iliamna area, although Lensink found it commonly about Bristol Bay.

BOREAL OWL, *Aegolius funereus*

Macy Hobson informed us that he has found boreal owls generally distributed in the wooded country of this area.

SAW-WHET OWL, *Aegolius acadicus*

We are inclined to accept Macy Hobson's very definite statement that the saw-whet owl occurs at Khakonak Bay, at Lake Clark, and along the Chulitna River. The authors have found it in the upper Cook Inlet region and there seems little reason to doubt a still farther westward extension of the range.

BELTED KINGFISHER, *Megaceryle alcyon*

We saw one kingfisher on May 23, 1958, flying across a narrow strip of land along the shore of Iliamna Lake. He passed out of view over a smaller lake. We also saw two over the Nushagak River at Ekwook on June 12, 1958. We were surprised that this species was otherwise absent from the area, especially from the bluffs along the Newhalen River. Both Osgood (1904)

and Gabrielson (1944) saw none in the Iliamna area, and neither Hurley (1931) nor Lensink saw kingfishers along the Kvichak River.

HAIRY WOODPECKER, *Dendrocopos villosus*

DOWNY WOODPECKER, *Dendrocopos pubescens*

BLACK-BACKED THREE-TOED WOODPECKER, *Picoïdes arcticus*

Macy Hobson reported that these three species of woodpeckers occurred about Lake Clark, albeit sparingly. He mentioned that *P. arcticus* was the rarest of the three.

NORTHERN THREE-TOED WOODPECKER, *Picoïdes tridactylus fasciatus*

We found only one northern three-toed woodpecker, at Sixmile Lake, where a male was observed and collected on June 22, 1959, in dense black spruce woodland as he carried food to young. Data for this specimen are: testis 6 mm, no fat, weight 57.4 gm.

TRAILL'S FLYCATCHER, *Empidonax traillii*

Traill's flycatcher was uncommon in the study area. One was heard singing on June 7, 1958, in the riparian woodland along Roadhouse Creek, and on June 17 of the following year one was heard in the same locality. On June 20, 1959, several were heard singing and were seen in the riparian woodland along Talarik Creek, a short distance west of Iliamna. They were regarded as common about Sixmile Lake in the spruce-birch woodland and in the low successional stages leading to this type of forest.

VIOLET-GREEN SWALLOW, *Tachycineta thalassina lepida*

Violet-green swallows were abundant and were seen foraging overhead in each of the different ecologic formations. They nested in boxes provided by the Walkers, and competition with tree swallows for these sites seemed to be keen. We believe that these swallows were nesting in crevices in the rocky cliffs on the Newhalen River, where we observed them in both years. They probably also nested in cavities in trees, for we observed them over the woodland at Copper River where no other suitable nesting sites were seen. Osgood (1904) found these birds to be common about Iliamna Lake and Lake Clark, and Hurley (1932) and Lensink reported them to be common along the Kvichak River. In the latter locality, these swallows apparently resort entirely to man-made nesting sites. We collected one specimen on June 7 of each year, and data for these are: female, largest ovum 9 mm, egg in the oviduct, one collapsed follicle, incubation patch, heavy fat, weight 20.8 gm; male, testis 10 mm, light fat, weight 15.6 gm.

TREE SWALLOW, *Iridoprocne bicolor*

Tree swallows occur in at least equal, and possibly greater numbers than the preceding species. They were observed foraging over all of the formations and nested in a variety of situations, including boxes provided by the local people, a dead spruce stub by Lover's Creek, and in a cavity in a living birch tree in riparian woodland. Osgood (1904) saw only a few at Old Iliamna on July 13-15, and Gabrielson (1944) saw one at Iliamna on July 24. None was seen by Hurley (1931, 1932) along the Kvichak River, but Lensink reported them as common in that area at the same time of year. This would seem to indicate a recent extension of range or recent increase in abundance. Aerial foraging, as well as flexibility in the sorts of nesting crevices selected, probably are attributes which foster rapid range extension by this and the violet-green swallow. We collected one male on June 7, 1959: testis 11 mm, light fat, weight 23.2 gm.

BANK SWALLOW, *Riparia riparia*

The bank swallow has not been recorded from the Iliamna area, and Hurley (1931, 1932) saw none along the Kvichak River. Lensink, however, considered them to be common in the same area. We found bank swallows only at Ekwok where they were foraging over the river and adjacent riparian woodland.

BARN SWALLOW, *Hirundo rustica*

Peyton saw one barn swallow on June 12, 1959, flying over the heath tundra. This swallow has an interesting history in this area, judging from the fragments of information available to us. Osgood (1904) considered it a common breeding species about Iliamna Lake, and Macy Hobson states that this was true until about 1925 when cliff swallows were seen utilizing the same nesting areas and the barn swallows were nearly all absent. Since that time, cliff swallows seem to have become increasingly more numerous. However, Gabrielson (1944) saw a dozen barn swallows and no cliff swallows at Iliamna. Although Hurley (1931, 1932) did not find this species along the Kvichak River, Lensink reported a colony at Naheen (=Nakeen of U.S.G.S.) (Squaw Creek cannery) in 1959; this colony was not occupied in 1960. Nesting localities and numbers apparently change markedly from year to year.

CLIFF SWALLOW, *Petrochelidon pyrrhonota hypopolia*

Cliff swallows were common about Iliamna, where they foraged over all of the ecologic formations and nested on buildings as well as in crevices

in the low rocky cliffs along the lake shore. They were seen less commonly along the Newhalen River where nests were thought to have been located on cliffs. Nests were also seen commonly on buildings at Nondalton. This appears to be the first record of the cliff swallow from the Alaska Peninsula, and, so far as we can determine, the first record west of the upper Cook Inlet area (Gabrielson and Lincoln, 1959). Our impression is that the range of this species has been expanded recently, reaching the Iliamna area about 1925. Competition with the barn swallow may have taken place. Data for two females taken in 1959 are: June 12, largest ovum 2.5 mm, four collapsed follicles, incubation patch, heavy fat, weight 25.6 gm; June 16, largest ovum 2 mm, oviduct not enlarged, no incubation patch, moderate fat, weight 25.8 gm.

GRAY JAY, *Perisoreus canadensis pacificus*

The gray jay, an uncommon bird, was seen on only two occasions in 1958, and on three in 1959. With one exception, a fledgling found in the open spruce woodland, all were seen in the spruce-birch woodland or where this formation merged with riparian elements along the stream courses such as Bear Creek. Even though our observations were late in the season, these birds were still in pairs, and one pair was with a number of young. Osgood (1904) also found this jay, commonly about Lake Clark. Data for a pair we collected on June 5, 1958, are: male, testis 3 mm, no fat, weight 77.6 gm; female, ova small, no fat, weight 66.6 gm.

BLACK-BILLED MAGPIE, *Pica pica*

Magpies were considered rare in the Iliamna area, at least during the spring and summer. Only two were seen, one flying over the Newhalen River and the other over the spruce woodland. Osgood (1904) saw magpies at Lake Clark, and Lensink considered them to be common along the Kvichak River in fall. Hurley (1931, 1932), however, failed to find them in the breeding season, and this indicates that in this area, as in others with which we are familiar, these birds move to mountain valleys near timberline during the breeding season and to lowlands during the fall and winter.

COMMON RAVEN, *Corvus corax*

Ravens were uncommon; a total of only five was seen, three in 1958, and two in 1959, all flying overhead in a variety of habitats. Osgood (1904) saw several along the Newhalen River and found them to be numerous at Lake Clark. In the latter locality he saw small flocks which were most

likely family groups. Both Hurley (1932) and Lensink found ravens to be common along the Kvichak River.

BLACK-CAPPED CHICKADEE, *Parus atricapillus turneri*

In 1958, two black-capped chickadees were seen in spruce-birch woodland along the Copper River, and two others together in riparian woodland at Ekwok. None was seen in 1959. Osgood (1904) considered this bird uncommon in the area but he did collect specimens at Lake Clark identified as *P. a. turneri*.

BOREAL CHICKADEE, *Parus hudsonicus hudsonicus*, *P. h. hudsonicus* × *columbianus*

The boreal chickadee was uncommon. Three were seen in 1958 in spruce-birch woodland along the Copper River. In 1959 birds were seen on five occasions, once in riparian woodland and the remainder in spruce-birch woodland. On June 10, 1959, we found a nest containing five downy young. The nest, about six feet above the ground in a rotten stub, was in riparian woodland mixed with spruce-birch woodland at Bear Creek. The data for the pair collected at this nest are: male, testis 6 mm, no fat, weight 11.3 gm; female, ova to 1 mm, incubation patch, light fat, weight 11.8 gm. The young were preserved as alcoholic specimens. Osgood (1904) also collected two birds, in the vicinity of Lake Clark.

ROBIN, *Turdus migratorius migratorius*

Robins were abundant and were seen foraging and heard singing in a wide variety of habitats, including all types of riparian woodland, spruce-birch woodland, spruce woodland, heath and wet tundra, and the rocky lake shore. Nesting seemed to be restricted to the wooded areas or on ledges of man-made structures. We found one old nest (previous year) about 2 feet above the ground in a small spruce tree in open spruce woodland, and another, containing two eggs and two newly-hatched young, in a small tree a few feet above the ground in mixed riparian woodland on June 8, 1959. A third nest, containing four young about three days old, was located on a ledge under a bridge in the riparian woodland on Roadhouse Creek on June 17, 1959. Osgood (1904) saw few robins, but Hurley (1932) and Lensink found them to be common in the Bristol Bay region. We collected one male each year: 1958, May 26, testis 14 mm, light fat, weight 75.5 gm; 1959, June 7, testis 15 mm, no fat, weight 78.8 gm.

