

HABITAT DISTRIBUTION OF BIRDS BREEDING ALONG THE UPPER KAOLAK RIVER, NORTHERN ALASKA

By WILLIAM J. MAHER

Until recently all that was known of the distribution of birds in northern Alaska was based on work done at or near the arctic coast. Kessel and Cade (1958) have now broadened our knowledge by a report summarizing a large amount of data on the distribution of birds along the Colville River, the largest river system north of the Brooks Range. The following report is a record of the avifauna of an area along the Kaolak River in northern Alaska, west and north of the area covered by their report. The area lies on the northern edge of the northern foothills of the Brooks Range just south of their transition to the coastal plain. It is distant from any major river system and thus lacks many physiographic features and the accompanying diversity in habitats associated with large river valleys. In this respect it is considered representative of a large part of the outlying foothill area which is normally inaccessible to field parties.

The Kaolak River was visited in 1957 from July 8 through August 9, and in 1958 from June 21 to 27, and again from July 9 through August 15. The chief purpose of these visits was an investigation of the ecology of the populations of Parasitic and Long-tailed jaegers, but in the course of this work notes were gathered on all species of birds which were seen, and these observations form the basis of the present report.

ACKNOWLEDGMENTS

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DESCRIPTION OF THE AREA

The arctic slope of Alaska consists of three physiographic provinces, the Brooks Range, the Arctic Foothills, and the Arctic Coastal Plain. The foothill province is divided into northern and southern sections (Payne *et al.*, 1951). The study area, within the former section, is at latitude 69° 50'N and longitude 159° 56'W. The precise location given here is based on the Utukok River Quadrangle of the Alaska Reconnaissance Topographic Series, 1951 edition, published by the United States Geological Survey.

Topographically, the region consists of gently rolling ridges and hills, the tops of which are approximately equal in elevation (fig. 1). Drainage is well developed, there are few lakes and many of those present are relicts occupying large, partly drained basins. A few small lateral lakes are present near bends of the rivers. The rivers are mature with intrenched meanders; they have done little side-cutting.

The study area comprised approximately ten square miles of foothill tundra on the east side of the Kaolak River between its east fork and a large eastward bend of the main river. It is shown in detail on the accompanying map (fig. 2).

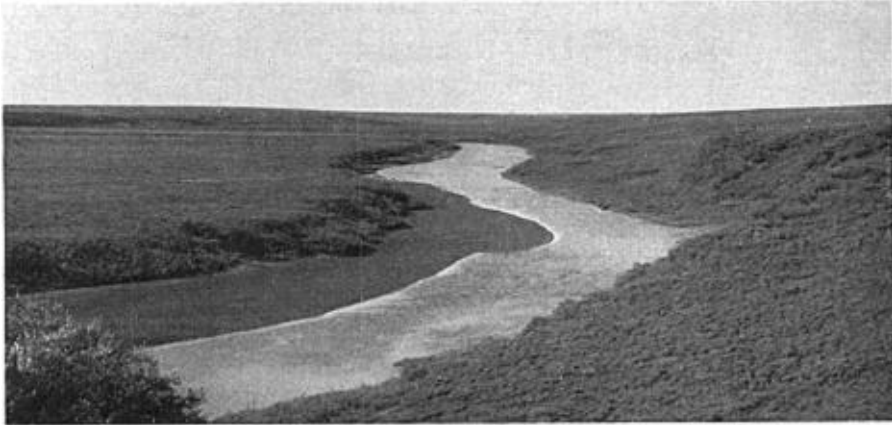


Fig. 1. General view of tundra along the Kaolak River. Riparian shrub habitat dominated by felt-leaved willows is seen at left-center (above beach) and also at right-center (in draws). Behind willows at left, *Carex* marsh is represented; beyond on slopes, tussuck-heath tundra.

The elevation of the river in the area is 60 to 70 feet above sea level. The river itself is small, about 60 feet wide, and shallow. Along its course there are narrow bluffs which may be occasionally as much as 40 to 60 feet high. From the river the terrain rises in a gently convex slope to a plateau approximately 150 feet above the river bed. Maximum elevation in the area is slightly less than 250 feet. On the plateau are two large relict lakes occupying a portion of a much larger basin now partly drained by a small stream.

Camp was located on a gravel bar 200 yards downstream from the confluence of the east and west forks of the river. From here the area was surveyed on foot. No field schedule was established the first season, but I was in the field almost daily and covered the entire area at least once a week. In the second season a regular schedule of weighing penned jaeger chicks was established. A route, which covered the south half of the area thoroughly, was traveled every three days. The north part of the plot was visited periodically to resurvey resident jaeger pairs. The areas west and south of the study plot were visited on occasion but most of the field work was concentrated in the area defined above.

CLIMATE

The climate of this region is severe; the winters are long and cold, but the summers are comparatively warm. The only climatological data available for this part of the arctic slope are from Umiat, situated 200 miles east in the Colville River valley, and they appear to be applicable here. Kessel and Cade (1958) have summarized the United States Weather Bureau data gathered at Umiat from January, 1947, through July, 1954. This brief discussion will be based on their analysis.

The mean annual temperature is 10°F. Winters are nine to ten months long; the coldest months are January and February, when the monthly mean drops below -20°F. The winter days are very short. At Umiat the sun remains below the horizon continuously from November 30 through January 10, and at the Kaolak study area it is not visible from November 26 through January 13. The summers are short and comparatively warm. The temperature rises above freezing in May and the snow pack begins to melt. The mean temperature is above freezing only for the months of June, July, and August. July is the warmest month, with a monthly mean of 43°F. The sun is above the horizon continuously from May 19 through July 24 at Umiat and from May 13 through July 27 at the Kaolak River.

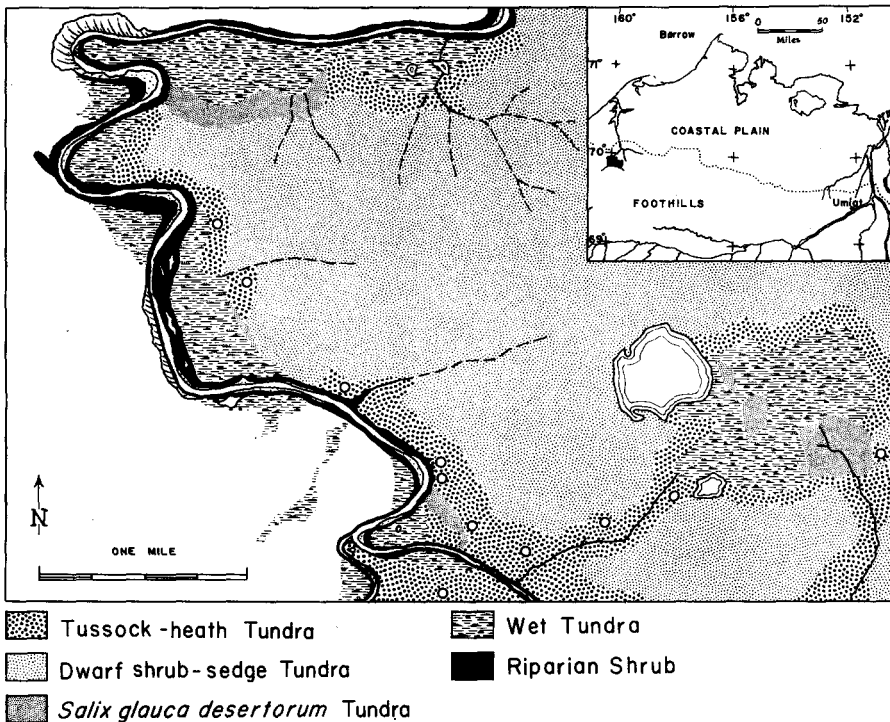


Fig. 2. Map of the study area showing the distribution of habitats. Upper right inset shows location of area. Small circles indicate location of territorial pairs of Golden Plovers in June, 1958. The unclassified area to the west of the river was not regularly surveyed.

