

than normal summer, a cooling effect of only 1.5°C. is indicated. Average values should lie somewhere between these extremes.

Two other studies of this kind may be mentioned for comparison. Schytt⁵ found the cooling effect of Stor Glacier, Swedish Lapland, to amount to 2.2°C. in July and 1.1°C. in August 1947, and Eriksson⁶ has shown that this effect usually results in a temperature depression of 3 to 4° C. at the Skagastøl Glacier, Norway during the summer. In reality the magnitude of the cooling effect can be compared regionally only very approximately because of the dissimilar environments encountered. For a specific locality, however, it provides insight into the climatic character of a particular observation season, as well as its year-to-year variation, by virtue of a simple and easily determined parameter that reflects those elements that in combination produce above-freezing temperatures in high latitudes. The cooling-effect parameter also gives some indication of the magnitude of the convective-heat-transfer term in the heat-balance equation.

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³Andrews, R. H. G. 1961. Meteorological and radiation studies at the Lower Ice Station. In Preliminary report, Jacobsen-McGill Arctic Research Expedition, 131-142.

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⁶Eriksson, B. E. 1958. Glaciological investigations in Jotunheimen and Sarek in the years 1955 to 1957. *Geographica*, No. 34, 208 pp.

OBSERVATIONS OF BIRDS AND MAMMALS IN THE PERRY RIVER REGION, N.W.T.

Introduction

During the summer of 1963, John Ryder and the author studied the breeding ecology of a colony of Ross's geese at Arlone Lake (67°23'N., 102°12'W.) approximately 28 miles south of Perry Island, N.W.T. Because of the inaccessibility of this remote region its vertebrate fauna has remained almost undescribed. The discovery of the nesting grounds of Ross's goose near the Perry River by Gavin in 1940 has encouraged a small number of investigators to conduct studies in the area. The purpose of this paper is to make additions to the lists of Hanson, Queneau and Scott¹ and to report changes in the status of some species.

The work was done under the auspices of the Canadian Wildlife Service. The Perry River Eskimos proved to be a valuable source of information especially for data on mammals. The most helpful of the Eskimos was Angulalik, one of the older men at Perry River. Mr. Duncan Pryde, manager of the Hudson's Bay Company post at Perry Island, helped as interpreter and with his knowledge of the area. Thanks are extended to Dr. Victor Lewin of the University of Alberta, Zoology Department, for his assistance in the preparation of the manuscript.

We arrived at Perry Island on May 21, 1963, and established camp at Arlone Lake on June 1. The geese left the area after completion of hatching and we had to move to the coast on July 12. There we set up our banding camp near the mouth of the Perry River from July 31 until August 10, when our work in the Perry River region ended for that season.

Most of the observations were recorded within a 2-mile radius of our base camp at Arlone Lake.

Topography

The following excerpt from ref. 1 describes the terrain generally. "Glaciation and differential erosion have

frequently produced a banded topography of parallel ridges separated by elongated, roughly parallel lakes or river courses." Glacial action took place in a north-northwest direction and as a result most ridges and streams run approximately in the same direction. The hills generally consist of bedrock and rise to a maximum height of 200 feet, often dropping off in sheer cliffs. Between the hills are streams, lakes, marshy grasslands and, less frequently, grassy plains, with numerous lakes and ponds. The soils are mostly high in clay but sandy soils are occasionally found, especially near the coast.

Weather

According to local residents spring came 10 days late to the Perry River region during the season of 1963, which consequently delayed the arrival of most migratory birds. However, the ensuing summer was far warmer than the one experienced by Hanson's party in 1949. The snow began to melt on June 2 and was gone by June 14, except for drifts bordering hills. Puddles of water began to form on lakes by June 6 and most lakes were ice-free by the end of June. For the month of June, means of daily maximum, minimum, and mean temperatures were 82°F., 29°F., and 45°F. respectively. During July comparable temperatures were 82°F., 34°F., and 53°F., and during the first ten days of August they were 76°F., 33°F., and 53°F. Between June 1 and August 13, precipitation, in the form of rain, occurred on 13 days, of which 6 were in August. A small amount of snow fell early in June. The season was windy, especially during the first 2 weeks of June, when winds of gale proportions were frequent.