VARIED THRUSH, *Ixoreus naevius meruloides*

The varied thrush was common in the spruce-birch woodland, and was also found in the stands of dense spruce. A marked evening chorus of song

was noted in such places. There are no previous records of this bird in the Iliamna area, although Lensink found it to be common about Bristol Bay. We collected a male both years: June 3, 1958, testis 12 mm, light fat, weight 71.2 gm; June 10, 1959, testis 14 mm, moderate fat, weight 78.7 gm.

HERMIT THRUSH, *Hylocichla guttata guttata*

The hermit thrush was abundant in the spruce and the spruce-birch woodland along the Newhalen River and its tributaries, was somewhat less common in the riparian woodland of mixed broad-leaved trees, and was seen once in the dense willows along Roadhouse Creek. Singing was heard almost exclusively during the evening hours and, in favorable habitats, the volume of song was exceedingly great. There was little question that this was one of the most numerous passerine birds of the area. A nest found on June 6, 1959, was in the mixed riparian woodland, and on June 10, 1958, a bird was observed building a nest on the ground in a dense heath mat at the edge of the spruce-birch woodland. Osgood (1904) saw hermit thrushes at Lake Clark, but they have not been previously recorded from the Iliamna area. Data for our specimens are presented in Table 2 along with those for other members of this genus.

SWAINSON'S THRUSH, *Hylocichla ustulata incana*

Swainson's thrushes were abundant in the spruce-birch woodland, uncommon in the open spruce woodland, and only one was heard in the riparian willows along Roadhouse Creek. A nest was found on June 10, 1959, 8 feet above the ground in a small birch in the spruce-birch woodland. Osgood (1904) heard Swainson's thrushes only rarely about Iliamna Lake and Lake Clark. Lensink observed it about Levelock on Kvichak Bay where it presumably breeds. The specimen data are presented in Table 2.

GRAY-CHEEKED THRUSH, *Hylocichla minima minima*

The gray-cheeked thrush was abundant in the riparian woodland of thick willows along Roadhouse Creek, and was common in the spruce-birch woodland. In the willows, two nests with two eggs and one nest with one egg, all 18-24 inches above the ground, were found in 1959. We observed these until incubation was under way. The first two contained five eggs each on June 17, and the third contained five eggs on June 23. There are no other records of this bird for the Iliamna area, although specimens have been taken in the Bristol Bay area (Gabrielson and Lincoln, 1959). Data for our specimens are presented in Table 2.

It is apparent from the foregoing accounts that both geographic and ecologic overlap occurs in the distribution of the species of *Hylocichla* in

TABLE 2. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Hylocichla* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
<i>Hylocichla guttata</i>				
Males				
8 mi. N	June 3, 1958	Testis 12 mm	Light	22.7
8 mi. N	June 3, 1958	Testis 12 mm	Light	24.5
8.5 mi. N	June 5, 1958	Testis 11 mm	Light	24.8
Iliamna	June 5, 1958	Testis 12 mm	Light	23.1
Females				
8 mi. N	June 3, 1958	Largest ovum 3 mm, enlarged oviduct, no incubation patch	Light	24.3
Iliamna	June 6, 1959	Largest ovum 2 mm, 4 collapsed follicles, incubation patch	None	25.4
<i>Hylocichla ustulata</i>				
Males				
Bidarka Bay	June 11, 1958	Testis 11 mm	Light	32.7
2 mi. N	June 11, 1959	Testis 12 mm	None	28.8
1 mi. N	June 13, 1959	Testis 10 mm	Light	29.4
Females				
1 mi. N	June 5, 1959	Largest ovum 4 mm, incubation patch	Light	32.7
8.5 mi. N	June 10, 1959	Largest ovum 7 mm, 4 collapsed follicles, egg in oviduct, incubation patch	Light	36.1
8.5 mi. N	June 10, 1959	Largest ovum 2 mm, collapsed follicles, incubation patch	Light	30.7
<i>Hylocichla minima</i>				
Males				
Iliamna	May 30, 1958	Testis 13 mm	Light	32.4
Iliamna	May 30, 1958	Testis 11 mm	Light	29.5
Iliamna	June 8, 1959	Testis 12 mm	None	32.5
8.5 mi. N	June 10, 1959	Testis 10 mm	Light	30.7
Females				
Iliamna	June 8, 1959	Largest ovum 10 mm, 3 collapsed follicles, incubation patch	None	36.7

the Iliamna area. There also was at least partial habitat segregation. The gray-cheeked thrush was consistently a bird of riparian willow thickets whereas its two congeners were conspicuously absent from this vegetation. It seemed to us that the hermit thrush was more numerous in the open, semi-xeric, spruce woodland, perhaps mixed with some broad-leaved elements, than was the Swainson's thrush, and the gray-cheeked thrush was virtually absent from such habitats. The overlap of all three species was conspicuous in the formation favored by the Swainson's thrush, the spruce-birch woodland, and where this vegetation overlapped with riparian elements along the stream courses. In a small area at Bear Creek 8.5 miles north of Iliamna Lake, it was usual to hear all three species singing during the same general period of time.

The ground foraging propensities of *H. guttata* and *H. minima* outlined by Dilger (1956), were also noted by us, indicating possible competition between birds of these species. Dilger (*ibid.*) also discussed the arboreal foraging of *H. ustulata*, which may allow broad sympatry of this species and *H. guttata* with minimum competition, for both may be numerous in this area in mixed riparian and spruce-birch woodland. There is an exceptional opportunity for studying the occurrence of these three species in single small areas of uniform vegetation in the Iliamna area. One additional observation made at separate localities on different occasions was that of alternated singing of *H. ustulata* and *H. guttata*. Males of one species sang in profusion for a short time, followed by an equally intensive chorus of the other species. The effect was striking. The general scarcity of *H. minima* in these areas of overlap did not permit us to ascertain what, if any, part this species played in this alternate singing.

ARCTIC WARBLER, *Phylloscopus borealis kennicotti*

We made a special effort to find Arctic warblers, but saw and heard none. Osgood (1904) collected two near Old Iliamna on July 13 and 14, and we have examined one of these, a female, at the U. S. National Museum. Osgood also reported that McKay collected one on the Aleknagik River and J. W. Johnson collected two at Nushagak. Farther west, Gabrielson (1944) collected one from a group of three at Brooks Lake in the Katmai National Monument. We believe that this species occurs and probably breeds, at least sparingly, in the Iliamna area.

RUBY-CROWNED KINGLET, *Regulus calendula calendula*

We heard only six ruby-crowned kinglets singing in 1958 and five in 1959; two were in spruce woodland and the remainder in spruce-birch woods. This bird apparently occurs west to the limit of timber, since

Gabrielson found a pair and a separate male in Katmai National Monument in July, 1946 (Gabrielson and Lincoln, 1959). Data for the three males collected are: 8.5 mi. N. Iliamna, June 5, 1958, testis 5.0 mm, light fat, weight 6.9 gm; 1 mi. N. Iliamna, June 5, 1959, testis 6.0 mm, no fat, weight 7.1 gm; 8.5 mi. N. Iliamna, June 10, 1959, testis 6 mm, light fat, weight 6.8 gm.

WATER PIPIT, *Anthus spinoletta*

In 1958, small groups of water pipits were seen foraging along the rocky lake shore on the 23rd, 24th, and 25th of May, and single birds were seen on the 26th and 28th of that month. In 1959, one was seen in the same habitat on June 7, and one was seen foraging on the upland dry tundra on June 9. We saw no evidence of breeding, and these birds were assumed to have been migrants, although it would seem that the June dates are late. Macy Hobson informed us that water pipits breed above timberline in the local mountains, as would be expected. There are no other records of this bird for the Iliamna area. Data for a male taken on May 25, 1958, are: testis 9 mm, moderate fat, weight 22.0 gm.

BOHEMIAN WAXWING, *Bombycilla garrula pallidiceps*

We saw only two Bohemian waxwings in 1958, one at Iliamna and one in the riparian woodland at Ekwook. They were common, however, in 1959, and, though most frequently seen in spruce-birch woodland, they were numerous also in black spruce bogs and in open spruce woodland. Lensink found this bird common in 1959 at Levelock, where two nests were located about 4 feet above the ground in small spruce trees. The first eggs were laid on May 28, and both clutches of four eggs each were completed four days later. Lensink surmised that there may have been a recent range extension into the lower Kvichak River area, for the residents were not familiar with this species. His supposition may be correct since there are no other records for the Alaska Peninsula or Bristol Bay regions. Data for two males taken on June 5, 1959, are: testis 9 mm, light fat, weight 58.3 gm; testis 10 mm, no fat, weight 59.4 gm.

NORTHERN SHRIKE, *Lanius excubitor*

We saw only three northern shrikes, all in 1959. One was chased by a robin over the wet and heath tundra formations on June 11, and two were seen in scattered spruces on June 19. Osgood (1904) collected a juvenile at the mouth of the Chulitna River on Lake Clark, Lensink saw shrikes twice at Levelock, and there are other records for the area west of Iliamna Lake. This bird can be assumed correctly to breed in this area, albeit sparsely.

ORANGE-CROWNED WARBLER, *Vermivora celata celata*, *V. c. celata* × *V. c. lutescens*

The orange-crowned warbler was abundant in riparian woodland of predominately willow and willow-alder-birch composition. It was common in the lush understory vegetation of the spruce-birch woodland, and in one of the latter locations a nest containing six eggs was found on June 11, 1959, in a dense mat of grass and *Empetrum* sp. A second nest also containing six eggs, was found in a dense clump of grass in the moist understory of the birch woodland at Ekwook. Osgood (1904) found a few birds remaining in the area in July and Lensink found them sparingly at Levelock. There are other scattered records from areas west of Iliamna Lake (Gabrielson and Lincoln, 1959). Data for our specimens are presented in Table 3.