Annual precipitation is low, averaging less than six inches a year. Almost half of this falls as rain in the summer months.

In the summer of 1958, I kept a record of daily maximum and minimum temperatures at the Kaolak River from July 15 through August 15. Daily mean temperatures averaged 55.5°F. in July and 53.5°F. for the first half of August; the means ranged from 47.0 to 64.0°F. The maximum temperature for that period was 81°F., the minimum 34°F. These data are summarized in table 1.

HABITATS

The vegetation of this area, as of tundra generally, has an outward appearance of monotony as a result of the generally low stature of the vegetation and the restricted number of life forms of the plants present. It has been demonstrated by Churchill (1955) and Bliss (1956) that quantitative analysis of tundra vegetation reveals a great diversity of community types. Communities distinguished on the basis of floristic composition, however, are of little significance to the student of bird distribution; yet it is apparent that the birds are responding to subtle differences in vegetation form. Hence, it is possible to differentiate meaningful ecological formations within the seemingly uniform tundra vegetation. I have recognized seven major habitats, four of which are based primarily on the life-form of dominant plants and three primarily on physical characteristics of the terrain. The distribution of these habitats on the study area is shown in figure 2.

Dwarf shrub-sedge tundra.—The upland plateau is covered by a formation charac-

terized by the presence of low shrub willow (*Salix pulchra*), 12 to 15 inches in height, and sedge tussocks (*Eriophorum vaginatum*). There is incipient polygonal patterning in this formation resulting in a characteristic microrelief consisting of level polygon tops separated by troughs 12 to 20 inches deep (fig. 3). The troughs tend to be narrow and deep near the edge of the upland, and broad and shallow toward the center where the terrain is more level. The troughs are filled with *Carex bigelowi*, *C. aquatilis*, and *Eriophorum angustifolium*. On the dryer polygon surfaces, in addition to shrubs of *Salix pulchra* and tussocks of *Eriophorum vaginatum*, various other sedges and grasses occur, including *Arctagrostis latifolia* and several species of *Poa*. Common and characteristic forbs are *Petasites frigidus*, *Pyrola grandiflora*, and *Pedicularis capitata*.

Table 1
Summary of Daily Fahrenheit Temperature Records, Kaolak River, Alaska,
July 15 to August 15, 1958

Date	Mean	Extremes	Mean minimum	Mean maximum
July 15-31	55.5	39-81	44.2	66.2
August 1-15	53.5	34-81	42.1	64.6

As a result of the segregation of plants between the polygons, troughs, and the polygon tops, this formation looks like a level mosaic of broad willow patches 10 to 30 yards in diameter, surrounded by narrower grassy areas, three to 15 feet across. The relative proportions of the two structurally dominant species changes from place to place on the upland. In some areas *Eriophorum vaginatum* is dominant and the willow is reduced in prominence. In other areas the tussocks are reduced in size and number, or almost absent.

On the north end of the study plot where the upland slopes gently downward in a broad drainage pattern the tussocks are much reduced in number. Willow shrub is scattered, and *Betula nana*, which is not conspicuous on the rest of the upland, here becomes 15 inches tall. Grasses and especially sedges are luxuriant so that the polygonal and tussock character of the formation is obscured. It remains, however, basically a two-layered, low-shrub habitat. In the bottoms and sides of the few swales on the upland, as well as in protected places along the edge of the upland lake basin, the willows reach two feet in height.

Salix glauca desertorum becomes a conspicuous part of this formation on the breaks of the bluffs and in areas of the upland lake basin, as well as on the lower part of some slopes (fig. 3). In the latter two situations *S. g. desertorum* reaches three feet in height and forms an open shrub formation which is an important, although only a local, habitat-type. When necessary, this habitat will be referred to specifically.

The dwarf shrub-sedge tundra as here described is partly similar to Kessel and Cade's dwarf shrub habitat, although they describe it as limited to drainageways. Apparently they did not find broad areas of willow shrub.

Tussock-heath tundra.—Typical tussock-heath tundra is characterized by conspicuous tussocks of *Eriophorum vaginatum* and associated heath plants. It is the presence of the tussocks which gives it a characteristic basketball structure. "The tussocks vary considerably in size and number in different areas but commonly attain heights of 6 to 10 inches and somewhat lesser diameters. Channels between tussocks are usually only a few inches wide and occupied by mosses, lichens and vascular species" (Britton, 1957). Common heath plants associated with *E. vaginatum* are *Ledum decumbens*, *Vaccinium vitis-idaea*, *Cassiope tetragona*, and *Arctostaphylos alpina*. Another common associate is *Rubus chamaemorus*.

On the slopes of the upland plateau the vegetation differs from more characteristic tussock-heath tundras as described above. Here tussocks are not as well developed and

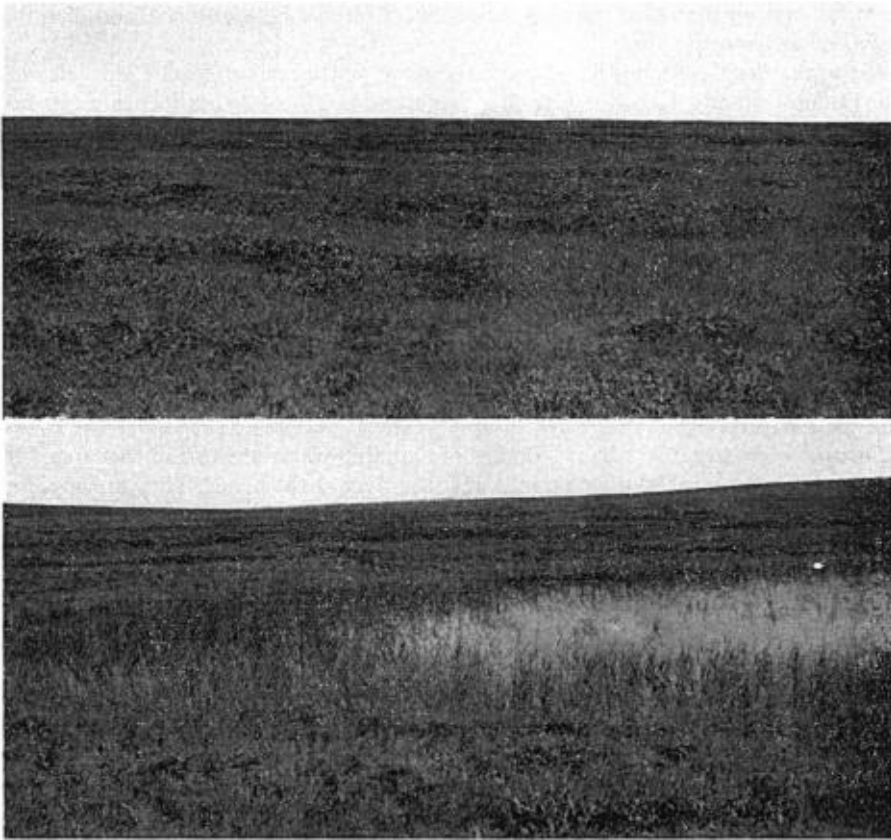


Fig. 3. Above, dwarf shrub-sedge tundra showing polygonal patterning, with dwarf willows occurring on polygon tops and sedges in broad shallow troughs.