Mosquitoes were first seen on June 26, but they did not become numerous until July, when they appeared in large swarms. Their numbers dropped sharply during the first week of August.

Vegetation

Lying in one of the colder regions of the Canadian mainland, the Perry

River area has only scanty vegetation. New plant growth began to appear about June 14, but it did not become general until June 29. Dwarf birch and prostrate willow reach a maximum height of 2 feet and they leafed out between June 29 and July 5. Most plants reached maturity by the third week of July.

Bird phenology chart

Perry River, N.W.T., 1963

<i>Species</i>	<i>Arrival Number</i>	
	<i>date</i>	<i>seen</i>
	1963	
<i>Buteo lagopus</i>	May 22	1
<i>Nyctea scandiaca</i>	May 22	1
<i>Larus argentatus</i>	May 22	5
<i>Plectrophenax nivalis</i>	May 22	30
<i>Grus canadensis</i>	May 25	35
<i>Branta canadensis</i>	May 25	25
<i>Olor columbianus</i>	May 31	3
<i>Anser albifrons</i>	June 1	10
<i>Corvus corax</i>	June 1	2
<i>Eremophila alpestris</i>	June 2	4
<i>Chen hyperborea hyperborea</i>	June 3	4
<i>Calcarius lapponicus</i>	June 4	100
<i>Pluvialis dominica</i>	June 4	10
<i>Chen rossii</i>	June 5	12
<i>Anas acuta</i>	June 5	15
<i>Larus hyperboreus</i>	June 6	5
<i>Erolia bairdii</i>	June 6	10
<i>Arenaria interpres</i>	June 6	6
<i>Stercorarius pomarinus</i>	June 7	7
<i>Clangula hyemalis</i>	June 7	5
<i>Somateria mollissima</i>	June 7	4
<i>Somateria spectabilis</i>	June 9	4
<i>Phalaropus fulicarius</i>	June 9	50
<i>Charadrius hiaticula</i>	June 9	1
<i>Mergus serrator serrator</i>	June 9	3
<i>Squatrola squatarola</i>	June 10	5
<i>Xema sabini</i>	June 10	2
<i>Sterna paradisaea</i>	June 10	5
<i>Asio flammeus</i>	June 11	1
<i>Erolia melanotos</i>	June 13	5
<i>Passerculus sandwichensis</i>	June 13	1
<i>Falco peregrinus</i>	June 13	1
<i>Ereunetes pusillus</i>	June 13	2
<i>Gavia arctica</i>	June 14	2
<i>Gavia stellata</i>	June 14	1
<i>Stercorarius parasiticus</i>	June 14	1
<i>Stercorarius longicaudus</i>	June 14	2
<i>Anas carolinensis</i>	June 24	3
<i>Lobipes lobatus</i>	June 24	2
<i>Aquila chrysaetos</i>	July 31	1
<i>Toxostoma rufum</i>	August 13	1

Annotated list of species

The scientific and common names used here are according to ref. 2 for birds and ref. 3 for mammals. All specimens collected

have been deposited in the museum of the Zoology Department, University of Alberta.

Birds

Gavia arctica. Arctic loon.

Fairly common in the vicinity of Arlone Lake; 12 were seen. A single nest containing two eggs was found on June 24. Extremely common along the coast where as many as 20 were seen in a single day.

Gavia stellata. Red-throated loon.

Definitely the less common of the two loons. Seen only occasionally inland and not along the coast. Two nests with two eggs each were found on June 28 and July 5, respectively, both on the islands of Arlone Lake. The nest consisted of a shallow depression in the ground, quite unlike the elaborate nest of the Arctic loon.