YELLOW WARBLER, *Dendroica petechia rubiginosa*, *D. p. amnicola*, *D. p. rubiginosa* × *D. p. amnicola*

Yellow warblers were abundant in the riparian woodland, especially in the dense willows along Roadhouse Creek. On one occasion singing was heard in the spruce-birch woodland along the shore of the Copper River. In 1958 these birds were first recorded on May 23, but they did not become common until May 30. The only nest found, in a small willow about 3 feet above the ground, was completed on June 17, 1959, and contained the full clutch of five eggs on June 23. Osgood (1904) found this bird to be uncommon, probably due to the lateness of the season. Surprisingly, Hurley (1931, 1932) saw none along the Kvichak River, although Lensink found it to be common there in the willows and alders. The data for our specimens are presented in Table 4 together with those for other species of the genus *Dendroica*.

MYRTLE WARBLER, *Dendroica coronata hooveri*

Myrtle warblers were common in the spruce-birch woodland, somewhat less so in the spruce woods, and individuals were seen only twice in riparian woodland. Osgood (1904) found them commonly about Lake Clark and, farther west, Cahalane (1959) considered them abundant at Katmai National Monument. Our specimen data are included in Table 4.

BLACKPOLL WARBLER, *Dendroica striata lurida*

The blackpoll warbler was abundant in the riparian woodland, especially so in locations with mixed species of broad-leaved trees, and also in the luxuriant understory of the spruce-birch woodland. Places such as the latter were of secondary preference. Osgood (1904) considered this bird the most common warbler seen in the Iliamna area, but Hurley (1931,

TABLE 3. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Vermivora celata* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or relation to Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
Males				
Iliamna	May 24, 1958	Testis 5 mm	Light	9.6
Iliamna	May 26, 1958	Testis 6 mm	Light	9.2
Iliamna	May 28, 1958	Testis 5 mm	Light	9.6
Iliamna	June 6, 1959	Testis 6 mm	None	9.9
Iliamna	June 6, 1959	Testis 5 mm	Light	9.8
Iliamna	June 8, 1959	Testis 6 mm	None	9.4
Iliamna	June 8, 1959	Testis 5 mm	Light	9.7
Iliamna	June 11, 1959	Testis 7 mm	None	10.3
1 mi. N Iliamna	June 11, 1959	Testis 7 mm	Light	10.4
Iliamna	June 12, 1959	Shot	None	9.5
Iliamna	June 12, 1959	Testis 5 mm	None	9.5
Iliamna	June 14, 1959	Testis 6 mm	Light	10.2
Females				
Iliamna	June 1, 1958	Largest ovum 3 mm, 2 collapsed follicles, egg in oviduct	Moderate	11.6
Iliamna	June 6, 1959	Largest ovum 6 mm, 3 collapsed follicles, egg in oviduct, incubation patch	Light	12.2
Iliamna	June 6, 1959	Largest ovum 1 mm, incubation patch beginning	Light	10.5
Iliamna	June 8, 1959	Largest ovum 5 mm, incubation patch	Light	11.7
Iliamna	June 8, 1959	Largest ovum 1 mm, incubation patch	Light	10.0
Iliamna	June 9, 1959	Largest ovum 2 mm	Light	9.1
Iliamna	June 11, 1959	Largest ovum 2 mm, incubation patch, incubating 6 eggs	Light	10.9
1 mi. N	June 14, 1959	Largest ovum 7 mm, 4 collapsed follicles, egg in the oviduct, incubation patch	Moderate	13.1

1932) and Lensink did not find it along the Kvichak River. Gabrielson and Lincoln (1959) indicate that no observer has listed the blackpoll warbler as a common breeding bird in Alaska when in fact this bird was found in abundance not only at Iliamna but also at Napaskiak on the Kuskokwim River (Williamson, 1957). The generally accepted notion that spruce woodland is the most favored nesting habitat does not seem to be true in western Alaska where these birds favor dense riparian woodland and

thickets, generally apart from coniferous trees. Data for our specimens are presented in Table 4.

NORTHERN WATERTHRUSH, *Seiurus noveboracensis notabilis*

The northern waterthrush was considered common in 1958 and abundant in 1959. It occurred in all types of riparian woodland and was most abundant in the dense willows along Roadhouse Creek. It also was found in the spruce-birch woodland along the stream courses, where there was a mixture of riparian elements or where there was a dense understory with a moist substrate. In our experience at Iliamna and other areas in southern Alaska, these birds are not confined to a narrow strip of vegetation bordering the streams as indicated by Gabrielson and Lincoln (1959). Osgood (1904) saw a pair at Old Iliamna, but otherwise this species has not previously been reported from the Iliamna area. Data for our specimens, all males, for 1958, are: May 25, testis 5 mm, light fat, weight 17.4 gm; June 1, testis 6 mm, light fat, weight 16.2 gm; for 1959: June 5, testis 7 mm, no fat, weight 16.7 gm; Bear Creek, June 10, testis 7 mm, no fat, weight 16.8 gm; June 12, testis 6 mm, no fat, weight 18.5 gm; June 17, testis 8 mm, light fat, weight 18.6 gm; Nondalton, June 22, testis 6 mm, no fat, weight 17.7 gm.

WILSON'S WARBLER, *Wilsonia pusilla pileolata*

One of the most abundant passerine birds of the area and certainly the most numerous of the wood warblers was Wilson's warbler. Their numbers were greatest in riparian woodland; it was not determined if they preferred dense willows over other types. A few were seen wherever suitable habitat was present, such as clumps of low *Salix* sp. only a few feet across on the heath tundra, in alder thickets bordering ponds and lakes, in small clusters of cottonwoods with grass understory, and commonly in the understory of the spruce-birch forest. On June 23, 1959, a nest containing six eggs was found in the shrubby heath tundra about 20 feet from the edge of the willows. Osgood (1904) also found Wilson's warblers in abundance in the area, and Lensink found them at Levelock. The data for our specimens are presented in Table 5.

RUSTY BLACKBIRD, *Euphagus carolinus carolinus*

Rusty blackbirds were uncommon, having been recorded only five times in 1958 and four times in 1959. They were seen in riparian woodland, spruce-birch woodland, spruce woodland, and they foraged along the rocky and marshy lake shores. Pairs also foraged on the tundra and in the riparian woodland, and on June 11, 1959, one was seen carrying some-

TABLE 4. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Dendroica* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
<i>Dendroica petechia</i>				
Males				
Iliamna	May 30, 1958	Testis 5 mm	Light	9.6
Iliamna	May 30, 1958	Testis 8 mm	Light	11.2
Iliamna	June 1, 1958	Testis 7 mm	Light	9.9
Iliamna	June 6, 1959	Testis 7 mm	Light	10.2
Iliamna	June 6, 1959	Testis 7 mm	Light	10.1
Iliamna	June 7, 1958	Testis 7 mm	Light	9.7
Iliamna	June 7, 1959	Testis 7 mm	None	9.7
Iliamna	June 8, 1959	Testis 9 mm	Light	9.6
Iliamna	June 8, 1959	Shot	None	9.9
Iliamna	June 9, 1959	Testis 8 mm	None	9.6
Iliamna	June 9, 1959	Testis 8 mm	None	10.1
Iliamna	June 12, 1959	Testis 7 mm	None	9.0
Iliamna	June 17, 1959	Testis 7 mm	Light	10.5
Iliamna	June 17, 1959	Testis 7 mm	Light	10.7
Nondalton	June 23, 1959	Testis 5 mm	Light	8.9
Iliamna	June 25, 1959	Testis 7 mm	Light	10.8
Females				
Iliamna	June 8, 1959	Largest ovum 4 mm, enlarged oviduct	Light	10.7
Iliamna	June 12, 1959	Largest ovum 1 mm	Light	8.7
<i>Dendroica coronata</i>				
Males				
Iliamna	May 25, 1958	Testis 7 mm	Light	14.2
8 mi. N	June 3, 1958	Testis 7 mm	Moderate	13.4
Iliamna	June 8, 1959	Testis 8 mm	None	14.0
8.5 mi. N	June 10, 1959	Testis 7 mm	None	13.0
8.5 mi. N	June 10, 1959	Testis 10 mm	None	14.4
Iliamna	June 11, 1959	Testis 10 mm	None	14.4
Females				
8 mi. N	June 3, 1958	Largest ovum 9 mm, 1 collapsed follicle, egg in oviduct	Light	16.7
1 mi. N	June 13, 1959	Largest ovum 1 mm, incubation patch	Moderate	14.6
<i>Dendroica striata</i>				
Males				
Iliamna	May 26, 1958	Testis 7 mm	None	12.7
Iliamna	May 26, 1958	Testis 9 mm	Light	13.5
Iliamna	May 28, 1958	Testis 7 mm	Moderate	13.1
Iliamna	June 6, 1959	Testis 8 mm	None	12.7
Iliamna	June 6, 1959	Testis 8 mm	Light	12.7

TABLE 4. *Continued*

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
Iliamna	June 8, 1959	Testis 8 mm	None	12.8
Iliamna	June 8, 1959	Testis 8 mm	None	12.7
Iliamna	June 9, 1959	Shot	Light	12.6
8.5 mi. N	June 10, 1959	Testis 7 mm	Light	12.7
1 mi. N	June 11, 1959	Testis 8 mm	Light	13.5
Iliamna	June 14, 1959	Testis 7 mm	None	13.0
Iliamna	June 14, 1959	Testis 6 mm	None	12.6
		Females		
Iliamna	June 9, 1959	Largest ovum 3 mm, enlarged oviduct	Light	12.0

thing in its bill (food item?) from the marshy border of a small lake into scattered spruces nearby. The evidence indicates the presence of a sparse nesting population during the time of our study. There are no other records for the Iliamna or the Kvichak River areas, but Osgood (1904) collected a specimen at Lake Clark. Data for two males taken in 1958 are: Nondalton, June 3, testis 12 mm, light fat, weight 59.6 gm; June 7, testis 12 mm, light fat, weight 63.9 gm.