Below, wet tundra, showing *Carex* marsh along edge of pond and adjacent wet tussock-heath tundra.

there is a greater abundance of grasses and sedges. Typical low shrubs such as *Ledum* and *Rubus chamaemorus* are absent. *Arctostaphylos* and *Cassiope* are rare.

This formation is equivalent in its more typical form to the tussock-heath tundra of Kessel and Cade (1958). It seems to include all four subtypes of Churchill's (1955) dwarf shrub heath type.

Wet tundra.—Wet tundra occupies the level land at the bends of the river and the lower part of the upland lake basin. As I have defined it here, it actually consists of two different plant formations, the *Carex aquatilis* marsh type, and a wet heath tundra. *Carex* marsh occurs in wetter areas, usually having water one to three inches deep overlying the substrate. The vegetation is almost entirely *Carex aquatilis*, other sedge species, and grasses. There is a broad area of this habitat around the two upland lakes and on parts of the river bends (fig. 3). *Carex aquatilis* marsh is equivalent to the formation of the same name of Churchill, and to the sedge-grass marsh of Kessel and Cade. A wet tussock-heath type is developed in some of the wet areas and sometimes interspersed with the *Carex* marsh in "low center" polygon areas. In some places it forms continuous stands. It is similar to typical tussock-heath tundra with greater abundance of sphag-

num moss and an increased importance of dwarf birch (*Betula nana*) and cloudberry (*Rubus chamaemorus*).

Riparian shrub.—Along the edges of the river, felt-leaved willows (*Salix alaxensis*) occur in dense stands. Here they reach a maximum height of 7 to 8 feet in a few favorable locations, although they average nearer 4 to 5 feet. This formation is never extensive, usually extending less than ten yards from the river. In a few places it extends into small draws in the river bluffs. *Salix alaxensis* is the most abundant species, followed by *S. richardsonii* and *S. arbusculoides* in order of decreasing frequency. Some characteristic forbs are associated with the riparian shrub. Most conspicuous of these are *Lupinus arcticus*, *Hedysarum alpinum*, and *Castilleja pallida*. This formation is the equivalent of the tall brush of Kessel and Cade. It is included in the *Salix* type of Churchill.

Fluvial waters and alluvial bars.—This category includes the river and the gravel bars exposed along its course. The latter are not extensive along the Kaolak and are subject to occasional inundation. In 1957 they were covered entirely with water after the third week in July.

Lacustrine waters and edges.—Bodies of standing water are few in this area. There are several small lateral lakes and ponds near the river at the bends. They are apparently not numerous enough to attract a large population of the birds which nest in this habitat. On the upland are the two relict lakes already mentioned.

Cliffs and talus slopes.—On the outside of the river bends, bluffs may reach a height of 40 to 60 feet. Although these were utilized as perches by immature Golden Eagles, they are apparently not extensive enough to attract cliff-nesting species.

SEASONAL CHANGES IN AVIFAUNA

Of the species of birds known to nest at the Kaolak River, only the Willow Ptarmigan (*Lagopus lagopus*) is resident through the winter. The Snowy Owl (*Nyctea scandiaca*), the Gyrfalcon (*Falco rusticolus*), and the Common Raven (*Corvus corax*) are resident in the northern foothills in winter (Kessel and Cade, 1958), and transients may occur in the Kaolak River during this season.

Migratory species begin to arrive in early spring. I have recorded a Peregrine Falcon (*Falco peregrinus*) feeding on a freshly killed Willow Ptarmigan at Umiat on April 17, 1955. Redpolls (*Acanthis "hornemanni"*) and Snow Buntings (*Plectrophenax nivalis*) are also early arrivals. Redpolls were observed in the Brooks Range on the Killik River at Easter Creek in early March, 1954. A flock of 40 to 50 was seen feeding on exposed grass stems at Umiat on April 23, 1955, and large flocks fed along the cliffs of the Chandler River on May 1, 1955. Snow Buntings were observed as early as April 27, 1955, when three were seen at Umiat. A flock of 30 to 40 was also observed at Umiat on May 5 of that year. Most other summer residents, however, do not arrive until late May and early June.

Fall departure begins by mid-July when the shorebird eggs have hatched and the passerine young are leaving the nest. Adult Pectoral Sandpipers, Semipalmated Sandpipers, Dowitchers, and Northern Phalaropes, begin departing at this time. The Golden Plover and Bar-tailed Godwit begin leaving later in the month. By mid-August only an occasional group of juvenal shorebirds is still present.

Passerine juveniles complete their postjuvinal molt after the adults depart. They are still present in reduced numbers in mid-August.

MAMMALS PRESENT

One species of shrew (*Sorex arcticus*) and five species of microtine rodents were trapped on the study area. The latter consist of the collared lemming (*Dicrostonyx*



Fig. 4. A close view of tussock-heath tundra in which cotton-grass tussocks are dominant.

groenlandicus), the brown lemming (*Lemmus trimucronatus*), the red-backed vole (*Clethrionomys rutilus*), the tundra vole (*Microtus oeconomus*), and the singing vole (*Microtus miurus*). The arctic ground squirrel (*Spermophilus undulatus*) was common along the river banks. In 1958, a pair of red foxes (*Vulpes fulva*) raised a litter of at least three kits on the study area. These foxes were important predators on the ptarmigan and shorebird populations. The arctic fox (*Alopex lagopus*) and the wolverine (*Gulo luscus*) occurred as transients. Large numbers of caribou (*Rangifer arcticus*) migrated through the area twice each summer. Gray wolves (*Canis lupus*) were associated with the herds. Grizzly bears (*Ursus horribilis*) were seen occasionally; they were usually observed trailing behind the moving caribou herds. One fed on a caribou carcass near camp on July 28, 1958.

SPECIES LIST

Gavia arctica. Arctic Loon. A pair nested on one of the upland lakes in 1957. In 1958 two pairs nested, one on each of the two upland lakes. Both pairs were present on June 23. On August 14, a half-grown young was observed with the pair on the smaller lake. At the larger lake, on July 26, a nest was found three feet from the water's edge; it contained two eggs. On August 1 the eggs had not yet hatched. However, on August 14 the pair was seen accompanied by two small downy young. It is likely that these did not succeed in maturing before the onset of cold weather. These young probably resulted from a second nesting attempt, for on August 1 an empty nest, obviously constructed in the same season, was found on the shore of the same lake.

The larger lake is one-half mile across its greater diameter and the smaller one is one-eighth of a mile across.

Anas acuta. Pintail. None was seen in 1957. On July 24, 1958, a female was seen alighting on the river.

Anas carolinensis. Green-winged Teal. This species was not observed in 1957. In 1958 a pair was seen swimming on the river on July 23.

Aythya marila. Greater Scaup. Rare in this area. Two pairs were known to nest in 1957; none was recorded in 1958. An adult female was seen with five downy young on July 16, 1957, on a small lateral lake adjacent to the river. A second female, also with five downy young, was seen on the river on July 28 of the same year.

Clangula hyemalis. Oldsquaw. Rare in both seasons. This species was seen on the upland lakes, on lateral lakes, and on the river. On July 11, 1957, a downy young was found on the shore of one of the upland lakes. In 1958, on June 26, a pair was seen on the river below camp. A female and two downy young were seen on July 11 on a lateral lake along the same stretch of river. Adults were observed flying on several occasions during both seasons.

