The CANADIAN FIELD-NATURALIST

Volume 74
1960

THE OTTAWA FIELD-NATURALISTS' CLUB

OTTAWA ONTARIO

The CANADIAN FIELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

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Can. Field Nat.	Vol. 74	No. 1	p. 1-58	Ottawa, January-March 1960

THE OTTAWA FIELD-NATURALISTS' CLUB

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Authorized as second-class mail by the Post Office Department at Ottawa, Ontario

The Canadian Field-Naturalist

Volume 74 JANUARY-MARCH 1960 Number 1

DR. ARTHUR GIBSON, ENTOMOLOGIST

1875—1959

In the death, on April 16, 1959, of Arthur Gibson, the Ottawa Field-Naturalists' Club has lost one of the last remaining links with its founders, and the Canada Department of Agriculture the last official whose work in federal entomology spanned the turn of the century. He came to Ottawa, from his native Toronto, in 1899 to assist James Fletcher and J. A. Guignard in the Division of Entomology and Botany at the Central Experimental Farm. His early work in Toronto as a lepidopterist had attracted Dr. Fletcher's attention and he was soon doing valuable life-history and other studies in his new position. When I came to the Farm in 1908, on Mr. Guignard's leaving, Gibson, a new stenographer, an old plotman and I were the entire staff of the Division, operating from the little office just inside the main entrance of the administration building of that day.

Dr. Fletcher's death late that fall left a heavy load of responsibility on Gibson's shoulders to be borne for nearly a year until new appointees to separate Divisions of Entomology and Botany arrived from England. The recent advent of the San Jose scale and of the brown-tail and gypsy moths were adding heavily to administrative duties. As fully as I could I relieved him of attention to botanical matters.

In the reorganization of the work in 1914 under Dr. C. Gordon Hewitt, Gibson was appointed chief of the Division of Field Crops and Garden Insects, Entomological Branch. On the sudden death of Dr. Hewitt in 1920 he succeeded him as Dominion entomologist, for which position experience, without the usual full academic training, had well prepared him. His promotion proved to be well merited and under his guidance the phenomenal growth continued. On his retirement in 1942 the still-expanding service was carried on from headquarters in Ottawa with its various units, from numerous regional laboratories and from temporary and inspection stations across Canada.

Recognition of distinguished achievements came from Queen's University with the conferring of the honorary degree of LL.D., by election to high office in many scientific societies, by fellowships in the Royal Society of Canada, the American Association for the Advancement of Science, the Royal Entomological Society, London, England, as well as by many other memberships of distinction.

Dr. Gibson kept in close touch with the leading entomologists of the world. He ably represented Canada at various international conferences on entomology: at Wageningen, Holland, in 1923, at London in 1925 and 1930, and at the international congresses of entomology at Ithaca, N.Y., in 1928, at Paris in 1932, at Madrid in 1935 and at Berlin in 1938.

Mailing date of this number: 19 May 1960

Among other appointments, more or less incumbent on the position, were Dr. Gibson's chairmanship of the Canada Destructive Insect and Pest Act Advisory Board and later a membership on the Canada Agricultural Pests Control Act Advisory Board, the Dominion Interdepartmental Advisory Board on Wild Life Protection, and the Management Committee of the Imperial Institute of Entomology, London. He was honorary curator of entomology, National Museum of Canada and, at various times, president of the Entomological Society of Ontario, the Entomological Society of America and the American Association of Economic Entomologists.

Retirement from the department was suitably marked by presentation of a silver tea service, made on behalf of the large staff by the deputy minister, Dr. G. S. H. Barton.

Dr. Gibson's association with the Ottawa Field-Naturalists' Club has been as notable in its way as everything else he did. I knew him first as its treasurer and took over from him in 1910 to release him for the editorship of the *Ottawa Naturalist* in succession to James M. Macoun. His tenure in this post was the longest among the journal's editors, ending in 1920; and during this period he was also president for 1914 and 1915. As recently as 1949 he was still on the council of the club as a member of the Reserve Fund Committee. He was made an honorary member of the club, as few could merit it more. For half a century he zealously served the organization, and was a frequent contributor of clearly written, informative articles to its journal.

For some time after his retirement Dr. Gibson applied himself to writing the story of entomology in the Canada Department of Agriculture, a subject which none could know as he did. Then impaired health and winters spent in the South intervened. A severe stroke six years ago kept him more closely at home, latterly at Brockville, with his devoted wife and daughter, Elaine. Another daughter, Mrs. Charles Palm, lives in Ithaca, N.Y. Interment was at Beechwood Cemetery, Ottawa.