PINE GROSBEAK, *Pinicola enucleator*

We failed to find pine grosbeaks, although Macy Hobson assured us that they are present in winter. Osgood (1904) saw none, but McKay collected specimens near Nushagak, near Lake Aleknagik, and on the Nushagak River. Among these was the type of *Pinicola enucleator alasensis* (USNM 86510) taken in spruce woods 6 miles above Nushagak. It seems improbable that pine grosbeaks do not breed in the Iliamna area, and we assume that our visits were made during a time when these birds were scarce or temporarily absent.

COMMON REDPOLL, *Acanthis flammea flammea*

Redpolls were abundant in all the wooded areas and were seen foraging also on the wet tundra, the rocky lake shore, and in grassy areas. They were most numerous in dense willows, somewhat less in spruce-birch woodland, and least in spruce woodland. Two nests found in dense willows on June 8 and 9, 1959, were both about 3 feet above the ground and each contained four eggs. Another, containing one egg and four young, was found about 3 feet above the ground in a small spruce in the spruce-birch woodland on June 10, 1959. The female from this nest was

TABLE 5. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Wilsonia pusilla* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
		Males		
Iliamna	May 25, 1958	Testis 7 mm	Light	7.8
Iliamna	May 26, 1958	Testis 6 mm	Light	7.4
Iliamna	May 28, 1958	Testis 6 mm	Light	7.2
Iliamna	June 7, 1959	Shot	None	7.1
Iliamna	June 7, 1959	Testis 5 mm	Light	8.3
Iliamna	June 7, 1959	Shot	None	8.0
Iliamna	June 8, 1959	Testis 6 mm	None	7.6
		Females		
Iliamna	June 6, 1959	Largest ovum 2 mm, enlarged oviduct	Light	8.4
Iliamna	June 8, 1959	Ova small, enlarged oviduct	None	7.5
Iliamna	June 8, 1959	Largest ovum 1 mm	Light	8.1
Iliamna	June 8, 1959	Largest ovum 5 mm, 4 collapsed follicles, egg in oviduct, incubation patch	Light	10.7

chased by two brightly colored males. Osgood (1904) found redpolls to be common in the area. Data for the males collected in 1958 are: May 25, testis 6 mm, light fat, weight 12.3 gm; May 25, testis 6 mm, light fat, weight 13.1 gm; May 25, testis 8 mm, light fat, weight 13.1 gm; May 28, testis 6 mm, no fat, weight 12.5 gm; May 30, testis 7 mm, light fat, weight 13.4 gm; June 7, testis 7 mm, moderate fat, weight 12.5 gm; for females: May 25, largest ovum 4 mm, incubation patch, light fat, weight 14.1 gm; for 1959: June 5, female, ova small, skull single-layered, weight 11.1 gm.

PINE SISKIN, *Spinus pinus*

Osgood (1904) collected one siskin and saw others at Old Iliamna and along the Newhalen River. We found none and do not believe they were present during the time of the study. Our previous experience with siskins in the upper Cook Inlet region has shown that these birds may be completely absent in some years while abundant in others. The loud, distinctive, and frequently uttered notes of siskins render them easy to detect.

WHITE-WINGED CROSSBILL, *Loxia leucoptera*

Although we did not find crossbills, we assume that they must occur regularly in some years. Macy Hobson informed us that he has seen them

in winter, and Osgood (1904) saw a few small flocks near Iliamna Lake and Lake Clark. Gabrielson and Lincoln (1959) reported two records for the Bristol Bay region, and Cahalane (1959) saw one in 1953 and many in 1954 in the Katmai National Monument. Cahalane reported that the males were very vocal in late August, an observation the senior author has made in the upper Cook Inlet region and also in the Mt. McKinley area of the Alaska Range.

SAVANNAH SPARROW, *Passerculus sandwichensis anthinus*

Savannah sparrows were abundant both years in a wide variety of habitats, apparently depending on the suitability of the ground cover for nesting sites. These birds were most abundant in the grassland bordering the rocky shore of Iliamna Lake, where small clumps of willows were used as singing perches. They were also numerous in some areas of shrubby heath tundra, and in the riparian woodland where the willows, alders, or birches formed open stands underlain with dense grass. Areas of wet tundra where grasses and sedges were tall also were utilized, and individuals were seen foraging along the rocky lake shore, and on the low wet lake margins. Savannah sparrows were only occasionally seen in the open areas of spruce woodland with grass understory. Of particular interest was the very dense population of these sparrows found on a grassy, knoll-shaped island in Bidarka Bay where they were the only passerine birds present. Only scattered low willows and occasional rocks were found in the dense grass. In 1959 two nests, both containing five eggs, were found in the grassland bordering Iliamna Lake on June 7 and 9, and a third nest, also containing five eggs, was located on June 10, 12 miles north of Iliamna, in the dense grass understory of the riparian willows along the Newhalen River. Osgood (1904) found savannah sparrows commonly in Iliamna Pass, at Old Iliamna, and along the Newhalen River. Hurley (1932) and Lensink both found them numerous along the Kvichak River. The data for our specimens are presented in Table 6.

SLATE-COLORED JUNCO, *Junco hyemalis hyemalis*

Juncos were uncommon both years in the principal study area where they occurred as widely scattered pairs, nearly always in the spruce-birch woodland. They were seen only twice in the open spruce woodland but were common at Nondalton and along the Copper River in more heavily forested areas. Osgood (1904) saw juncos nearly every day throughout this area, and collected several specimens. There are other records from the forested portions of the Alaska Peninsula as far west as the Katmai National Monument (Cahalane, 1959; Gabrielson and Lincoln, 1959).

TABLE 6. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Passerculus sandwichensis* COLLECTED IN THE ILIAMNA AREA, ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
Males				
Iliamna	May 25, 1958	Testis 11 mm	Light	19.5
Iliamna	May 25, 1958	Testis 10 mm	None	17.2
Iliamna	May 28, 1958	Testis 8 mm	Moderate	20.0
Iliamna	May 28, 1958	Testis 8 mm	None	19.2
Iliamna	June 7, 1959	Testis 11 mm	None	20.7
Iliamna	June 7, 1959	Testis 9 mm	None	18.1
Iliamna	June 8, 1959	Testis 9 mm	None	18.0
Iliamna	June 9, 1959	Testis 10 mm	Light	20.1
1 mi. N	June 11, 1959	Testis 12 mm	Light	20.8
Iliamna	June 12, 1959	Testis 10 mm	None	19.6
Iliamna	June 12, 1959	Testis 11 mm	Light	19.4
Iliamna	June 16, 1958	Testis 10 mm	Light	18.9
Females				
Iliamna	May 28, 1958	Largest ovum 1 mm	Light	17.3
Iliamna	May 28, 1958	Largest ovum 2 mm	Moderate	18.6
Iliamna	June 2, 1958	Largest ovum 2 mm	Light	16.2
Iliamna	June 7, 1959	Largest ovum 2 mm, collapsed follicles, incubation patch	Light	20.1
Iliamna	June 16, 1959	Largest ovum 1 mm, incubation patch	Light	15.7
Iliamna	June 17, 1959	Largest ovum 1 mm, incubation patch	Moderate	18.5
Iliamna	June 17, 1959	Largest ovum 3 mm, incubation patch	Moderate	19.6

Most of our specimens were necessarily collected at Nondalton, and the data for these are presented in Table 7.

TREE SPARROW, *Spizella arborea ochracea*

The tree sparrow, one of the most abundant passerine birds of the area, used a wide range of habitats for foraging and nesting. Shrubby heath tundra with scattered clumps of willows or single low spruces was the preferred habitat, although they were also abundant in grassland dotted with scattered willows, and in the more open riparian woodland with a grassy understory. Some were seen in the spruce woodland with a heath understory, and a few were found in the spruce-birch woodland. The species was recorded on four occasions on the wet tundra, and a favorite foraging area was the rocky lake shore adjoining nesting areas on the heath tundra. Data for nests observed, all in 1959, are: June 5, five eggs, grassy

TABLE 7. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Junco hyemalis* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
Males				
Iliamna	June 5, 1959	Testis 9 mm	None	18.3
1 mi. N	June 5, 1959	Testis 9 mm	None	18.2
Iliamna	June 16, 1959	Testis 9 mm	Light	20.2
Nondalton	June 22, 1959	Testis 9 mm	Light	19.1
Nondalton	June 22, 1959	Testis 9 mm	None	19.8
Females				
8 mi. N	June 11, 1959	Largest ovum 2 mm, incubation patch	None	20.5
Nondalton	June 22, 1959	Largest ovum 2 mm, incubation patch	Light	18.1
Nondalton	June 22, 1959	Largest ovum 4 mm, 1 collapsed follicle, egg in oviduct, incubation patch	Light	22.4
Nondalton	June 22, 1959	Largest ovum 2 mm, incubation patch	Light	19.2
Nondalton	June 22, 1959	Largest ovum 2 mm, incubation patch	Light	18.5

understory of the spruce-birch woodland; June 9, four eggs, depression in the heath tundra; June 11, five eggs, in dense crowberry (*Empetrum* sp.) mat in open spruce woodland; June 15, one egg, four downy young, heath tundra near the edge of spruce-birch woods; June 17, five incubated (advanced) eggs, in dense lichens mixed with *Ledum* sp., *Betula nana*, *Vaccinium* sp. in shrubby heath bordering the spruce-birch woodland; and, June 23, five young in grass understory of open riparian woodland. In addition to these nests we observed adults carrying food to nestlings in an area of wet tundra on June 16. Both Osgood (1904) and Gabrielson (1944) found tree sparrows in this area and collected specimens, and Hurley (1932) found them to be common on the tundra along the Kvichak River. We collected two males, one each year, and the data are: May 25, testis 12 mm, light fat, weight 17.4 gm; June 9, testis 11 mm, light fat, weight 18.4 gm.