Mergus serrator. Red-breasted Merganser. Scarce in this area. It was seen only in 1958. A pair was observed swimming on the river on June 24. Several females and a male were seen on the river occasionally in late June and early July. In mid-July a female was frequently seen resting on a gravel bar above camp. On July 24, a female and eight downy young swam downstream past the tent. The following day a female and ten downy young also traveled downstream past camp. I cannot be sure that these were two separate broods, since I might have miscounted the number of chicks on one occasion. From the number of females seen earlier in the season, however, I consider it likely that two pairs nested in the vicinity. The crops of three of five chicks collected on July 25 contained the remains of small fish. All five of these downy chicks were males. Their weights were 56.2, 47.4, 49.2, 47.5, and 50.5 grams, respectively.

Aquila chrysaetos. Golden Eagle. An immature eagle was resident in both 1957 and 1958. Occasionally a second individual was seen, but only one was present regularly each season. It frequented the low bluffs along the river and foraged over the entire area. On August 6, 1957, one was seen to stoop unsuccessfully at an adult Willow Ptarmigan. On August 14, 1958, one was attracted by a flock of ptarmigan which flushed ahead of me. It glided over and circled the spot where they had landed for several minutes before departing. On two separate occasions in July, 1958, I saw an eagle feeding on a caribou carcass on the tundra. Eagles were frequently harassed by Parasitic and Long-tailed jaegers.

Falco rusticolus. Gyrfalcon. Transient individuals were noted occasionally in both seasons.

Lagopus lagopus. Willow Ptarmigan. This species nested commonly in the area in both seasons. It seemed to be more abundant in 1958 than in 1957. In late June and early July, single males were commonly flushed on upland dwarf shrub-sedge tundra and some from among riparian willows. Only one nest was located. It was situated in a hollow among tussocks of *Eriophorum vaginatum* on a tussock-heath tundra slope. The nest was a simple bowl lined with grasses; it contained the shells of seven hatched eggs. Young were first seen on July 13 in 1957 and July 10 in 1958. Family groups were encountered in all habitats where good cover was provided by the vegetation. They were frequently flushed on the upland dwarf shrub-sedge tundra, and occasionally in riparian shrub and in the *Salix glauca desertorum* shrub tundra along the base of the hillsides. Five broods ranged from one to five in number, with an average of three.

There was some evidence of nonbreeding in the 1958 population. On June 26, 1958, I observed a group of three females and a male feeding together. Flocks of adults numbering up to a dozen were noted in riparian shrub by the last week in July. Males predominated in these groups. This may indicate a surplus of males in the population.

Ptarmigan were being heavily preyed on by a family of red foxes in the breeding season of 1958. In addition, two fox kills from the previous winter were found on the tundra, and a large number of winter kills were noted around the fox den on June 22. On July 11 the remains of ptarmigan chicks, mostly wings, were abundant by the same den. Few ptarmigan remains were found here later in the season, and it may be that the impact of the fox predation on the ptarmigan is greatest on the winter flocks and on the chicks before they are able to fly well.

Data on specimens are: ♂♂, July 21, 1957, testis 9 mm., weight 695 gm. (little fat); July 22, 1957, testis 7 mm., weight 613 gm. (little fat), testis 7.5 mm., weight 630 gm. (little fat); July 23, 1957, testis 7 mm., weight 585 gm. (little fat), testis 7 mm., weight 545 gm. (little fat), testis 7 mm., weight 560 gm. (little fat), testis 6 mm., weight 558 gm. (little fat). ♀, July 22, 1957, ova to 2 mm., weight 556 gm. (little fat). Jv., sex ?, July 12, 1957, weight 54 gm. (no fat); ♂ jv., July 22, 1957, testis 2 mm., weight 73 gm. (no fat); jv., sex ?, Aug. 6, 1957, weight 183 gm. (no fat). ♂ jv., Aug. 3, 1958, weight 222 gm. (no fat).

Grus canadensis. Sandhill Crane. A rare transient in this area. Two were seen in 1958 on August 1, calling as they glided in circles high overhead. They flew out of sight toward the west.

Charadrius semipalmatus. Semipalmated Plover. Uncommon. I have only one indication of breeding in the area: On July 16, 1957, I saw two adults and two newly hatched downy young on an alluvial bar. One other adult was seen on July 23 of that year in the same habitat. None was observed in 1958.

Pluvialis dominicus. American Golden Plover. A common nesting species, it was also the most conspicuous nesting shorebird in the area. In 1958, territorial pairs present at the end of June were mapped (fig. 2). Nesting density would seem to be two to three pairs per mile along suitable habitat. This mapping was incidental to other work, and the numbers indicated should be considered a minimal figure. As can be seen from the figure the habitat preference of these birds seemed to restrict them to the river course and to drainageways traversing the uplands. None was seen in the dwarf shrub-sedge tundra on the upland. The areas selected were tussock-heath tundra, the prerequisite seeming to be a lack of willow shrub and an openness of the vegetation. The birds also showed a preference for being on a slope; this is probably related to the need of territorial males for a prominent position for observing the surroundings. All nesting pairs were located either on slopes above the river, on the breaks of the river bluffs, or on the edges of lesser drainageways.

A downy chick weighing 91.4 grams was collected on July 16, 1958. This was the only chick seen. The plover population remained relatively constant in numbers through late July when all other shorebirds were already reduced in numbers or absent. On August 4, a flock of five flying juveniles was seen. Two flocks of 7 and 12, also of juveniles, were seen the following day. None was observed after this date.

Data on two specimens collected are: ♂, July 16, 1958, testis 6 mm., weight 134.1 gm. (little fat); jv.?, July 16, 1958, weight 91.4 gm. (no fat).

Capella gallinago. Common Snipe. Rare. On June 22, 1958, one was seen circling high and "winnowing" over a section of *Carex* marsh. This is the only record of this species for the two seasons.

Erolia melanotos. Pectoral Sandpiper. An uncommon nesting shorebird in this area. Birds exhibiting alarm at my approach, and thus suggesting the presence of chicks, were seen on the uplands in dwarf shrub-sedge tundra, and in *Carex* marsh at river bends and in the upland lake basin. They were never common, perhaps two to four individuals would be seen in a mile or mile and a half of uplands.

On July 10, 1958, a male downy chick weighing 37.7 grams was collected in *Carex* marsh. On July 16, a downy chick was found at a fox den. A flock of 16 adults was seen in the upland lake basin on July 11, 1958. By July 20 their numbers had dropped off noticeably. Several adults and approximately four flying chicks were flushed from *Carex* tundra along the edge of the upland lake on July 26, 1958. The last flocks seen that year, of four and five, respectively, were seen on August 4.

Data on specimen collected: ♂, Aug. 1, 1958, weight 61.0 gm. (little fat).

Limnodromus scolopaceus. Long-billed Dowitcher. An uncommon breeder. Two or three pairs were seen in 1957, and perhaps five or six in 1958. They seemed restricted to the *Carex* marshes near the upland lakes and at river bends. One territorial pair was seen in an area of tussocks and shrub willows in the upland lake basin in close proximity to *Carex* marsh.

On July 20, 1958, they were noted as decreasing in numbers. Four to six flying chicks were flushed from *Carex* marsh in the lake basin on July 26. On August 7, 1957, two young of the year were seen on wet tussock-heath tundra along the river. One juvenile was seen on August 13, 1958.

Data on specimens collected are: ♀ jvs., Aug. 1, 1958, weight 84.6 gm. (no fat), 97.5 gm. (little fat).