Olor columbianus. Whistling swan.

Three were observed flying near the mouth of the Perry River on May 31. A pair was seen on a small tundra lake on July 8 and a second pair near the Perry River on July 12.

Branta canadensis. Canada goose.

Not abundant but seen regularly during the summer. No nests were found although several broods were seen near the Perry River on July 12. These geese began to flock along the lower reaches of the Perry River during the first 10 days of August.

Anser albifrons. White-fronted goose.

Uncommon, but seen fairly regularly during the first 3 weeks of June. None were seen after this period until July 12 when a number of them, including two broods, were encountered near the Perry River. Seen flocking on the Perry River early in August.

Chen hyperborea hyperborea. Blue goose and lesser snow goose.

Found nesting both on the mainland and in the colony of Ross's geese on the islands of Arlone Lake. Hatching began on July 5 and terminated on July 11. Approximately 15 geese in the blue phase were seen, and perhaps 300 in the white phase.

Chen rossii. Ross's goose.

Approximately 750 breeding pairs used Arlone Lake during the summer of 1963. Nesting took place only on the islands. Egg-laying began on June 9, 3 days after the geese arrived at the lake. After the beginning of hatching on July 5, broods began leaving the lake until July 12, when all eggs had hatched.

Anas acuta. Pintail.

Common all summer, both inland and on the coast. They were seen both in pairs and in small flocks, the largest flying flock seen in the spring was a group of 15. The majority were males, but since pairs, consisting of one male and one female, were commonly seen in June, they probably breed in the area. One male in full adult plumage was collected in late June and was found to have testes in non-breeding condition.

A number of large flocks of flightless birds were observed along Laine Creek, a tributary of Perry River, on July 12. The moulting period was over by the first week in August, when flocks were seen flying along the Perry River.

Anas carolinensis. Green-winged teal.

Two males and one female were observed June 24 at an inland tundra lake. Two males were seen in the same general area on June 28 and three males at Arlone Lake on July 9. This is far north of the normal range for the species and the sex ratio indicates that they probably do not breed in the region. Hanson *et al.*¹ found the Green-winged teal to be even less common.

Clangula hyemalis. Oldsquaw.

Certainly the most common duck in the Perry River area. Despite this, however, only one nest was found. The sex ratio at Arlone Lake was approximately two males to one female. During June each female was usually accompanied by two males and sometimes by three.

It appeared that these ducks were already mated when they reached the tundra lakes. The second male in the usual group of three displayed with great vigor to draw the attention of the female but it is not known how successful these unmated males were.

On July 5, a nest containing three eggs was found on an island in Arlone Lake. It consisted entirely of down held together by some plant material and was extremely well hidden by rocks and shrubs.

Rafts of flightless oldsquaws were extremely numerous along the coast.

Somateria mollissima. Common eider.

Four were seen flying over Arlone Lake on June 7.

Somateria spectabilis. King eider.

Migrating flocks were common at Arlone Lake during the first 3 weeks in June. Pairs were seen at many of the small lakes and presumably nested there. However, after the third week in June the males became scarce, with only very few remaining in the area, although the females were still numerous. Two nests with five eggs each were found on a small island in Arlone Lake on June 28.

A number of large flocks and a single brood of five young were seen along Laine Creek on July 12. King eiders were not as numerous as the oldsquaws found along the coast.

Mergus serrator. Red-breasted merganser.

Three were observed near Arlone Lake on June 9 and periodically during the next 7 days. A single female was seen at Arlone Lake on July 8.

Buteo lagopus. Rough-legged hawk.

These birds were numerous in the Perry River region during the summer of 1963. They used the cliffs for nesting sites and almost every suitable one had a nest. Two pairs nested in the immediate vicinity of

Arlone Lake. The first nest, with one egg, was found on June 6. On June 15 it contained five eggs. The second nest with six eggs was found on July 3. On July 12 a third nest was found along Laine Creek and the behavior of two other pairs seen there indicated that they too had nests. A pair nested on the south end of Perry Island; the nest had four eggs.