WHITE-CROWNED SPARROW, *Zonotrichia leucophrys gambelii*

White-crowned sparrows were common in a variety of habitats including shrubby heath tundra with scattered taller plants, riparian thickets, and spruce woodland of open character. They apparently occupied the first two of these in nearly equal numbers. A few were seen foraging along

TABLE 8. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Zonotrichia* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
<i>Zonotrichia leucophrys</i>				
Males				
Iliamna	June 14, 1959	Testis 9 mm	Light	26.7
Iliamna	June 15, 1959	Testis 9 mm	Light	25.2
Females				
Iliamna	May 30, 1958	Largest ovum 2 mm	Light	24.0
Iliamna	June 1, 1958	Largest ovum 3 mm	Light	22.8
Iliamna	June 14, 1959	Largest ovum 2 mm, incubation patch	Light	27.9
Iliamna	June 15, 1959	Largest ovum 2 mm, incubation patch	Light	23.3
<i>Zonotrichia atricapilla</i>				
Males				
Iliamna	May 24, 1958	Testis 10 mm	Light	35.2
Iliamna	May 28, 1958	Testis 11 mm	Light	33.7
Iliamna	May 28, 1958	Testis 10 mm	Light	31.3
Females				
Iliamna	May 25, 1958	Largest ovum 2 mm	Moderate	31.9

the rocky lake shore. We found no nests but saw a pair carrying food to young in the spruce woodland. Osgood (1904) saw white-crowned sparrows along the Newhalen River and at Lake Clark. Both Hurley (1932) and Lensink found them to be common in the riparian woodland along the Kvichak River, and Hurley remarked that they were abundant on the higher tundra. Data for our specimens are presented in Table 8.

GOLDEN-CROWNED SPARROW, *Zonotrichia atricapilla*

The golden-crowned sparrow was found most often in the less dense riparian woodland and its edges and was considered common; it was only slightly less abundant in heath tundra, grassland, spruce woodland, and spruce-birch woodland. One was seen foraging on the rocky lake shore. In 1959, a nest containing four eggs was found on June 7, in dense grass under an open stand of mixed willow and cottonwood, and one found on June 11, in the dense grass of the spruce-birch woods, contained one egg and four downy young. Adults were observed on June 12 carrying food to a nest concealed in dense grass in the riparian woodland. Osgood (1904) saw large streaked young about Iliamna Lake on July 17 and saw a few birds

TABLE 9. DATA ON REPRODUCTIVE CONDITION, FAT, AND WEIGHT FOR SPECIMENS OF *Passerella iliaca* COLLECTED IN THE ILIAMNA AREA ALASKA, 1958-1959

Locality (or distance from Iliamna)	Date	Reproductive condition	Fat	Weight (grams)
Males				
Iliamna	May 24, 1958	Testis 11 mm	Light	36.2
Iliamna	May 26, 1958	Testis 11 mm	Light	36.4
Iliamna	May 30, 1958	Testis 11 mm	Light	36.6
Iliamna	June 1, 1958	Testis 10 mm	None	37.6
Iliamna	June 1, 1958	Testis 9 mm	None	34.6
Iliamna	June 6, 1959	Testis 12 mm	None	37.7
Bidarka Bay	June 9, 1958	Testis 10 mm	Light	36.1
Bidarka Bay	June 10, 1958	Testis 12 mm	Light	38.0
8.5 mi. N	June 10, 1959	Testis 10 mm	Moderate	38.5
Iliamna	June 18, 1959	Testis 10 mm	Light	37.8
Nondalton	June 22, 1959	Testis 11 mm	Light	36.9
Females				
Iliamna	May 24, 1958	Largest ovum 21 mm, egg in oviduct	Moderate	45.0
Iliamna	June 1, 1958	Largest ovum 5 mm	Light	35.5
Iliamna	June 9, 1959	Largest ovum 3 mm, incubation patch	Light	39.4
Bidarka Bay	June 10, 1958	Largest ovum 3 mm, incubation patch	Light	37.8
Bidarka Bay	June 10, 1958	Largest ovum 2 mm, incubation patch	Light	36.6
Bidarka Bay	June 11, 1958	Largest ovum 3 mm, incubation patch	Light	38.1

about Lake Clark. Lensink found golden-crowned sparrows to be common along the margins of Kvichak Bay. Data for our specimens are presented in Table 8.

FOX SPARROW, *Passerella iliaca unalaschcensis*, *P. i. zaboria*, *P. i. sinuosa*, *P. i. unalaschcensis* × *P. i. sinuosa*, *P. i. unalaschcensis* × *P. i. zaboria*

We considered the fox sparrow to be an uncommon species restricted almost entirely to the various types of riparian woodland. This is of special interest in light of the very dense populations of these birds which exist in the lush riparian vegetation bordering most of the streams entering Cook Inlet. Fox sparrows were seen occasionally in the spruce-birch woodland. No nests were found, but adults were observed carrying food on June 18, 1959. Because of the especially interesting overlap of races of this species in the Iliamna area, and also because the senior author is studying the distribution and relationships of these races in the Cook Inlet region, an effort was made to secure as many specimens as possible. Data for these

are given in Table 9, and further comment on local distribution is made in the discussion of racial relationships presented below.

LINCOLN'S SPARROW, *Melospiza lincolnii lincolnii*

The Lincoln's sparrow was not seen in 1958 and was uncommon in 1959, when only eight birds were found. All but one of these, a male singing in an area of sparse, open spruce mixed with willow, were found in the riparian willows along Roadhouse Creek. Our experience in the upper Cook Inlet region has shown that this species may be common to abundant locally, but otherwise is absent from areas of apparently similar habitat. This seems to be the case in the Iliamna area where it is probably common in some areas. The only previous record for the area is that of Gabrielson (1944), who saw one immature bird on the portage between Iliamna Lake and Iliamna Bay. Positive evidence of breeding was gained from examination of the specimens, and these represent the westernmost extent of range for this species. Data for the males are: June 9, testis 10 mm, no fat, weight 18.0 gm; June 12, testis 10 mm, light fat, weight 17.3 gm; June 25, testis 10 mm, light fat, weight 16.7 gm; for females: June 25, largest ovum 2 mm, three collapsed follicles, incubation patch, light fat, weight 16.0 gm; June 25, largest ovum 3.0 mm, incubation patch, light fat, weight 14.8 gm.

LAPLAND LONGSPUR, *Calcarius lapponicus alascensis*

Longspurs were common, and in a few isolated localities, even approached the population density seen in the arctic and western coastal regions. We found them to be most common on the heath tundra, and on higher and drier areas scattered through the wet tundra; they were commonly seen foraging along the rocky lake shore adjacent to the nesting areas. On June 16, 1959, we watched females carrying food to nests on the wet tundra. One of these nests contained five young nearly ready to fledge. Osgood (1904) failed to find longspurs, indicating a striking change in abundance or, more likely, an early departure from this area. All other observers have found them numerous in nearby localities. Data for a pair collected on May 28, 1958, are: male, testis 9 mm, moderate fat, weight 24.9 gm; female, largest ovum 4 mm, moderate fat, weight 23.1 gm.

RACIAL RELATIONSHIPS OF ILIAMNA BIRDS

It is apparent from the preceding species accounts and from the introductory remarks that the Iliamna area is inhabited by populations of several species of birds possessing certain characteristics which are intermediate between those of races of inland and coastal environments. This is not surprising when the striking overlap of distinctive vegetation types

is considered, and when the area is already known to be one where units of major ecological classification merge. We found six species of birds, *Canachites canadensis*, *Parus hudsonicus*, *Vermivora celata*, *Dendroica petechia*, *Junco hyemalis*, and *Passerella iliaca* which fall into this category. It seems likely that three additional species, *Branta canadensis*, *Bubo virginianus*, and *Dendrocopos pubescens*, believed to occur in the Iliamna area, may also be found to represent populations of a morphologically intermediate nature.

Canachites canadensis osgoodi, described as a pale form of the spruce grouse, is thought to occupy all of interior Alaska south to the Bristol Bay region, with the darker race, *C. c. atratus*, occurring about Cook Inlet and south to Prince William Sound (American Ornithologists' Union, 1957). Ridgway and Friedmann (1946) did not believe that the geographic variation was consistent enough to warrant the recognition of *C. c. osgoodi*, and they refer the birds of interior Alaska to the nominate race *C. c. canadensis*. Gabrielson and Lincoln (1959) agreed with this interpretation, but we have decided to follow the A.O.U. Check-list nomenclature. Regardless of how this matter is resolved, the fact remains that the grouse from interior Alaska are generally paler than those of the southern coastal areas and there is a mixing of these stocks in the Iliamna area. A specimen taken by Osgood at Lake Clark on July 28, 1902, as well as some of our specimens from near Iliamna Lake, while like *C. c. atratus*, are not quite as dark as those of that race from the low country about Cook Inlet. This is especially noticeable on the backs, which tend to be more ashy, less olivaceous, and show less reduction in the number and extent of the white markings of the scapulars and tertials. Though similar to *C. c. atratus*, an approach toward *C. c. osgoodi* is evident. Cahalane (1959) reported the grouse of the Katmai area as belonging to the race *C. c. osgoodi*, although he apparently did not collect any specimens. In our opinion, it is more likely that the race *C. c. atratus* occurs in that area.