Ereunetes pusillus. Semipalmated Sandpiper. An uncommon breeding bird. A few pairs were seen in both seasons. The majority were observed in marshy habitats, one pair in a *Carex* marsh at a river bend and several others, perhaps four to six pairs, in the *Carex* marsh of the upland lakes. A pair was seen in the dwarf shrub-sedge tundra of the upland and another pair in *Salix glauca desertorum* shrub tundra in the lake basin. Although several males were seen displaying in the latter part of June, no nest or chick was ever found. Adults were observed frequently on alluvial bars in late July of 1957. None was seen after July 15 in 1958.

Data on specimen collected: ♂, July 13, 1958, testis 3 mm., weight 20.7 gm.

Limosa lapponica. Bar-tailed Godwit. Although scarce in this area, this species, because of its

noisy behavior, is one of the most conspicuous of nesting shorebirds. Its numbers seemed to be approximately the same in both seasons. In 1957 there were at least six pairs and possibly more on the study area. In 1958 there were seven and possibly eight pairs nesting.

All pairs noted in late June in 1958 were in the vicinity of Long-tailed Jaeger nests. Of 11 jaeger nests, five had one pair of godwits associated with it and one nest had two pairs. No godwit nests were found. The males made their presence known by springing up and screaming when I was approximately 150 yards from a jaeger nest. Usually they would remain with me circling, and screaming a continuous, high pitched metallic call: *yet'-a, yet'-a, yet'-a, yet'-a*, uttered rapidly with the first syllable heavily accented. The call was given with no variation in pitch and was continued for as long as I was within 100 to 150 yards of the jaegers' nest. During this period only one bird was seen at each jaeger nest, presumably the males which, according to Brandt (*vide* Bent, 1927:290), do not incubate. None was noted in the vicinity of three nests of the Parasitic Jaeger. One pair which acted as if it had chicks was observed in a *Carex* marsh at a river bend on July 15. This was the only pair observed in 1958 not associated with a jaeger nest.

In the course of the work on the two jaeger species in 1958, a record was kept of the occurrence of godwits through the season. Of seven pairs noted in late June, three pairs were still present on July 20. Only two pairs remained on July 26, and one on July 29. Two adults were seen separately on August 5, and on August 12 a group of three flying juveniles was seen.

The association of godwits with jaegers was not observed in 1957. In that year, of five pairs noted, two occurred together in wet tussock-heath tundra, one on a tussock-heath tundra slope along the river, one in a shrubby swale, and one on a slope of *Salix glauca desertorum* shrub tundra above an area of wet tundra. All of these pairs had chicks, judging by their reactions to my presence, so that it is impossible to say whether or not they had nested in the situations in which they were first observed. Nevertheless, I believe, from the fact that the association between the jaegers and godwits in 1958 continued through the season, that had it occurred in 1957, it would have been readily apparent.

A dead chick of this species was found at the mouth of a red fox den on July 16, 1958. On July 26, 1957, a two-thirds grown chick and one adult were observed in riparian shrub.

The stomach of an adult male collected on July 20, 1957, contained 70 partly digested land snails (*Succinea strigita*). I had made a special effort to collect land snails and observed this species of snail only in the riparian shrub. This fact, plus the fact that godwits were observed along the alluvial bars, especially late in the 1957 season, suggests that riparian shrub may be an important foraging area for this species. They were not observed in these habitats in 1958 (see discussion).

Data on two specimens collected: ♂, July 20, 1957, testis 7 mm., weight 261 gm. (little fat); ♀, July 21, 1957, largest ovum 1.5 mm., weight 304 gm. (no fat).

Phalaropus fulicarius. Red Phalarope. Rare in this area. Its breeding status is questionable. None was seen in 1957. In the following season, six were seen on June 22 in the *Carex* marsh of the upland lake basin. Two of these showed considerable alarm at my intrusion, and I thought they might be breeding. One other was seen the next day about some small tundra ponds at a river bend. No more were seen for the remainder of the season. I do not think they bred in 1958, but the presence of birds in breeding condition in late June indicates that they could breed occasionally.

Lobipes lobatus. Northern Phalarope. Seen regularly in small numbers in marshy areas and about all the ponds and lakes in the area in late June. On July 12, 1957, a male was seen leading three downy chicks through riparian shrub to the river. On July 10, 1958, a male with one downy chick was observed on a small pond 30 yards from the river. An hour later the same male and chick were seen swimming on the river. Single males were occasionally seen on tundra ponds until mid-July. By July 23, 1958, few were still present. One flock of four adults was seen on July 24 of that year.

Stercorarius parasiticus. Parasitic Jaeger. Three pairs nested in the area each season. They were spaced one and one-half to two miles apart. All three were located in wet tundra, two on river terraces and one in the upland lake basin.

In 1957, the eggs were already hatched by July 8. In 1958 all three nests contained two eggs; one of these was found pipping on June 27. All chicks were hatched by July 9. Flying young were seen on August 9, 1957. Adults were still present in mid-August of both years.

Stercorarius longicaudus. Long-tailed Jaeger. Five pairs of these jaegers were located on the study area in 1957. In 1958, 11 nests were found, eight of which were on the area surveyed in 1957. When I arrived on July 8, in the first season, all of the jaeger pairs present already had chicks, and since the

chicks are precocial, no nests were found. Of the 11 nests located the following season, eight had clutches of two eggs, and three only one. All but two of the clutches were hatched by July 9. One egg had hatched the previous day, judging by the size of the chick, and the other chicks were estimated to be from five to seven days old. One clutch of two eggs was infertile. The parents incubated until July 22, when I found the eggs cool. This nest was found on June 26. Had the eggs been laid on that date they should have hatched on July 22 at the latest. These eggs were found destroyed on July 24. One single-egg clutch was still unhatched on July 13. The fate of this egg is not known.

The majority of the jaeger nest sites were in dwarf shrub-sedge tundra, although there were a few in wet tundra and one in tussock-heath tundra. Nests on the upland were usually located on the sloping sides of the swales. No nest was present on the flattest part of the upland, although one at the upper end of a swale near the large upland lake was in an area of barely perceptible slope. Three nests were in the upland lake basin. They were distributed about its periphery within a few yards of the steeply sloping sides of the basin. Three nests were on river terraces, two of these in an area having prominent mounds. One was in an area of well developed tussock-heath tundra.

A factor of significance common to these sites seems to be their location on a slope, or the presence nearby of an elevated surface, from which the resting bird has unobstructed view of the terrain in the immediate area of the nest.

Flying young were first seen in 1957 on August 6. Adults were still present in mid-August of both seasons.

Parasitic and Long-tailed jaegers are the only avian predators nesting in the area. They are known to feed on shorebird chicks, passerine young and adults, Willow Ptarmigan chicks, microtine rodents, the least weasel, and insects, as well as carrion of all kinds. In 1958, they also fed heavily on cloudberries (*Rubus chamaemorus*) and blueberries (*Vaccinium uliginosum*) when they were ripe. More detailed data on food habits of jaegers and their role as predators in the tundra biome of northern Alaska will be presented elsewhere.

Larus hyperboreus. Glaucous Gull. Transient individuals were seen occasionally throughout both seasons. They normally foraged along the river course and rarely flew over the tundra. During the first week in August, 1958, a group of 12 remained in the vicinity of a caribou carcass on which they fed.

Larus canus. Mew Gull. This species was observed only once, on June 25, 1958, when an adult landed on a river bar near camp.

Sterna paradisaea. Arctic Tern. Several pairs were present about the large upland lake in both seasons. They were seen regularly foraging along the river course. No nests were located in 1957, although two adults with a juvenile just able to fly were seen at the large lake on July 27 of that year. On June 23, 1958, two nests were found on sphagnum mounds 30 yards from the edge of the same lake. They were 20 feet apart and contained one and two eggs, respectively. On August 1 a flying juvenile was collected here and along with it a downy chick. Two adults were still present on August 14, 1958.