Happy personal memories of Arthur Gibson crowd upon the mind, as they must for all who knew him. It was good to have enjoyed his friendship.

HERBERT GROH

The Editorial Committee regrets the unavoidable delay in the publication of this issue.

FOODS OF CARIBOU IN WELLS GRAY PARK, BRITISH COLUMBIA

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CARIBOU (*Rangifer arcticus*) in Wells Gray Park, British Columbia, live in a wide variety of habitats. Through the year these caribou use all elevations, roaming from permanent snow high in the mountains to dense forests in the valley bottomlands, and they encounter many kinds of plants potentially suitable as food. The purpose of this study was to determine those species of plants selected by caribou from the profusion of species available to them.

Since 1951, biological investigations in this park have included the collection of data on the foods of caribou. This was not intensive study. In most cases data were gathered on reconnaissance trips through the mountains. It is difficult to be intensive in the study of these animals. Their numbers are small with the result that an intensive program of taking animals for stomach analysis might be reflected in decreased abundance of the caribou. Observations of living animals have provided most information, and here each fragment of data accumulated is the result of good fortune. It is good fortune, in this rough terrain, to find caribou undisturbed and feeding, and further good fortune to be able to observe what species of plant is eaten or, later, to find evidence of plants eaten where a caribou was observed feeding.

Most data on foods eaten in fall and winter were gathered by R. G. Miller, who spent two winters on caribou winter range and made observations from valley floor to timberline in this area of severe winters with deep snow.

DESCRIPTION OF AREA

The topography, climate and vegetation of Wells Gray Park (Lat. 52°N, Long. 120°W) have been described elsewhere (Edwards, 1954; Miller, Ritcey and Edwards, 1955; Ritcey and Edwards, 1958). The terrain inhabited by caribou in this area has a subdued mountainous topography with wide, heavily glaciated valleys at 3500 feet, and steep sided foothill elevations reaching up to 8000 feet. The climate is wet in an area where air masses from the Pacific are cooled by mountains after crossing the warm Interior Plateau of British Columbia. Winters are cold and snowfalls are heavy. Snow fields persist through summer in high, sheltered places. Higher mountains to the north have extensive glaciers.

The vegetation in this area is divided altitudinally into three major zones. Treeless alplands occur above timberline. Vegetation here is quite variable from place to place, depending upon soil depths and water conditions. Lushest areas, supporting luxuriant mats of sedges and flowering herbs, occur in areas of water seepage near timberline and in the openings among the highest forests. Below the alplands, a subalpine forest of alpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) extends down from about 7000 feet to 4000 feet. This forest becomes increasingly dense, with higher canopy, as elevation decreases. Below the subalpine forest is the Columbia Forest (Halliday, 1937),

characterized by western red cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) with some alpine fir and Engelmann spruce. This is a mature forest with trees of large size, a forest closely allied to the forests of giant trees found on the wet Pacific Coast.

FOODS AND FEEDING

Caribou, as we know them and as described by many authors, do not eat browse nearly so much as do moose (*Alces alces*) or mule deer (*Odocoileus hemionus*). Moose and deer feed predominantly on twigs in winter. Caribou in this area feed on softer material, taking leaves from shrubs it is true, but rarely taking twigs. Repeated attempts to detect evidence of feeding on coarse, woody vegetation have failed. These caribou do feed extensively upon certain dwarf, woody plants such as the dwarf dogwood (*Cornus canadensis*). This is perhaps browsing of a sort, but it is probably better described as grazing.

Winter droppings of these caribou are mostly blackish in color and contain no coarse material whatsoever. In our experience all winter pellets have these characteristics. They are quite different from the brown winter pellets of deer and moose, which normally contain large amounts of recognizable wood fiber. Further, of 13 caribou stomachs examined none had material which could be classified as browse. Those few woody stems found were twigs of spruce and fir which, along with some needles from these same species, were probably eaten accidentally with other foods. Coarse material in moose and deer stomachs collected in fall and winter contrasts markedly with the fine contents of these caribou stomachs.