Two nests with young birds were seen along Perry River in the first week of August.

Aquila chrysaetos. Golden eagle.

Rare in the region. A single bird was seen along Laine Creek on July 31 and a second along Perry River on August 1.

Falco peregrinus. Peregrine falcon.

One was seen at Arlone Lake on June 13. The distinctive call of another was heard at the cliffs along Perry River in early August. On August 11, a falcon was seen flying over Perry Island. Neither the eagle nor this bird were common, although Hanson *et al.*¹ found it to be fairly common. Macpherson and Manning⁴ found it to be quite abundant on Adelaide Peninsula, about 100 miles east.

Lagopus mutus. Rock ptarmigan.

Very abundant during the summer of 1963. A flock of approximately 100 was seen along Laine Creek on May 31. No nests were found, but a single brood was seen near Laine Creek on July 31.

Grus canadensis. Sandhill crane.

Flocks arrived in the area during the last week in May. These birds were commonly seen both singly and in pairs throughout the whole summer. On July 8, a pair of cranes was seen that went into the broken-wing act when approached but no nest was found. Especially common along the lower reaches of Perry River.

Charadrius hiaticula. Ringed plover.

One was seen on June 9, but no others until July 3, when five were seen near Arlone Lake. This bird was commoner along the coast.

Pluvialis dominica. Golden plover.

It first appeared in the region on June 4 and remained very common for 2 weeks. One was seen on June 24, two on July 13 along Laine Creek, another pair on July 31 in the same area. However, it was not as common this summer as Hanson *et al.*¹ found it in 1949.

Squatarola squatarola. Black-bellied plover.

As far as could be observed, this bird occurred only as a migrant in the area. It was common from June 10 to June 17. Only one other was recorded on August 2.

Arenaria interpres. Ruddy turnstone.

Encountered only once—a flock of six on June 6.

Erolia melanotos. Pectoral sandpiper.

A common breeding species in the Perry River region in 1963. Hanson *et al.*¹ found the nesting density to be roughly 9 pairs per square mile; this summer it was per-

haps 4 or 5 pairs per square mile.

Erolia bairdii. Baird's sandpiper.

This species probably occurred only as a migrant, although Hanson *et al.*¹ believed that it had bred in the area in 1949. Ten were seen on June 6, after which they remained quite common for a week. None were observed later.

Ereunetes pusillus. Semipalmated sandpiper.

Two were seen on June 13. This bird remained common all summer, with a fairly uniform distribution over the tundra. *Phalaropus fulicarius*. Red phalarope.

Between June 9 and 22, this bird was extremely abundant; up to 50 were seen in a day. However, after the migration only a few scattered pairs remained. On July 8, nine adults and one downy young were seen.

Lobipes lobatus. Northern phalarope.

Two were seen on June 24 and a third on June 28. Hanson *et al.*¹ found this bird much commoner in 1949.

Stercorarius pomarinus. Pomarine jaeger.

Definitely the most common jaeger during spring migration. Later it decreased in numbers and the long-tailed jaeger became more abundant.

The behavior of two pairs observed early in July indicated that they probably had nests. This jaeger remained fairly common during the summer. Dark-phase birds represented perhaps 5 per cent of the total.

Stercorarius parasiticus. Parasitic jaeger.

The least common of the three jaegers, it was seen only periodically, although a resident.

Stercorarius longicaudus. Long-tailed jaeger.

The most common jaeger in the area. A nest, which consisted of a shallow depression in the ground and contained two eggs, was found on June 24. The behavior of other birds indicated that they nested in the area.

Larus hyperboreus. Glaucous gull.