Data on specimens collected: ♂ juv., Aug. 1, 1958, testis 1 mm., weight 114.5 gm. (moderate fat); ♀ juv., Aug. 1, 1958, weight 67.3 gm. (no fat).

Asio flammeus. Short-eared Owl. This species was observed only once. Late in the evening of July 21, 1958, one flew past camp downriver.

Corvus corax. Raven. Transient individuals were seen infrequently in both seasons.

Luscinia svecica. Bluethroat. An uncommon breeder, this species was found only in areas where willow shrub at least two feet high offered cover.

In 1957, I observed only one territorial male in the breeding season, on July 9. In the following year at least four pairs nested. Two of these were located on the edge of the upland lake basin where a narrow fringe of willow shrub two feet high offered cover. All other pairs observed were in riparian shrub. Owing to the extremely secretive habits of this bird, however, my observations may not reflect their actual abundance.

On July 11, 1958, adults of the two pairs on the uplands were seen carrying food. On July 12, a juvenile was observed in willows near camp, and on July 15, an adult and two juveniles were seen, also in riparian shrub.

Data on one specimen collected: Jv., sex ?, July 15, 1958, weight 12.5 gm.

Motacilla flava. Yellow Wagtail. A rare breeder. In 1957 an adult and "several" juveniles were

seen on July 9 in riparian shrub. A juvenile was found dead on a river bar on July 16. In 1958, one locally settled pair was observed on June 22 on tussock tundra adjacent to riparian shrub. This pair was not seen later in the season.

Lanius excubitor. Northern Shrike. A juvenal female (weight, 73.5 gms.) was collected in tall riparian shrubs on August 13, 1958. This is the only record for this species.

Acanthis "hornemanni." Redpoll. Baldwin (1955) as well as Kessel and Cade (1958) have pointed out an uncertainty regarding the taxonomy of Redpolls on the arctic slope. Following their lead I have assumed that the Redpolls occurring in the area were all of one species. At the suggestion of Frank A. Pitelka, the specific name heretofore applied to the common type of Redpoll in arctic Alaska (Bailey, 1948:292) is placed in quotation marks to emphasize the current uncertainty, pending results of studies now underway by Paul H. Baldwin. It should be noted that on the basis of studies in Greenland, Salomonsen (1951) already regards the arctic and subarctic races of Redpolls as all representing merely one species, *Acanthis linaria*.

Next to the longspur and the Savannah Sparrow, the Redpoll is the most abundant species of bird in the area. It is ubiquitous. In late June Redpolls are seen and heard in flocks in all vegetation types. As nearly as I could determine, nesting was confined to riparian shrubs and to hillsides of *Salix glauca desertorum* shrub tundra. The willows did not have to be very large to accommodate the Redpoll. One nest was found at the base of an open willow shrub which was scarcely 20 inches tall.

Seven nests were found in 1958. Five of these were in riparian shrubs four to seven feet tall. The nests themselves were placed two to two and a half feet from the ground. Two of these nests were well hidden in willows which had been crushed into a dense tangle by the ice of the spring break-up. The remaining three were quite exposed. Two nests found were on the ground in the base of *Salix g. desertorum* shrubs on hillsides sparsely covered with willow. The only nest located in 1957 was on the ground in the side of a tussock at the base of a slope of *Salix g. desertorum* shrub tundra.

Table 2

Breeding Data on *Acanthis "hornemanni,"* Kaolak River, Alaska, 1958

Date	Nests					
	1	2	3	4	5	6
June 21		3 eggs				
22	5 eggs	3 eggs				
23	5 eggs	Abnd				
July 10			3 eggs			
15			4 eggs			
16				2 eggs		
17				3 eggs		
19				5 eggs		
20					4 eggs	
26					4 eggs	
28					3 eggs, 1 chick	4 chicks
29					2 eggs, 2 chicks	4 chicks
30					1 egg, 3 chicks	4 chicks
Aug. 1					1 egg, 3 chicks	
3						4 chicks
4						0 chicks
6					1 egg, 3 chicks	

All breeding data are summarized in table 2. The average clutch size for the six nests found was 4.1 eggs. Nest number 2 possibly does not represent a complete clutch; the eggs were cold when found, indicating that they were already abandoned.

Baldwin (1955), in his study of the breeding cycle of the Redpoll at Umiat, in 1953, concluded that the Redpolls did not have second broods. Kessel and Cade (1958), on the basis of several records of eggs and naked young from early to mid-July, suggest the occurrence of second broods. My own data tend to support their suggestion.

On July 15, 1958, juvenal Redpolls were common in large flocks of juvenal fringillids occurring in the riparian shrub. From this peak their numbers gradually declined. A flock of approximately 15 was seen over the uplands on July 30. The juveniles were still abundant in riparian willow on August 6. Very few were seen after the first week in August.

Data on specimens: ♀, July 10, 1958, largest follicle 6 mm., 2 ruptured follicles, egg in oviduct, weight 13.4 gm.; ♂, July 14, 1958, testis 6 mm., weight 13.1 gm. (moderate fat); ♂ juv., July 14, 1958, testis 1.5 mm., weight 12.0 gm.; ♀, July 31, 1958, weight 12.0 (moderate fat); ♂ juv., July 31, 1958, testis 1 mm., weight 12.5 gm. (heavy fat).

Passerculus sandwichensis. Savannah Sparrow. An abundant nesting bird, this species ranks second in numbers only to the longspur. It nests primarily in the dwarf shrub-sedge tundra of the uplands. I have also recorded two pairs in the back edge of the riparian shrub where the willows are dwarfed to 12 to 24 inches in height. These showed alarm at my presence and were apparently nesting in this habitat.

No nests were found. Young were first seen on July 12, in 1957, and on July 10, in 1958. From mid-July until the end of the month the Savannah Sparrow was abundant on the uplands. On August 6, although its numbers were considerably reduced, it was still, with the longspur, the most numerous bird in dwarf shrub-sedge tundra. Its numbers continued to decline rapidly in early August, and only a few were present by August 14.

Because of its retiring habits and the lack of any penetrating quality to its song and alarm note, I found it difficult to judge the abundance of the Savannah Sparrow relative to the longspur. They are most conspicuous in July when the young leave the nest. At this time I estimated that they were one-third to one-half as abundant as the longspur. An interesting corroboration of this estimate is given by the data on birds caught in two snap-trap lines which were run to census microtine rodent populations. The lines were 1000 feet long with three traps grouped in a six-foot radius about stakes placed every 20 feet. There were 153 traps per line. They were set for three-day periods and were checked every 12 hours in that time. One line was located in upland dwarf shrub-sedge tundra and one in tussock-heath tundra. The data on the birds taken are given in table 3. These data tend to

Table 3
Birds Caught in Snap Trap Lines, Kaolak River, Alaska, 1958

Species	Habitat types				Totals
	Dwarf shrub-sedge tundra		Tussock-heath tundra		
	July 18-21	Aug. 7-10	July 22-25	Aug. 10-13	
<i>Calcarius</i> , adults	2	2	0	0	} 10
juveniles	4	0	2	0	
<i>Passerculus</i> , adults	2	0	0	0	} 4
juveniles	1	0	1	0	

confirm my own estimate of the relative abundance of the two species, and they also show clearly the preference of the Savannah Sparrow for the dwarf shrub-sedge tundra over the tussock-heath tundra. The decline in the populations of passerine birds in late July and early August is also reflected in these catches.