Ninety-three observations of identified plants observed to be eaten may be divided seasonally, as listed in Table 1. Observations from January to

TABLE 1. NINETY-THREE OBSERVATIONS OF PLANTS BEING EATEN BY CARIBOU

Species	Number of Observations		
	Jan. to April	May to Aug.	Oct. to Dec.
Black Arboreal Lichen (*Alectoria* spp.*)	9	3	14
Green Arboreal Lichen (*Alectoria sarmentosa*)	2		11
Boxwood (*Pachystima myrsinites*)	1		11
Foam Flower (*Tiarella unifoliata*)			9
Bunchberry (*Cornus canadensis*)			8
Twinflower (*Linnaea borealis*)			5
Horsetail (*Equisetum arvense*)			3
Grass		2	2
Bracken Fern (*Pteridium aquilinum*)			2
Lichen (*Lobaria pulmonaria*)			1
Lichen (*Cetraria* sp.)			1
Lichen (*Cladonia bellidiflora*)		1	
Moss		1	
Sedge		1	1
Willow (*Salix* sp.)			1
Trailing Rubus (*Rubus pedatus*)			1
Elephant Head (*Pedicularis groenlandicum*)		1	
Valerina sp.		1	
Slide Lily (*Erythronium grandiflorum*)		1	

*Four darkly pigmented species in Wells Gray Park are difficult to separate: *Alectoria fremontii, A. oregona, A. chalybeiformis* and *A. jubata*.

April were made near timberline, those from May to August were made in alpine meadows and adjacent forests, while those for October to December (there being no data for September) were made in lowland forests.

In winter the food of caribou is mainly arboreal lichens. Within their winter habitat when snow is deep there is little else available, except for the foliage of conifers. Deep snow makes all low-growing vegetation more or less inaccessible. There is no evidence that coniferous plants are eaten, except for fragments ingested accidentally with lichens.

In late autumn and early winter, and again in early spring, caribou seek out several evergreen plants in the forest, favoring such dwarf shrubs among them as *Cornus canadensis*, *Pachystima myrsinites*, and *Linnaea borealis*.

Data from 13 caribou stomachs have augmented observations of feeding. Of these, five stomachs were collected in October, two in November, three in December, and one in each of September, January and May. Contents identified are shown in Table 2. Caution must be exercised in interpreting this table. Less than five percent of contents were identifiable macroscopically; microscopic techniques were not used. Also, it appeared that certain fibrous foods remain intact longer in caribou stomachs than do softer foods. Note especially the abundance of parts of coniferous trees, mainly needles and twigs but including some bark, which are considered to be debris taken accidentally while feeding from the ground, or while taking lichen from trees. As Norris (1943) concluded after a study of the stomach contents of domestic sheep, it seems doubtful that the contents of the stomachs of ungulates can be used as more than a general source of information on foods eaten.

TABLE 2. PLANTS FOUND IN 13 CARIBOU STOMACHS FROM WELLS GRAY PARK, BRITISH COLUMBIA

Food	Number of stomachs in which occurred	Number of stomachs in which common
Lichen (*Alectoria* spp.)	12	3
Lichen (*Alectoria sarmentosa*)	1	1
Lichen (*Lobaria pulmonaria*)	2	2
Other Foliose Lichen (unidentified)	11	0
Lichen (*Cladonia* sp.)	4	0
Fungus	1	0
Moss	1	0
Grasses	12	2
Sedges	7	3
Horsetail (*Equisetum* spp.)	2	0
Lady Fern (*Athyrium filix-femina*)	1	0
Twinflower (*Linnaea borealis*)	7	1
Foamflower (*Tiarella unifoliata*)	7	1
Bunchberry (*Cornus canadensis*)	5	2
Trailing Rubus (*Rubus pedatus*)	5	0
Huckleberry (*Vaccinium membranaceum*)	4	1
Dwarf Huckleberry (*Vaccinium caespitosum*)	1	0
Boxwood (*Pachystima myrsinites*)	4	1
Willow (*Salix* sp.)	2	0
Lupine (*Lupinus* sp.)	1	0
Debris from Conifers	13	7

Table 2 substantiates field observations; both suggest that winter food consists predominantly of arboreal lichen and low evergreen plants. The debris indicated consisted mainly of twigs and leaves from alpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), western red cedar (*Thuja plicata*) and lodgepole pine (*Pinus contorta*).

In hot summer weather these caribou are attracted to patches of snow where they loaf and play. We have noticed that snow is eaten frequently on such occasions. In winter they paw at snow on the ice of lakes, presumably to obtain water. This habit has been noted most frequently in December when caribou are in the lowlands. One area especially favored was on the slushy ice of a lake where caribou dug into the slush over an area 200 yards across. The ice and slush in this area were quite yellow, possibly indicating a mineralized spring entering the lake below. Perhaps the colored slush was eaten for its chemical content.