Hanson *et al.*¹ found the glaucous and herring gulls to be approximately equally common. However, during our stay in the region the glaucous gull was definitely the more common of the two species. Only one nest was found on June 28 on a small island in Arlone Lake, containing three eggs, but it was quite obvious that many other pairs nested in the area.

Thirteen were seen at Arlone Lake on July 7. This sudden abundance coincided with the hatching of the geese on the islands. Near the culmination of the hatching a gull was observed to pick up a young Ross's goose and fly off with it.

Larus argentatus. Herring gull.

Seen only occasionally at Arlone Lake but they were commoner on the coast. On July 1 a flock of 13 was seen on an ice floe in Arlone Lake. They were distinctly darker in colour than those seen earlier.

Xema sabini. Sabine's gull.

Occurs only as a migrant in the Perry River region. They appeared first on June 10, remained common for about a week, and then disappeared completely. A single one was seen at Cambridge Bay on August 14.

Sterna paradisaea. Arctic tern.

Two pairs probably nested on the islands of Arlone Lake, although only one nest was found on June 29, which consisted of only a slight depression in the ground and contained one egg. Later the egg was found to be broken and only the half-grown embryo left.

The tern was only fairly common at Arlone Lake, but very numerous on the coast.

Nyctea scandiaca. Snowy owl.

Hanson *et al.*¹ found it to be very rare here and saw only three. However, it was extremely common in the summer of 1963. This abundance coincided with a great abundance of lemmings. Five nests, containing an average of 6.2 eggs each, were found on June 24. Nestlings were first seen on July 8; on July 31, young owls had left the nest, though still unable to fly.

Asio flammeus. Short-eared owl.

Three were seen between June 11 and July 31. Hanson *et al.*¹ did not record this owl and despite the fact that lemmings were abundant during the summer of 1963, it remained scarce. Macpherson and Manning⁴ reported it equally rare on Adelaide Peninsula.

Eremophila alpestris. Horned lark.

A common resident in the Perry River region in 1963.

Corvus corax. Common raven.

First seen on June 1, when two were encountered. A third was seen on June 5, three more on August 10.

Toxostoma rufum. Brown thrasher.

A single bird was seen at Perry Island on August 13. This is so far north of its normal distribution that it must have been a stray.

Passerculus sandwichensis. Savannah sparrow.

Although it was not overly abundant, it was fairly evenly distributed throughout the Perry River region. Two nests were found, one with five eggs and the other with five nestlings.

Calcarius lapponicus. Lapland longspur.

Definitely the commonest bird in the area during the summer of 1963. Eight nests were found, containing an average of five eggs each.

Plectrophenax nivalis. Snow bunting.

Common on our arrival in the region; 30 were seen on May 22. However they decreased in numbers rapidly and were seen only occasionally in July and August.

Mammals

Sorex sp. Shrew.

Small-mammal trapping at Arlone Lake gave no evidence of shrews. However, the

Eskimos have a name for the shrew and recognized it when shown pictures in ref. 5. Angulalik reported that shrews occur along the coast both on the mainland and on islands but that they are nowhere common.

Lepus arcticus. Arctic hare.

Three were observed during the summer, one on May 25, another on June 5, and a third on August 6. Tracks were occasionally seen while snow was still on the ground.

Citellus parryii. Parry's ground-squirrel.

Tracks were first seen on May 24; the animal itself on May 26, long before the ground thawed. It was very common in the area, both on the islands and the mainland.

Dicrostonyx groenlandicus. Collared lemming.

Far less common than the brown lemming. It occurred mostly on hills and other well-drained areas. Eight were collected.

Lemmus trimucronatus. Brown lemming. Extremely common during our stay in the region. It occurred mainly in low grassy areas, although specimens were occasionally taken on the rocky hills. Fifteen specimens were collected.

Clethrionomys rutilus. Red-backed mouse.

Like the collared lemming, it inhabits mainly the high well-drained spots on the tundra. It was very common during our stay in the area. Twelve specimens were collected.