One of our two specimens of *Parus hudsonicus*, a male, was found to be quite dark dorsally and was considered intermediate between the races *P. h. hudsonicus* and *P. h. columbianus*. The zone of intergradation of these two races is known to extend from Bristol Bay, the base of the Alaska Peninsula, and somewhat inland along the northern shore of Cook Inlet at least to the Skwentna River (Gabrielson and Lincoln, 1959).

We collected a fairly large series of *Vermivora celata* (20 specimens) and of these only one was not of the nominate race *V. c. celata*. This one, a male, was referable to the race *V. c. lutescens*, though tending to be somewhat grayer and thus intermediate in racial characteristics. Apparently, the race *V. c. lutescens* is confined in this area to the extreme coastal

areas about Cook Inlet. The range has not previously been known to extend along the northern side of Cook Inlet, but there are records from Kodiak and the Kenai Peninsula. The race *V. c. celata* occurs in the Iliamna-Bristol Bay region along the Kvichak and Nushagak Rivers and also possibly farther west and south on the Alaska Peninsula. Reports from the Katmai National Monument (Cahalane, 1959; Gabrielson and Lincoln, 1959) of the race *V. c. celata* apparently are not based on specimens and should be verified by collecting. We have found a zone of intergradation in the upper Cook Inlet area, and the evidence from Iliamna, albeit scanty, indicates that this zone may extend down the north side of Cook Inlet at least to the vicinity of Iliamna Lake.

A review of the records for the distribution of *Dendroica petechia amnicola* indicates that the southern limit of the known breeding range lies in the vicinity of the Kuskokwim River, while the northern limits of the breeding range of the race to the south, *D. p. rubiginosa*, are on the northern side of the Cook Inlet, the Iliamna Lake area, and the Alaska Peninsula (A.O.U. Check-list, 1957; Gabrielson and Lincoln, 1959). This leaves a large area wherein the racial identity of breeding yellow warblers has not previously been determined. Specimens from near Bethel on the Kuskokwim River, listed as *D. p. rubiginosa* (Williamson, 1957), have been rechecked and found to be *D. p. amnicola*. The specimen collected by Osgood at Old Iliamna is *D. p. rubiginosa*, and our series from Iliamna was identified as follows: *D. p. amnicola*, 1; *D. p. rubiginosa*, 8; *D. p. rubiginosa* × *D. p. amnicola*, 9. Some of these specimens of an intermediate nature are difficult to assign in that they are much closer to one race than the other. Nonetheless, there was generally close agreement among four different observers who examined the series, even for those specimens showing intergrading characteristics. This evidence indicates that *D. p. amnicola* breeds in the area south of the Kuskokwim River, including the drainage of the Nushagak River. A male taken by McKay at Nushagak near the mouth of the Nushagak River was identified as *D. p. rubiginosa* by Gabrielson and Lincoln (1959) indicating a northward coastal extension of the range of this race. The zone of intergradation between these two races may extend along the north shore of Cook Inlet for an undetermined distance east of the Iliamna area.

A somewhat different situation was found in the juncos, *Junco hyemalis*, of which we obtained a series of ten specimens, including six taken at Nondalton. These were examined by Dr. Alden H. Miller, who identified two females as intermediate between the races *J. h. hyemalis* and *J. h. cismontanus*. *Junco hyemalis cismontanus* occurs from southern Yukon Territory (Carcross) south through interior British Columbia, and on the borders

of its breeding range, it breeds freely with the closely similar *J. h. hyemalis* (Miller, 1941). All of Alaska, from Prince William Sound northward, is occupied by the race *J. h. hyemalis*. Specimens of juncos are scarce for the large area separating the Cook Inlet area in the west from the breeding range of *J. h. cismontanus* to the east, but there seem to be no barriers to the distribution of this species through that timbered area. It seems likely that the breeding range of *J. h. cismontanus* extends north and west from southern Yukon Territory. In any event there is some gene flow between these two populations resulting in the occurrence of characters of *J. h. cismontanus* in the Iliamna juncos.

The fox sparrows, *Passerella iliaca*, were of particular interest to us at the outset of this study for reasons given earlier, and the Iliamna area was thought to be one that merited special attention. This assumption was based partly on the remark of Osgood (1904) that only 100 miles separated the breeding ranges of the very dissimilar races *P. i. zaboria* (= *P. iliaca* of Osgood), at Nushagak, and *P. i. unalaschcensis* (= *P. unalaschcensis* of Osgood), at Iliamna Lake, and partly on the fact that the racial identity of fox sparrows occurring along the northern side of Cook Inlet was unknown. The only specimen from this latter area was collected by Osgood (1901) at Tyonek, on September 18, 1900, and is now in the U. S. National Museum. This specimen has been identified as *P. i. unalaschcensis*, as were the specimens collected by Osgood in the Iliamna area. Concerning the general distribution of fox sparrows in southwestern Alaska, the range map presented by Swarth (1920) remains the most definitive information available for the races in the Cook Inlet region. This map necessarily leaves large gaps between all the races, since certain knowledge of the zones of intergradation (or hybridization) was not available at that time. More recently, Murie (1959) discussed the relationships between *P. i. unalaschcensis* and *P. i. zaboria* at points along the Nushagak River. He mentioned that typical *P. i. zaboria* has been collected at Nushagak, Kakwok (= Ekwok), Snag Point, and Dillingham, while birds showing intermediate characteristics have been taken at Ekwok (two immatures), and somewhere else in this general area (USNM No. 110105, an adult collected by J. W. Johnson on July 14, 1885). Osgood (1904:76) examined this last specimen and believed it to be ". . . intermediate in character between *iliaca* and *unalaschcensis*, but nearer to *iliaca*."

Our specimens are of some aid in elucidating the relationships of these races in the Iliamna area. We collected two *P. i. unalaschcensis*, six *P. i. sinuosa*, and seven intermediates of these two races. At Ekwok we collected six *P. i. zaboria* and one of an intermediate nature between this race and *P. i. unalaschcensis*. One other specimen intermediate between these

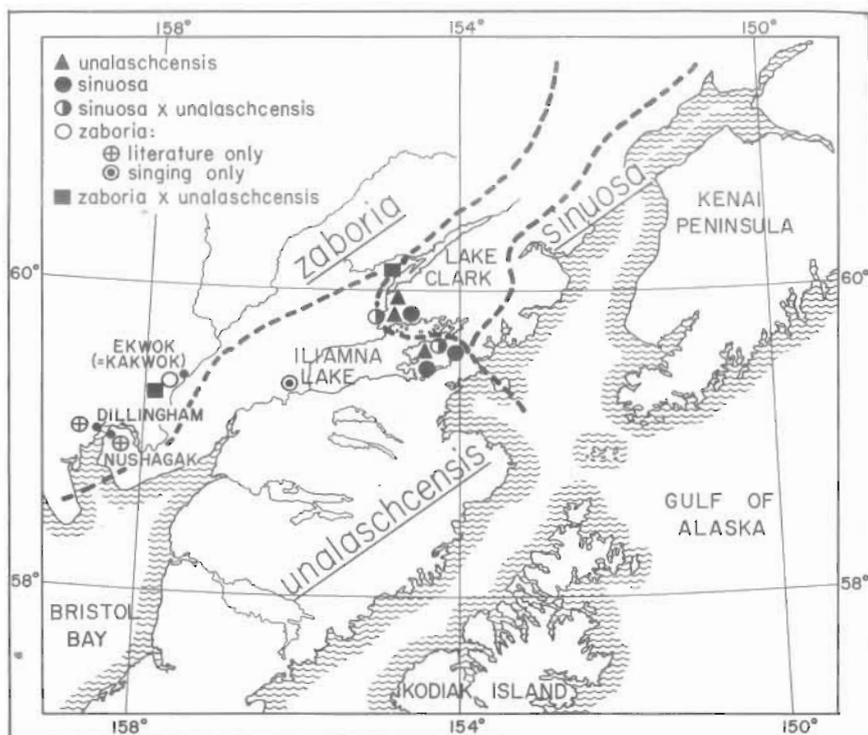


Figure 16. Distribution of races of fox sparrows in the Iliamna area; broken lines indicate suggested range margins.

last two races was collected at Nondalton. The localities where these specimens were taken are shown in Figure 16 along with suggested range limits for the respective races. The zone of intergradation between *P. i. sinuosa* and *P. i. unalaschcensis* is of undetermined width, but lies partially in the Iliamna Lake area. Free interbreeding of these very closely related races is indicated by our specimens, but the presence of pure parental types as well as intermediates would seem to indicate that in the vicinity of Iliamna Lake the zone of overlap is relatively narrow. On the other hand, it may be that where the topography and vegetation are uniform, such as along the shores of Cook Inlet, the zone of overlap may be quite extensive. The intermediates between *P. i. zaboria* and *P. i. unalaschcensis* (or perhaps *P. i. sinuosa* in the case of the Nondalton specimen) are best referred to as hybrids between well differentiated parental types. Since the zone of overlap is not great and hybrids are apparently rare, a relatively recent contact between long isolated populations is indicated. Similar contacts

between interior and coastal populations of fox sparrows have been found in the upper Cook Inlet region near Anchorage, where hybrids also are rare, even in areas where pairs of both races nest in proximity. Further study is needed before any conclusions can be reached regarding distribution and relationships of the races of fox sparrows in the Cook Inlet region.