COMPARISON WITH CARIBOU ELSEWHERE

Conclusions from these data that caribou in summer feed on a wide variety of succulent plants are supported by studies in Alaska (Murie, 1935; Dixon, 1938), in the central arctic of Canada (Banfield, 1954), and in Newfoundland (Dugmore, 1913). Reindeer (*Rangifer tarandus*) in the Canadian arctic have similarly varied tastes (Porsild, 1954).

Cabot (1939) recorded that caribou ate slush on lakes in Maine. His observations were similar to those recorded in this study.

The importance of lichens as food for the genus *Rangifer* has been noted by many authors (Pike, 1917; Hadwin and Palmer, 1922; Palmer, 1926; Murie, 1935, 1944; Banfield, 1954). Porsild (1954) has noted that lichens are not essential, but the fact remains, as the same author points out, that survival in winter is usually dependent upon an adequate lichen supply. Usually the lichens mentioned as most important in arctic regions are terrestrial fruticose species typified by a number of species of *Cladonia*. These are popularly grouped under the term 'reindeer moss.'

Terrestrial lichens are scarce in Wells Gray Park. Perhaps as a result of this scarcity, and also because of deep snow, caribou in that area feed upon arboreal lichens in winter to a degree mentioned in no account of caribou foods elsewhere. With few exceptions other studies of food habits either do not mention caribou feeding upon arboreal lichens, or mention it only casually, presumably as relatively unimportant behavior. Use of these lichens in winter in arctic Canada is noted by Banfield (1954) and Harper (1955), in Alaska by Lutz (1956), and in the Gaspé by Moisan (1956); for reindeer in arctic Canada by Porsild (1954) and in Lapland by Perez-Llano (1944). Pike (1917) places considerable importance upon arboreal lichens as winter food for caribou in northern Canada, as does Cringan (1957) for caribou in western Ontario. Both of these authors describe conditions approaching those observed in Wells Gray Park.

These arboreal lichens appear to be nutritious. Smith (1921), quoting other sources, recorded that in northern Eurasia lichens were gathered as cattle fodder, and that when the terrestrial *Cladonia rangiferina* was not available, the arboreal *Alectoria jubuta* was the principal alternative.

The importance of arboreal lichens as a factor in the winter survival of caribou may vary in time and space, depending upon other foods present and their availability in winter. Where winter ranges are more or less forested, however, arboreal lichens may be the key to the successful wintering of caribou. This appears to be the case in Wells Gray Park.

SUMMARY

Foods eaten by caribou inhabiting mountainous range in central British Columbia have been noted in 93 observations of feeding, and from examination of 13 stomachs.

A variety of foods is eaten in summer, but in winter the main food is provided by arboreal lichens of the genus *Alectoria.* Five species of these lichens are present in Wells Gray Park.

These lichens appear to be essential for survival of caribou in winter.

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Received for publication 25 July 1958

THE FLORA OF THE VICINITY OF THE MEREWETHER CRATER, NORTHERN LABRADOR*

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IN THE SUMMER of 1954, Dr. V. B. Meen, Director of the Royal Ontario Museum of Geology and Mineralogy, conducted an expedition to investigate the nature and origin of a small lake located near the tip of Labrador some fifty miles west-southwest of the Moravian Mission hamlet of Hebron. From aerial photographs Dr. Meen suspected it to be of meteoric origin and named it in honor of Colonel A. F. Merewether of the United States Air Force who first noticed it on a routine flight made during World War II.