Canis lupus. Gray wolf.

Occurs in the Perry River region but is uncommon. One was seen about 50 miles northwest of Perry Island on May 21. The Eskimos occasionally bring pelts to the Post.

Alopex lagopus. Arctic fox.

Only one was seen during the summer, on July 12 near Laine Creek. However, this is not an indication of the number of foxes in the area, as it is the mammal most commonly trapped by the Eskimos.

Vulpes fulva. Red fox.

None were seen but apparently they occur here as four or five pelts are brought in to trade every winter.

Ursus horribilus. Grizzly bear.

Gavin⁶ reported that two were encountered on the sea-ice 15 miles west of Perry River by an Eskimo in March 1938. There have been no other records since.

Thalarctos maritimus. Polar bear.

Occurs along the coast near Perry River but is quite rare. One was shot by an Eskimo and two more were seen in the summer of 1962. Three skulls were found but no trace of skins. Gavin⁶ mentioned that as many as 20 skins of this bear were brought in to the Hudson's Bay Post during a single year.

Mustela erminea. Short-tailed weasel.

One adult and two young were seen on June 26, the adult and one of the young

were collected. On July 2 another female was caught in a trap; a fifth was seen on July 23. Ermine pelts are commonly brought by the Eskimos to the Perry Island Hudson's Bay Post.

Gulo luscus. Wolverine.

Common, one was seen on May 31 and another on July 13. Two young were seen near Laine Creek on July 31.

Phoca hispida. Ringed seal.

Very common and hunted heavily by the natives.

Phoca groenlandica. Harp seal.

Occurs, but it is very rare; one skin was seen at an Eskimo camp. None were seen.

Erignathus barbatus. Bearded seal.

Periodically skins of this seal are brought to the Hudson's Bay Post, but it is uncommon.

Rangifer arcticus. Barren-ground caribou.

First seen on June 17; and periodically later, but they were never numerous at Arlone Lake. However, a very large herd was seen and hunted heavily along Perry River by Eskimos.

Ovibos moschatus. Musk-ox.

According to Gavin⁶ it was common in the Perry River region about 1940. The large number of implements made of musk-ox horn supports this. None were seen, but two skulls were found near Arlone Lake. A third skull was found near Perry River. The introduction of the rifle into the region was probably the main cause for the decline of the number of musk-oxen. According to the Eskimos they are still found in the region of MacAlpine Lake, at the headwaters of Perry River.

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SOME QUATERNARY EVENTS OF NORTHERN ALASKA*

Despite the current increased interest in Quaternary research in northern Alaska the information now available is not sufficiently complete to understand, except in general terms, the past events of the region. Detterman *et al.*¹ updated and extended the knowledge of Pleistocene events, and in so doing assigned the glacial deposits of the Killik River area (about 68°42'N.) to the Itkillik (early Wisconsin?) age. Discovery of an organic deposit in 1963 necessitates re-examination of the glacial chronology and some comments on the present and past climate of the upper Killik River area.

The studies reported here were carried out where the Killik River flows northward from the Brooks Range through the southern foothills. The valley is 2 to 5 miles wide and has terrace remnants 70 to 100 ft. high. Field observations indicate that most of the valley floor was once covered with glacio-fluvial deposits, most of which were subsequently eroded away.

Along the left bank of the Killik River 0.5 mile south of the southeast corner of Imiaknikpak Lake is a terrace, the upper 70-foot section of which is shown in Fig. 1. At the 0- to 10-foot depth gravel-free sands show virtually no evidence of stratification, which, together with the presence of active sand dunes confirms the reworking and transportation of surficial material by wind action (Fig. 1 - K1, K5 and K6). Below a depth of 10 feet sands are poorly stratified (Fig. 2) but show definite evidence of being water-deposited. A histogram showing the approximate particle-size distribution of the 10- to 40-foot section is given in Fig. 1 - K2.

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