Our opinion was mentioned earlier that we felt *Branta canadensis*, *Bubo virginianus*, and *Dendrocopos pubescens* all occur in the Iliamna area and likely represent populations of intermediate nature. This assumption is based necessarily on our findings with other species in the area with interior and coastal populations, and on our findings concerning this particular group of species in the upper Cook Inlet region where we have found evidence of intergradation in a relatively narrow zone.

Aside from the racial relationships of the species just discussed, certain matters regarding the taxonomy of other passerine birds in the Iliamna area require at least brief attention. These species are *Regulus calendula*, *Anthus spinoletta*, *Dendroica striata*, and *Melospiza lincolnii*.

We identified our only specimen of *A. spinoletta* as belonging to the race *A. s. rubescens*, indicating that the bird was a migrant of this far northern and eastern race. We have collected *A. s. rubescens* in migration in the upper Cook Inlet region but have found the breeding birds there to be *A. s. pacificus*. *Anthus spinoletta pacificus* is undoubtedly the race breeding in the Iliamna area as well. Recently, Irving (1960) has identified pipits from a number of localities in the Brooks Range of northern Alaska as *A. s. rubescens*, thus extending the known breeding range of this race westward from Yukon Territory to a point within 200 miles of the western arctic coast. This finding makes important a study of all the pipits collected in Alaska so as to better understand their racial relationships.

We obtained only five specimens of *Melospiza lincolnii*, but these, in addition to a larger series taken in the upper Cook Inlet area where this species is common, enabled us to make some judgment concerning the racial identity of these specimens. Gabrielson and Lincoln (1959) believed that the Alaskan Lincoln's sparrows belong to the race *M. l. alticola* and stated that these birds entirely lack the rich browns that characterize the eastern race *M. l. lincolnii*. However, these authors state that they had available only two breeding birds from Alaska, both of the gray type. Other specimens from the Yukon Territory and Mackenzie River were also referred to *M. l. alticola*. Other investigators in the Yukon Territory have identified specimens from Old Crow (Irving, 1960) and from points along the Canol Road (Rand, 1946) as *M. l. lincolnii*. We have found that the Cook Inlet specimens occur in gray and brown phases and, for the most

TABLE 10. WING LENGTH OF SOME BREEDING MALE *Melospiza lincolni*

Locality	No. of specimens	Mean wing length/mm
Newfoundland (<i>M. l. lincolni</i>)	11	63.8*
Interior Alaska (<i>M. l. lincolni</i>)	7	62.2*
Cook Inlet region (<i>M. l. lincolni</i>)	13	60.3*
San Bernardino Mts., California (<i>M. l. alticola</i>)	15	65.2 ¹

* 90% are 60.0-64.5

¹ 90% not less than 64.0

part, agree well with specimens from Newfoundland (near toptypical *M. l. lincolni*) taken in July. We also compared our series with a comparable one from British Columbia and found the same agreement in color characteristics. Gabrielson and Lincoln did not mention measurements, particularly that of wing length, useful in separating races of Lincoln's sparrows, and a point stressed by Miller and McCabe (1935) in their study of racial differentiation in this species and in their description of *M. l. alticola*. A comparison of measurements of our specimens with those for *M. l. lincolni* and *M. l. alticola* is presented in Table 10. Since Miller and McCabe pointed out that no specimen of a breeding male of *M. l. alticola* had a wing length of less than 64.0 mm, whereas our smallest was 58.2 mm and largest 63.0 mm, we feel that the general agreement in measurements and in color mentioned above make it impossible to identify the Cook Inlet specimens (including those from Iliamna) as belonging to other than the race *M. l. lincolni*. In the northern portion of the range of *Melospiza lincolni* the apparent east to west clines of decreasing percentage of reddish birds and of decreasing wing length do not seem to be of a nature that would substantiate the suggestion by Gabrielson and Lincoln that there may exist in Alaska an undescribed grayer race of this species.

The blackpoll warblers of the Iliamna area, and other parts of Alaska as well, are distinctly different in color from specimens taken in eastern Canada. Our specimens are considerably paler above and should be considered as belonging to the race *D. s. lurida* (Burleigh and Peters, 1948). Irving (1960) reported the same situation among specimens from Old Crow, Yukon Territory, noting that intermediates between *D. s. lurida* and *D. s. striata* were found around Fort Severn, Ontario, and Churchill, Manitoba by Burleigh and Peters.

The three specimens of *Regulus calendula* from the Iliamna area are all referable to the nominate race. In the upper Cook Inlet region near Anchorage, however, all but one of a series of 12 are clearly referable to the darker race, *R. c. grinnelli*, and the exception is only somewhat toward *R.*

c. calendula. It seems probable that a zone of overlap of these two races extends along the north shore of Cook Inlet and could enter the Iliamna area. A large series of specimens from various localities in this and other areas in the Cook Inlet region is needed to clarify this point.

FAUNAL AFFINITIES OF ILIAMNA BIRDS

As mentioned earlier, Osgood (1900) believed that only the coastal area south of the Lynn Canal should be considered a part of the Sitkan District, and that the remainder of the coastal area north to Kodiak Island was similar to the Yukon District (coniferous forests of interior Alaska). It is true that much of the characteristic fauna and flora of the distinctive Sitkan District does not extend north of the Lynn Canal, but the Hudsonian components of the biota are still probably outweighed by those of Sitkan affinity. Grinnell (1910) believed that the northern coastal region was divisible into four distinct faunal districts: Yakutat Bay, Prince William Sound, Cook Inlet, and Kodiak (this last includes Afognak Island). Grinnell (1910) discussed the composition of the Prince William Sound avifauna, comparing it with that of the Yukon and Sitkan Districts; the lack of data did not permit him to make comparisons with the other nearby coastal units he suggested as separate faunal districts.

The data are still insufficient to permit detailed comparisons and to decide upon the faunal distinctiveness of these areas. T. M. Shortt (1939) worked in the Yakutat Bay area, but his findings are not entirely conclusive; the number of specimens he collected was small, and these have never been studied taxonomically. Our data from the Cook Inlet, still under study, are substantial and will soon make possible detailed comparisons.

Since we cannot at this time properly assess the percentage distinctiveness of these smaller faunal units, and the relation of the Iliamna area to them, we have, for purposes of this brief discussion, decided to consider the Iliamna avifauna only in relation to larger units of ecological classification as follows: (1) the Moist Coniferous Forest Biome of Shelford (1945) (Sitkan Biotic Province), including the coastal areas of southeastern Alaska north to Cook Inlet and Kodiak and Afognak Islands; (2) the Tundra Biome of Shelford (Aleutian and Eskimoan Biotic Provinces), including the coastal tundra of the Alaska Peninsula and Bristol Bay; and (3) the Coniferous Forest Biome (Hudsonian Biotic Province), including the coniferous forest of interior Alaska. The characteristic avifaunas of these areas, elements of each of which are found at Iliamna, will be subsequently referred to as Sitkan, Eskimoan, and Hudsonian, respectively. We have attempted to analyze the avifauna of the Iliamna area to ascertain where its greatest faunal affinities lie. In doing this we have considered

only those species which have been actually observed or collected, by ourselves or other biologists, and only those which we believe breed in this or the other areas considered.

Many species of birds in the Iliamna area are so generally distributed as to have no value there in detecting faunal relationships. Fourteen such species and subspecies are found in all three biomes and do not seem to exhibit any preference. Nearly all of these are aquatic birds (*Gavia immer*, *Anas platyrhynchos*, *Anas acuta*, *Anas carolinensis*, *Histrionicus histrionicus*, *Mergus serrator serrator*, *Charadrius semipalmatus*, *Actitis macularia*, *Larus canus brachyrhynchus*, *Megaceryle alcyon*), but two are birds of prey (*Haliaeetus leucocephalus alascanus*, *Circus cyaneus hudsonius*), and two are passerine birds (*Corvus corax principalis*, *Wilsonia pusilla pileolata*). Five additional species are, with a few qualifications, best placed in this group. Three of these (*Mareca americana*, *Spatula clypeata*, *Asio flammeus*) are widely distributed in the Tundra and Coniferous Forest Biomes, but are restricted to the northern portions of the Moist Coniferous Forest Biome; American widgeon and short-eared owl are found only as far south as Yakutat Bay and the shoveler as far south as Cook Inlet. A fourth species (*Pandion haliaetus*) is widely distributed in both of the forested biomes, but occurs only sparingly in the Tundra Biome in the vicinity of Bristol Bay. The peregrine falcon (*Falco peregrinus*) is widely distributed in Alaska but may be represented in the Iliamna area by the strongly coastal race *F. p. pealei*.

Five species of birds in the Iliamna avifauna (*Empidonax traillii traillii*, *Iridoprocne bicolor*, *Hirundo rustica*, *Pica pica*, and *Spinus pinus*) are found in both the Coniferous Forest and Moist Coniferous Forest Biomes, although the black-billed magpie occurs only as far south as Yakutat Bay.