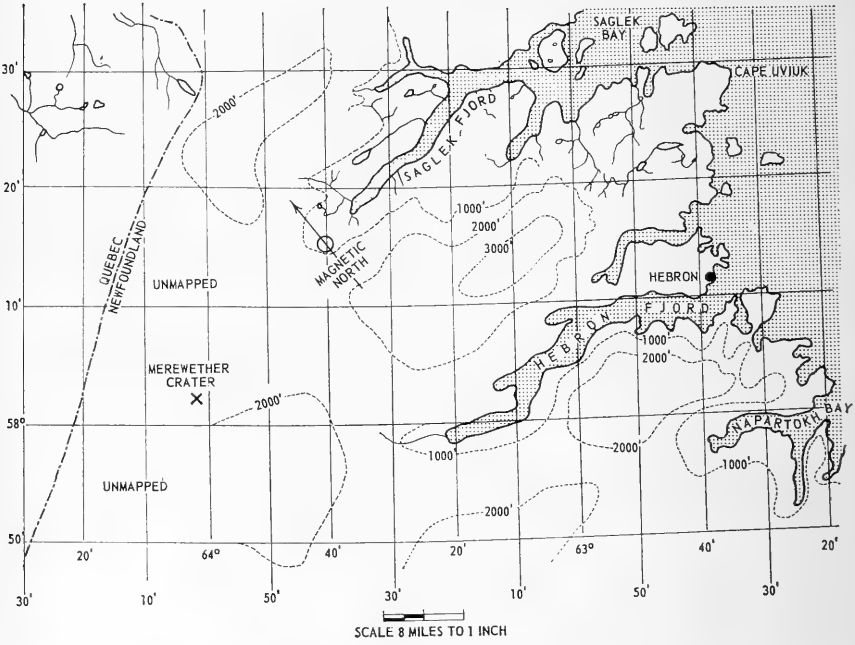

FIGURE 1. Map showing the location of the Merewether Crater.

Sponsored jointly by the Museum and the National Geographic Society, the expedition was a sequel to the 1952 investigation of the Chubb Crater in northern Ungava (Meen, 1950, 1951, 1952). Members of the party included, in addition to Dr. Meen, Dr. G. M. Stanley, Fresno State College, California, glacial geologist; Mr. J. B. Vise, University of Toronto who conducted magnetometry observations; Mr. L. Cowan, Royal Ontario Museum, assistant to Dr. Meen; Dr. F. H. Rigler, Chalk River, Ontario, limnologist; Dr. Sean

*Contribution No. 1749 from the Botany and Plant Pathology Laboratory, Science Service, Canada Department of Agriculture, Ottawa, Ontario.

Moore, Montreal, Quebec, who served in the unusual combination of doctor, radio operator and cook; Mr. Richard H. Stewart, Chief Photographer, National Geographic Society, Washington, and finally, the writer, on loan from the Canada Department of Agriculture, as botanist to the expedition. Transportation from Toronto to Goose Bay and Saglek was supplied by the United States Air Force. Transportation inland from Saglek to the lake was by two USAF Sikorsky helicopters.

From the botanical standpoint there were two objectives: to ascertain if the nature of the surrounding vegetation could contribute to an explanation of the origin of the crater and to record the species in the immediate vicinity of the lake.

Twenty-four days, from July 24 to August 18, were spent in camp at the Merewether Crater. Two afternoons were devoted to collecting at the junction of two small rivers temporarily labeled the North and South Hebron Rivers because they eventually flowed into Hebron Fjord, and over two hours were profitably spent on the height of land that forms the boundary of Labrador and Quebec. In addition, a few days spent at Goose Bay enabled me to revisit some points of interest seen during a previous visit in 1950. A single evening at Hebron, a few miles south of Saglek, was botanically ineffectual but this area was covered to some extent by J. F. McAlpine of the Division of Entomology, Science Service, Canada Department of Agriculture, who was stationed there that summer. Two days at Saglek, July 23 and August 19, and one afternoon at Frobisher Bay, Baffin Island, enabled a few general collections to be made at these points.

The general nature of the country in this part of northern Labrador is that of a plateau with low, rounded, obviously glaciated hills not exceeding 3000 feet in height, punctuated by many deep glacial valleys containing small streams whose size is out of proportion to that of the valleys. At the coast, the steep-sloped valleys produce long fjords reaching several miles to the sea. The crater area is at the plateau level, because the Torngat Mountains could be seen to the northeast from a low ridge near our camp site. The Kaumajet Mountains lay just out of sight to the southeast. To the west, on the horizon, one could perceive the Quebec-Labrador divide. This height of land constitutes the unsurveyed border between the provinces of Quebec and Newfoundland. The Merewether Crater lies approximately twelve miles east of this divide (Figure 1). The latitude and longitude are estimated at 58°02′N and 64°02′W; the elevation is approximately 2100 feet.

Somewhat flattened and obconic in vertical outline, the lake measures 455 feet along the diameter running from north-northwest to south-southeast and 464 feet along the diameter running from west to east. It is 123.7 feet deep at the center. Situated on coarse glacial moraine, it is almost round but more nearly apple-shaped with the gully of the short drainage outlet forming the stem of the apple (Figure 2). The campsite, consisting of a central laboratory tent and five smaller tents for sleeping, was located near the outlet.

The moraine in the vicinity of the lake is of coarse boulders bound together with sands and clays. However, where the fine material had washed away there were broad stretches of sometimes precariously perched rocks. The

FIGURE 2. *Top.* View looking north across the moraine. The Merewether Crater lies between the flag and the camp. The knoll to the right of the camp is the "Two Sisters." *Bottom.* Aerial view of the Merewether Crater.

whole mass is traversed at intervals by deep steep-banked gullies consisting of ridges and piles of coarse boulder litter.