Data on specimens: ♀, July 16, 1958, weight 17.1 gm.; ♂ ?, July 19, 1958, weight 17.9 gm.; ♀, July 21, 1958, largest ovum 1.0 mm., weight 15.5 gm.; ♂ juv., July 21, 1958, testis 2 mm., weight 18.6 gm.; ♂ juv., July 25, 1958, testis 1 mm., weight 18.9 gm.; ♂, Aug. 3, 1958, weight 20.4 gm. (little fat); ♂, Aug. 4, 1958, testis 1.5 mm., weight 19.7 gm. (little fat); ♂ ?, Aug. 9, 1958, weight 16.5 gm.; ♂, Aug. 9, 1958, testis 1 mm., weight 18.7 gm.

Spizella arborea. Tree Sparrow. This species was uncommon. In June, 1958, I recorded four singing males and observed two pairs. They were associated with willow shrub two feet or more in height and were observed in riparian shrub, *Salix glauca desertorum* shrub tundra, and in dwarf shrub-sedge tundra on the sides of a draw where the willow reached two feet in height. None was seen on the upland at this time. The males do very little singing later in the season. In 1957, I obtained only one song record. A male was seen singing from riparian shrub on July 16. No nests were found in either season.

In mid-July of both seasons a few Tree Sparrows were recorded from upland dwarf shrub-sedge tundra. None occurred in the area after the end of July.

Zonotrichia leucophrys. White-crowned Sparrow. An uncommon nesting bird. It was observed only in riparian shrub. I recorded six pairs along a two-mile section of the river traversed frequently. This suggests a density of three to four pairs per mile of riparian shrub. Its numbers were comparable in the two seasons.

An adult feeding about my tent was carrying food into the willows on July 12, 1958. On July 13, the young appeared about the tent feeding with the adults. These were the first young seen. They fed actively on bread scraps and foraged about the base of the tent, eating mosquitoes. A few juveniles were seen on July 15, 1958, in the large flocks of fringillids which occur in the riparian shrub from mid-July until early August. White-crowned Sparrows were the only birds which fed about the tent, and they continued to do so until I left the area on August 15. On August 12, the young feeding about the tent were already in their postjuvinal plumage.

Data on specimens: ♂ *juv.*, July 14, 1958, testis 2 mm., weight 29.1 gm. (heavy fat); ♀, July 17, 1958, largest ovum 1 mm., weight 27.1 gm.; *juv.*, sex ♀, Aug. 1, 1958, weight 27.6 gm. (no fat).

Calcarius lapponicus. Lapland Longspur. This is the most abundant nesting bird in the area. It occurs on the uplands in dwarf shrub-sedge tundra and on the tussock-heath tundra. It was also noted in areas of one- to two-foot willow shrub on the slope of the upland lake basin and in riparian shrub. All of these habitats were used for nesting except the riparian shrub.

In 1958, only one nest was found; it contained one egg on June 23. This nest was situated on a moss tussock under a dwarf birch (*Betula nana*) in an area of wet tussock-heath tundra. A fledgling barely able to fly was seen on June 25. Flocks of juvenal fringillids, mostly of this species, were seen on July 15 in riparian shrub. At the same time their numbers on the uplands dwindled, only occasional groups of five to 12 juveniles being seen on the uplands. By July 24, adults were few but juveniles remained common. Two days later their numbers had declined noticeably. The decline continued through late July, and on August 4 only a few were seen. This decline is well reflected in trapping data summarized in table 3.

A few juveniles in postjuvinal plumage were noted among several individuals seen on August 4, 1958. Individuals in this plumage were predominant by August 12.

Data on specimens: ♀ *juv.*, July 15, 1958, weight 23.9 gm.; ♂ *juv.*, July 15, 1958, testis 1.5 mm., weight 27.6 gm.; ♂ *juv.*, July 19, 1958, testis 2 mm., weight 21.6 gm.; ♂ *juv.*, July 19, 1958, testis 1 mm., weight, 26.5 gm.; *juv.*, sex ♀, July 20, 1958, weight 22.3 gm.; *juv.*, sex ♀, July 20, 1958, weight 24.1 gm.; ♂, July 20, 1958, testis 2 mm., weight 25.4 gm.; ♀, July 20, 1958, weight 24.4 gm.; ♀ (?) *juv.*, July 21, 1958, weight 20.7 gm.; ♂ *juv.*, July 23, 1958, testis 1.5 mm., weight 22.5 gm.; ♀, July 23, 1958, largest ovum 1 mm., weight 25.6 gm.; ♀ *juv.*, July 25, 1958, weight 22.4 gm.

DISCUSSION

A total of 34 species of birds was observed at the Kaolak River in the two years. In 1957, 25 species occurred of which 20 were breeding and one more, the Tree Sparrow, probably bred, also. Three species were transient, and the Golden Eagle was present as a non-nesting resident. In 1958, 32 species occurred. Nineteen of these were known to breed, and two additional ones possibly bred, also. Ten transient species and the resident Golden Eagle were also noted.

Irving and Paneak (1954) reported 47 species, all but two of which were nesting, in the Howard Pass region of the Brooks Range 150 miles south of the Kaolak River. Kessel and Cade (1958) recorded a total of 87 species from the Colville River, and listed 54 known breeding species from foothill tundra. The comparative paucity of breeding species at the Kaolak River is probably related to the limited ecological diversity of the area. Reference to the map (fig. 2) shows that two of the seven habitats, dwarf shrub-sedge tundra and tussock-heath tundra occupy approximately 80 per cent of the total area. The remaining 20 per cent is occupied mostly by wet tundra. Riparian shrub is distributed in a narrow band, seldom exceeding 30 feet in width, along the river. The

remaining two habitats, the river and alluvial bars, and cliffs and taluses, are of very limited extent.

Data on the status of all birds in the area as well as nesting habitats used by the species known to breed are summarized in table 4. The effect of inadequate amounts of certain habitats on representation of species utilizing these habitats is most evident in columns 6 and 7 of table 4. No cliff-nesting birds bred in the area in the two seasons. Three of the five cliff nesters occurring in foothill tundra were observed as transients. The other two, Peregrine Falcon and the Rough-legged Hawk, were not seen at all. We may assume that cliff-nesting species wandering through the area would have nested if

Table 4

Nesting Distribution and Status of the Birds of the Kaolak River, Alaska, for 1957 and 1958

Species	Status	Habitats						
		1	2	3	4	5	6	7
<i>Gavia arctica</i>	N						X	
<i>Anas acuta</i>	A							
<i>Anas carolinensis</i>	A							
<i>Aythya marila</i>	n						X	
<i>Clangula hyemalis</i>	N						X	
<i>Mergus serrator</i>	n						X	
<i>Aquila chrysaetos</i>	R							
<i>Falco rusticolus</i>	T							
<i>Lagopus lagopus</i>	N	X	X					
<i>Grus canadensis</i>	A							
<i>Charadrius semipalmatus</i>	n					X		
<i>Pluvialis dominica</i>	N		X					
<i>Capella gallinago</i>	A							
<i>Erolia melanotos</i>	N	X		X				
<i>Limnodromus scolopaceus</i>	N	x?		X				
<i>Ereunetes pusillus</i>	N	x?		X				
<i>Limosa lapponica</i>	N	X		x				
<i>Phalaropus fulicarius</i>	n?			X?				
<i>Lobipes lobatus</i>	N			X				
<i>Stercorarius parasiticus</i>	N		X	X				
<i>Stercorarius longicaudus</i>	N	X	x	X				
<i>Larus hyperboreus</i>	T							
<i>Larus canus</i>	A							
<i>Sterna paradisaea</i>	N						X	
<i>Asio flammeus</i>	A							
<i>Corvus corax</i>	T							
<i>Luscinia svecica</i>	N	X			X			
<i>Motacilla flava</i>	N/n?		X?					
<i>Lanius excubitor</i>	A							
<i>Acanthis "hornemanni"</i>	N	X			X			
<i>Passerculus sandwichensis</i>	N	X			x			
<i>Spizella arborea</i>	N	X			X			
<i>Zonotrichia leucophrys</i>	N				X			
<i>Calcarius lapponicus</i>	N	X	X					