Thirty-eight species and subspecies of birds in the Iliamna avifauna show a marked preference for, and/or center of distribution in, the Coniferous Forest Biome. Eight species of this Hudsonian element are ones with races which occur at Iliamna and other races (those listed in brackets) which do not but are present in some part of the Moist Coniferous Forest Biome (*Falco columbarius bendirei* [*F. c. suckleyi*], *Turdus migratorius migratorius* [*T. m. caurinus*], *Ixoreus naevius meruloides* [*I. n. naevius*], *Hylocichla guttata guttata* [*H. g. nanus*], *Hylocichla ustulata incana* [*H. u. ustulata*], *Regulus calendula calendula* [*R. c. grinnelli*], *Passerculus sandwichensis anthinus* [*P. s. crassus*], *Melospiza lincolni lincolni* [*M. l. gracilis*]). The southeastern Alaska race of the savannah sparrow, *P. s. crassus* (Peters and Griscom, 1938), is not currently recognized by the A. O. U. Five additional races of Hudsonian affinity (*Canachites canadensis osgoodi*, *Parus hudsonicus hudsonicus*, *Vermivora celata celata*, *Den-*

droica petechia amnicola, *Passerella iliaca zaboria*), discussed in the section on racial relationships, overlap in range and interbreed in the Iliamna area with other races generally occurring in the Moist Coniferous Forest Biome. Two Hudsonian species (*Parus hudsonicus*, *Junco hyemalis*) are replaced by closely related species (*P. rufescens*, *J. oregonus*) farther south in the Moist Coniferous Forest Biome at Prince William Sound and Yakutat Bay, respectively. These 38 species and subspecies of Hudsonian birds also occur about Cook Inlet, and 22 (*Bucephala clangula americana*, *Bucephala islandica*, *Melanitta deglandi dixonii*, *Falco columbarius bendirei*, *Capella gallinago delicata*, *Totanus melanoleucus*, *Erolia minutilla*, *Limnodromus griseus caurinus*, *Larus argentatus*, *Larus philadelphia*, *Picoides tridactylus fasciatus*, *Tachycineta thalassina lepida*, *Parus atricapillus turneri*, *Turdus migratorius migratorius*, *Ixoreus naevius meruloides*, *Hyalocichla guttata guttata*, *Dendroica coronata hooveri*, *Wilsonia pusilla pileolata*, *Acanthis flammea flammea*, *Loxia leucoptera*, *Passerculus sandwichensis anthinus*, *Junco hyemalis hyemalis*) are found as far south along the coast as Prince William Sound. All of this group except two (*Junco hyemalis hyemalis*, *Ixoreus naevius meruloides*) occur also at Yakutat Bay, but only 10 (*Bucephala clangula americana*, *Falco columbarius bendirei*, *Totanus melanoleucus*, *Larus argentatus*, *Picoides tridactylus fasciatus*, *Tachycineta thalassina lepida*, *Dendroica coronata hooveri*, *Wilsonia pusilla pileolata*, *Acanthis flammea flammea*, *Loxia leucoptera*) occur in extreme southeastern Alaska. Actually, this last figure is somewhat misleading and could be reduced since two species, *Dendroica coronata hooveri* and *Acanthis flammea flammea*, are rare in southeastern Alaska, and a third, *Tachycineta thalassina lepida*, is uncommon. Further, there still seems to be some question about the relationships of the two races of pigeon hawks in southeastern Alaska. The race *Falco columbarius suckleyi* has been taken in that area and may later be found to overlap in breeding distribution with *Falco columbarius bendirei*. The woodpecker (*Picoides tridactylus*) is probably a relatively recent arrival in southeastern Alaska, and possibly has pioneered this area from the adjacent interior (Swarth, 1936). Grinnell (1909) considered the three-toed woodpecker of southeastern Alaska a distinct race *P. t. fumipectus* (= *Picoides americanus fumipectus*), but this race has not been recognized.

Twenty members of the Iliamna avifauna have a distinct preference for the Tundra Biome. Eleven of these species and subspecies are found also about Cook Inlet (*Gavia arctica pacifica*, *Gavia stellata*, *Phalacrocorax auritus cincinatus*, *Olor columbianus*, *Aythya marila nearctica*, *Oidemia nigra americana*, *Buteo lagopus*, *Heteroscelus incanum*, *Lobipes lobatus*, *Sterna paradisaea*, *Zonotrichia atricapilla*), although only a few of these

are common at all, and two, *Heteroscelus incanum* and *Zonotrichia atricapilla*, are usually found breeding only above timberline. Seven members of this group (*Gavia stellata*, *Aythya marila nearctica*, *Buteo lagopus*, *Heteroscelus incanum*, *Lobipes lobatus*, *Sterna paradisaea*, *Zonotrichia atricapilla*) are found also at Prince William Sound, and, with one exception (*Heteroscelus*), this last group occurs also at Yakutat Bay. Only four (*Gavia stellata*, *Aythya marila nearctica*, *Buteo lagopus*, *Sterna paradisaea*) are regularly found in extreme southeastern Alaska. The same 11 species and subspecies are also found in the Coniferous Forest Biome. The remaining nine species and subspecies of Eskimoan birds (*Lagopus lagopus alexandrae*, *Pluvialis dominica fulva*, *Squatarola squatarola*, *Aphriza virgata*, *Stercorarius parasiticus*, *Stercorarius longicaudus*, *Phylloscopus borealis kennicotti*, *Passerella iliaca unalaschcensis*, *Calcarius lapponicus alascensis*) are, in general, restricted to the Tundra Biome, although three (*Squatarola squatarola*, *Phylloscopus borealis kennicotti*, *Calcarius lapponicus alascensis*) are found uncommonly in the Coniferous Forest Biome, and one (*Stercorarius parasiticus*) is found sparingly along the coast south of Prince William Sound. One subspecies (*Passerella iliaca unalaschcensis*) is a derivative of the Sitkan avifauna now restricted to the Alaska Peninsula and Unimak Island.

* At the present time, we know only five members of the Iliamna avifauna to be distinctively birds of the Moist Coniferous Forest Biome (*Canachites canadensis atratus*, *Parus hudsonicus columbianus*, *Vermivora celata lutescens*, *Dendroica petechia rubiginosa*, *Passerella iliaca sinuosa*). One of these (*Parus hudsonicus columbianus*) is not found along the coast south of Cook Inlet. Only one bird of strong Sitkan affinity (*Vermivora celata lutescens* based on one collected specimen) is found at Iliamna and also along the coast all the way to southeastern Alaska.

The presence of Iliamna Lake has an influence on the distribution of many species of aquatic birds, although most of these would be present in the same area on less extensive waters. There is, however, a small maritime element (*Phalacrocorax auritus cincinatus*, *Brachyramphus marmoratum*, *Arenaria melanocephala*, *Larus glaucescens*), which is thought to occur only because of the lake. These species have been considered earlier as belonging to the Sitkan and Eskimoan avifaunas, though the cormorant is also found on large lakes on the Kenai Peninsula and southcentral Alaska in the Coniferous Forest Biome.

The avifauna of the Iliamna area is one of essentially Hudsonian affinities. In fact, the relatively few components of the Sitkan avifauna found in this area are present only because there is a belt of nearly continuous forested country connecting Iliamna Lake and Cook Inlet. Further, this

westernmost extension of the Moist Coniferous Forest Biome, adjacent to Iliamna Lake, is inhabited by a relatively dilute Sitkan avifauna. The relationship of the forested area about Iliamna Lake to the forest along the shores of Cook Inlet can be seen in Figure 3, along with the virtually continuous forest of interior Alaska which extends into and covers most of the Iliamna area. The sizable Eskimoan element of the Iliamna avifauna is present as a result of the extension into this area of the Tundra Biome, also represented in Figure 3.

The most distinct breaks between Hudsonian and Sitkan faunal elements occur between Cook Inlet and Prince William Sound, and between Yakutat Bay and extreme southeastern Alaska. This and other data suggest to us that there are two distinct faunal districts in the Moist Coniferous Forest Biome of Alaska, the Sitkan District in the extreme southeast, and the Prince William Sound District in the north. Yakutat Bay and Cook Inlet (including the Iliamna area) do not have similar distinctive faunal characteristics although this is admittedly somewhat arbitrary. The last two areas represent rather, zones with strikingly mixed faunas. It does appear likely that a third faunal district might include Kodiak and Afognak Islands.

SUMMARY

During May and June of 1958 and 1959, 86 man-days were spent by the writers in the vicinity of Iliamna Lake, Alaska, where, in conjunction with studies of animal-borne diseases, information was gathered on birds.

Previous ornithological work in the area, climate, physiography, and major ecological considerations, including the overlap in this area of three biomes (Moist Coniferous Forest, Coniferous Forest, and Tundra Biomes), are briefly discussed. Twelve ecological formations, based on life-form of the plants and distinctive features of geology, are described in general terms, and are used to analyze the distribution of birds. An annotated list of 103 species is presented, including 81 species we observed as well as others which have been recorded in this area by other observers. We obtained evidence of breeding for many of these species and believe it is probable that the remainder also breed in the vicinity of Iliamna Lake. Data from our specimens are included.

A comparison of our findings with the earlier work shows evidence of marked fluctuations in the population levels of some species and also evidence of shifting range margins for others.

Five species of birds (*Canachites canadensis*, *Parus hudsonicus*, *Vermivora celata*, *Dendroica petechia*, *Passerella iliaca*) were found to be represented in the Iliamna area by populations possessing characteristics inter-

mediate between those of races of the interior and coastal regions. One species, *Passerella iliaca*, is represented in the area by three races (*zaboria*, *unalaschcensis*, *sinuosa*). Specimens of an intermediate nature between *zaboria* and the other races are apparently rare. These and other problems of racial relationships are discussed.

The Iliamna avifauna was found to be comprised of elements from the Sitkan, Hudsonian, and Eskimoan avifaunas, elements associated with the Moist Coniferous Forest, Coniferous Forest, and Tundra Biomes, respectively. The majority of the species (38) are of Hudsonian affinity, a sizable segment (20) is essentially Eskimoan, but the Sitkan avifauna is only weakly represented (5). Another large element (19) is comprised of species so generally distributed as to have little value in detecting faunal relationships. Our data suggest that distinct faunal districts exist in extreme southeastern Alaska, Prince William Sound, and probably Kodiak and Afognak Islands. The Iliamna-Cook Inlet region is one with a mixed avifauna.

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