The terrain in the immediate vicinity of the Merewether Crater appeared at first impression to be devoid of vegetation but this barrenness was deceptive. Closer examination disclosed that the rugged moraine did not offer a uniform habitat but was composed of a large number of microhabitats, each owing its existence to differences in exposure, sunlight, water availability and the presence of soil, and each having a different density or association of plants.

The moraine in which the lake lies is ribbed lengthwise roughly in a north-south direction by a number of strips of loose and gravel-bound rocks, forming a series of elongate 'islands' on which a few species of plants manage to obtain a foothold and often even form fairly compact mats. *Carex bigelowii, Luzula confusa, Ledum palustre* var. *decumbens, Salix uva-ursi, Trisetum spicatum,* and *Salix herbacea* are the principal components of the vegetation of these islands. Scattered individuals of *Hierochloë alpina, Festuca brachyphylla, Poa alpina, Poa arctica, Oxyria digyna* (sheltered gullies), *Cardamine bellidifolia, Epilobium latifolium, Pyrola grandiflora, Cassiope hypnoides* and *Vaccinium vitis-idaea* were also present..

Twenty-five species of higher plants were found within a distance of one hundred feet from the margin of the lake water. These were as follows:

Kobresia myosuroides
Carex bigelowii
Carex lachenalii
Carex rariflora
Poa arctica
Poa glauca
Poa pratensis
Festuca brachyphylla
Hierochloë alpina
Trisetum spicatum
Salix herbacea
Salix uva-ursi
Silene acaulis
Oxyria digyna
Empetrum nigrum
Pyrola grandiflora
Ledum palustre var. *decumbens*
Cassiope hypnoides
Cassiope tetragona
Phyllodoce caerulea
Vaccinium uliginosum
Vaccinium vitis-idaea
Diapensia lapponica
Antennaria angustata
Gnaphalium supinum

None of these species is localized in the area and all are found more abundantly elsewhere in similar habitats. The 100-foot horizontal distance includes species from the unstable slopes as well as from the more stable terrain beyond the crater rim.

In order to indicate the density of these species and to see whether or not their local distribution might contribute toward the study of the lake's origin, a number of quadrats six feet square were laid out at various points around the crater as indicated in Figure 3. For convenience, quadrats were set out fifteen feet from the water's edge and from markers laid out for physical measurements. By this method samples were obtained at regular intervals around the almost circular lake. In some instances there were either insufficient plants to warrant the laying out of a quadrat or the banks were so unstable that such a quadrat would not represent the distribution of vegetation. For comparison several quadrats were also marked on more stable moraine in the vicinity. The distribution of vegetation of two quadrats from the crater banks has been diagramed in order to indicate the sparsity of the cover (Figure 3).