HABITATS: 1, dwarf shrub-sedge tundra; 2, tussock-heath tundra; 3, wet tundra; 4, riparian shrub; 5, fluviatile waters and alluvial bars; 6, lacustrine waters and edges; 7, cliffs and talus slopes. SYMBOLS: N, a species which nested in the area both seasons; n, a species known to nest in only one of the two seasons; R, a resident non-nesting species; T, transients, species seen infrequently in both seasons; A, accidental or vagrant, a species seen only once in the two seasons; X, primary nesting habitat; x, secondary nesting habitat.

their nest-site requirements had been met. During both seasons an immature Golden Eagle utilized the bluffs as a perch.

The alluvial bars along the Kaolak River are small. The record of the Semipalmated Plover is the only nesting record I have for this habitat. Three other species, Spotted Sandpiper, Glaucous Gull, and Arctic Tern, could be expected to breed on alluvial bars.

Dwarf shrub-sedge tundra occupies about 70 per cent of the area, yet only three species, the Lapland Longspur, the Savannah Sparrow, and the Willow Ptarmigan, nest in it abundantly. It also seems to be the primary nesting habitat of the Long-tailed Jaeger and of the Bar-tailed Godwit. Three passerine birds, the Redpoll, the Bluethroat, and the Tree Sparrow, which also nest in this habitat, do so only along cut banks and in draws where willow shrubs reach heights of two feet or more.

Tussock-heath tundra, which is the next most extensive habitat, is utilized by five species, and only one, the Golden Plover, is confined to it.

The *Carex* marsh wet tundra occupies very restricted areas around lakes and at river bends. As far as nesting shorebirds are concerned, it is the primary habitat type. Seven of the nine species of shorebird in the area nest in it wholly or virtually so, if the Red Phalarope is included as a nesting species. The Bar-tailed Godwit and the Parasitic and Long-tailed jaegers also nest in this habitat.

The species diversity and abundance of passerine birds seems largely determined by the extent and physiognomic development of the riparian shrub. Kessel and Cade (1958) list ten species of passerines which breed primarily in the tall willow brush of the Colville River valley. Five of these species are not present at the Kaolak River, and one, the Northern Shrike, was seen only once as a vagrant. The tall brush habitat in the Colville drainage ranges from three to 25 feet in height, with an average of eight to ten feet. In the Kaolak River area, as already mentioned, the riparian shrub averages four to five feet, with a maximum of seven to eight feet. It seems clear that the limiting factor here is the reduction in height and areal extent of the willow shrub. Without more precise data from intermediate areas, the limits of the requirements of these six species cannot be defined.

The response of the Northern Shrike, *Lanius excubitor*, is especially interesting. Suitable prey species are certainly present at the Kaolak River. The absence of willow tall enough to provide the shrike with suitable look-out perches may be the significant factor in this instance. Climate is not limiting to the distribution of birds in the foothills except as it acts on the vegetation. The response of the passerine species to the progressive northward decline of their nesting habitat is worthy of more precise study.

The same reduction in number of forms is shown in the nesting birds which are associated with lakes and edges. Only one of the three species of loon which nest in the foothills did so in this area. No geese or swans were observed. Five species of ducks occurred. These include all of the five species known to breed in the foothills. However, two, the Pintail and the Green-winged Teal, were passage vagrants and did not breed in either year. Two species which did breed, the Greater Scaup and the Red-breasted Merganser, did so in only one of the two years. Of the five species, only the Oldsquaw bred in both seasons, and only one nesting is known for each year.

This paper appears to provide the first definite report of breeding of the Bar-tailed Godwit in the foothill province. Kessel and Cade (1958) cite several records from the coastal plain only. Bailey (1948) reports it as breeding, although rarely, on the coastal plain inland from Barrow and also along the Meade River. He also records that Charles D. Brower considered the main breeding ground of this species to be 80 to 100 miles inland from Barrow. This would place it in the northern edge of the foothills. In western Alaska, *Limosa lapponica* has been reported from marshy coastal areas. Grinnell (1900)

found it "tolerably common" in the Kowak (now Kobuk) Delta at Cape Blossom where it was "generally found around marshy places far out on the tundra." In view of these previous reports of its predilection for marshy coastal areas, its occurrence at the Kaolak River is particularly interesting.

The nesting of this species in association with the Long-tailed Jaeger has not been reported previously. Dixon (1938:73), however, records an association of the Whimbrel (*Numenius phaeopus*) with nesting Long-tailed Jaegers in McKinley National Park. He suggests a mutual benefit to the two species from this association when he says "we found these two species closely associated during the nesting season. The curlews are excellent watchmen . . . the jaegers . . . drive away any caribou, gull, or other intruder which they find invading the common nesting ground. There appears to be no friction between the jaegers and the curlews . . ." Protection from fox predation seems to be the most likely benefit to the Bar-tailed Godwit from this association at the Kaolak River. I do not think that the jaeger in turn benefits from the alertness of the godwit. The jaeger itself is watchful; one member of the pair is always in the vicinity of the nest or chick. The Long-tail is also extremely aggressive and hostile toward the fox and other predators. I have several records of foxes being put to flight by the combined attacks of the two jaegers of a pair.

An interesting feature of this association, as observed at the Kaolak River, is that it did not occur in both seasons. Although both the Long-tailed Jaeger and the Bar-tailed Godwit nested both years, they were not observed nesting in close proximity in 1957. In 1958, all of the godwits found in the period of incubation in late June were in the vicinity of jaeger nests. The association lasted through the season. The only factor of possible significance to the godwit that differed in the two seasons was the presence in 1958 of a family of red foxes in the area. It may be that the nesting of the godwits with the jaegers was a response to the presence of the foxes in the early part of the season. Another possibility which cannot be ruled out is that the godwits and jaegers nested together initially in 1957 as in 1958 but that in the former year, the absence of the foxes allowed the association to break down after the chicks were hatched. This would also explain the frequent occurrence of the godwit along the alluvial bars and in riparian shrub in the latter part of 1957, a fact which was not noted in 1958.

SUMMARY

A sector along the Kaolak River in northern Alaska was visited in the summers of 1957 and 1958. This report is an analysis of the nesting distribution of all species of birds observed there.

Seven major habitats are defined and characterized. They are dwarf shrub-sedge tundra, tussock-heath tundra, wet tundra, riparian shrub, fluvial waters and alluvial bars, lacustrine waters and edges, and cliffs and talus slopes.

A total of 34 species was recorded in the two seasons. Twenty-one species bred in 1957 and nineteen in 1958. The nesting distribution in the major habitats is given for each species for which adequate data were obtained. Such information as was obtained in the two seasons on breeding biology, density, and population trends are presented.

It is suggested that the restricted area of three of the major habitat types at the Kaolak River (lacustrine waters and edges, cliffs and talus slopes, and fluvial waters and alluvial bars) are responsible for the absence of several species in this area. It is further suggested that the reduced height and extent of the riparian shrub is the factor responsible for the absence from the Kaolak River avifauna of six passerine species which have been reported nesting in the foothill tundra of the Colville River valley.

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