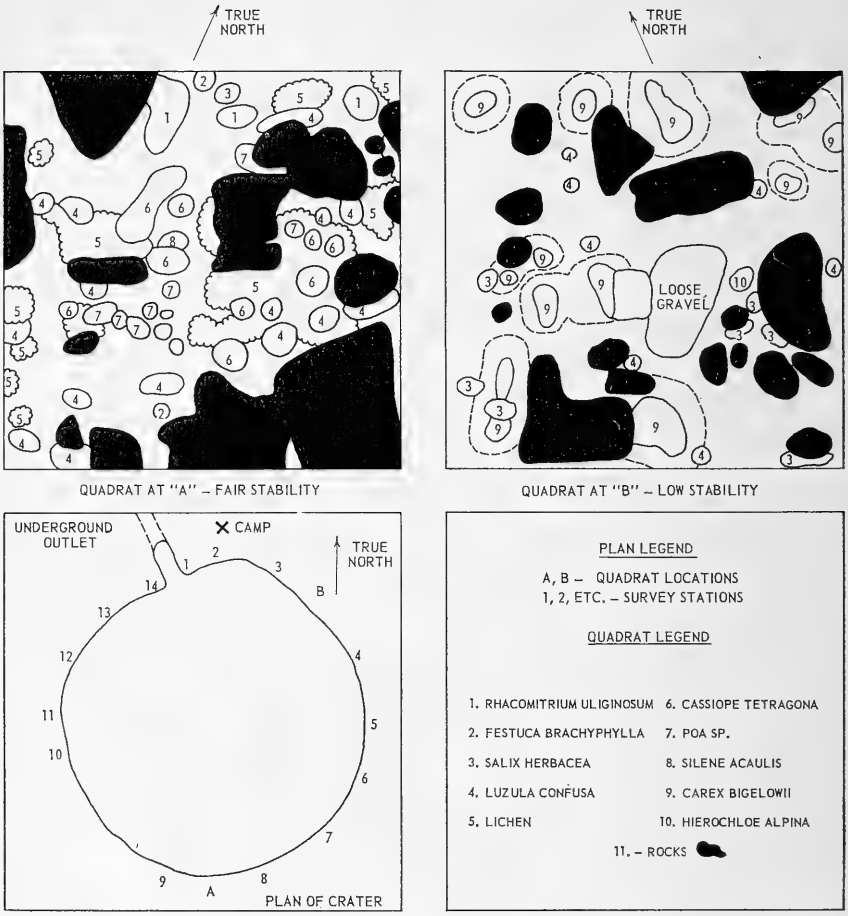

FIGURE 3. Plan view of Merewether Crater and two sample quadrats demonstrating vegetation types and density.

There are four shoreline stability zones that could be visually recognized and which were confirmed by observations on density and stability of species in the quadrats. These four zones are:

1. A low bank of moderate slope, north shore near the campsite.
2. A steep rocky slope on the east shore.
3. A low slope of fair stability along the south shore and part of the west shore.
4. A zone of active slumping along most of the west (east-facing) shore.

The north slope is stable perhaps because it is the lowest part of the shore and has been undisturbed by running water. There is much loose material

here and such rhizomatous species as *Carex bigelowii*, *Salix herbacea* and *Vaccinium vitis-idaea* that are good soil binders have successfully held the gravel together. There is very little organic material to assist this process. Tap-rooted plants such as *Salix uva-ursi* and *Silene acaulis* moved in later and indicate a stability of some length of time.

Most of the east shore had either no plant cover whatsoever or bore a few scattered plants in the lee of boulders. The lack of soil here can be attributed to erosion by surface and underground waters. The lighter material was carried away and the heavy rocks then collapsed in piles where they now stand.

On the south slope slumping had occurred in the past but a degree of stability had now been reached because the angle of slope had decreased. The west shore was actively slumping but with the advance of the season movement seemed to increase as a result of lowering of the frost level. The presence of this area of active slump might reasonably indicate that the shape of the lake was perhaps less circular in the past.

Of the fourteen quadrats laid out, a number bore either no vegetation at all or contained only one or two species covering a very small amount of the surface area. The sparsity of species and of cover is apparently due to instability of the slopes rather than to any effect of change of the chemical content of the soil or similar factors resulting from meteoric impact. But since this instability exists and the plants are for the most part still undergoing initial stages of ecological succession, the lake may have been formed fairly recently through thawing of its site and the surrounding terrain. The reports on sediment deposits would seem to indicate that the water has been present for several hundreds of years, (Meen, 1957).

Plant distribution within the quadrats indicates that *Carex bigelowii*, *Luzula confusa* and to some extent *Hierochloë alpina* are the principal soil binders and first invasion plants on exposed slopes. These species are assisted and at times replaced by others or by such mosses and lichens as *Rhacomitrium* and *Cetraria*. These plants first become established in the lee of rocks and form a patch which links up with adjacent patches. The soil produced allows other species to come in either by the shelter produced or by the retention of water in the root mat. In the two diagrams appended (Figure 3) the approximate extent of root spread of each patch of *Carex* is indicated.

Quadrats laid out at some distance from the lake on a nearby ridge indicate a higher degree of stability there. This stable association consisted of *Salix uva-ursi* and *Diapensia lapponica* interspersed with *Vaccinium vitis-idaea*, *Trisetum spicatum* and occasional *Pedicularis*. Sedges were absent in this area.

A quadrat on a west-facing slope of the ridge was covered by snow until late in the season. Evidence for this was seen by the almost lichen-free rocks found along the lower portion of the slope. The gravelly upper slope was not heavily covered by continuous perennial vegetation but supported a heavy cover of annuals. On the east-facing slope of the same ridge the subshrubby perennial *Cassiope tetragona* was predominant and was mixed with willow and Labrador Tea.

Because the Merewether Crater was suspected of being of meteoric origin the soil in the immediate vicinity of the lake might prove to contain more iron

and nickel than that at points further afield. This increase would perhaps be reflected in an analysis of the plants growing upon this soil. Accordingly, a number of samples of vegetation were collected at various points about the lake and at some distance away. This dried material was submitted to the Chemistry Divison of Science Service, Canada Department of Agriculture, for analysis. The analyses were determined colorimetrically for iron and polarographically for nickel, by Dr. Claude Sirois.

The results are inconclusive because of the method of collection of samples but they do point to a trend toward higher nickel-iron content in plant material collected in the vicinity of the crater than in that collected away from it (Table 1). Dr. Sirois noted these trends and was distrustful of their signifi-

TABLE 1. IRON AND NICKEL CONTENT (PPM) OF TWO SPECIES* OF PLANTS OCCURRING IN THE CRATER AREA AND AWAY FROM IT

Species	Sample	In Crater Area			Away from Crater	
			Ni	Fe	Ni	Fe
Ledum decumbens	1	Leaves	4.0	785		
		Stems	7.2	512		
	7	Leaves	3.7	395		
		Stems	3.1	230		
	13	Leaves			1.6	114
		Stems			1.7	50
Salix uva-ursi	2	Leaves	10.4	420		
		Stems	–	–		
	8	Leaves	4.7	465		
		Stems	5.0	635		
	11	Leaves	7.7	1060		
		Stems	7.8	930		
	12	Leaves			2.5	190
		Stems			1.6	87
	14	Leaves			5.5	390
		Stems			3.5	123

*Analysis of other species have been omitted because they are not comparable.

cance. The meager data was turned over to Mr. J. Friesen, statistician, who made an analysis of variance. Mr. Friesen's conclusions support those of Dr. Sirois (Table 2).

These difficulties would not have arisen had material been collected with a view to the selection of comparable species and with greater care for the removal of soil contaminants. Again, more samples should have been collected. The selection of identical species from widely separated habitats was not easy and was complicated by the sparsity of vegetation and by lack of experience in the collection of samples for this type of analysis. Because of these difficulties

TABLE 2. ANALYSES OF VARIANCE OF NICKEL AND IRON CONTENT OF VEGETATION FROM CRATER AND SURROUNDING AREA

Item	Number of Samples in Crater Area	Number of Samples outside Crater Area	In Crater x_1	Out of Crater x_2	Difference $x_1 - x_2$
Ni leaves	8	3	6.75	3.200	3.475
Ni stems	7	3	7.700	2.2667	5.433*
Ni whole	10	3	7.055	2.733	4.322
Fe leaves	8	3	675.25	231.33	443.92
Fe stems	7	3	511.71	86.67	425.04**
Fe whole	10	3	825.2	159.0	666.2*

*Significant at the 5 percent level of probability
**Significant at the 1 percent level of probability

only two species, *Salix uva-ursi* and *Ledum palustre* var. *decumbens*, could actually be used for comparison between the two locations, "in" and "away from" the suspected crater. Tables 1 and 2 are presented because the data may contribute in some measure to the support of the theory of meteoric origin of the crater and because it is scarcely possible to return and re-collect the material for confirmatory analysis.

Our campsite was located at a relatively high altitude for this latitude and was established from the air so that botanizing of the country was characterized by climbing down the hills to the valleys and returning in the evening, the reverse of the usual method. There was, of course, a pronounced increase in the number of species and in the density of the vegetation at the lower elevations. A shrub line along the sides of the valleys north of the camp area was evident. These shrubs were chiefly *Betula glandulosa*, *Salix vestita*, *S. arctophila* and *S. cordifolia* associated with numerous herbaceous species. In these high valleys shrubs appeared on the lower slopes and near marshy patches along streams but the dry floors bore a mottled cover of *Oxytropis*, *Armeria* and other herbs.

The low valleys of the Hebron River below the herb-covered river benches were dense in alder and glandular birch which formed almost impenetrable thickets and with which were associated a number of herbs not found at higher altitude. *Salix argyrocarpa* and *Ribes glandulosa* appeared in thick patches amid the higher alder, and tufted perennial herbs were abundant on drier portions.

Within one mile of the Merewether Crater several biotite-schist outcrops rose above the moraine and the nearby border ridges. On examination these outcrops were observed to support an interesting array of species. One of the outcrops was situated at the north end of a ridge east of the camp and rose above it perhaps 50 to 75 feet. This outcrop we referred to as the "Two Sisters" because of the two humps forming it. The top of the knoll was very dry and smooth and rather uniformly covered by lichens, *Salix uva-ursi* and *Diapensia*

lapponica. The west and east sides had steep faces with talus slopes below. On the talus, in addition to the common *Festuca brachyphylla, Trisetum spicatum, Hierochloë alpina* and *Luzula confusa*, were found *Papaver radicatum, Oxyria digyna, Polygonum viviparum, Sagina intermedia, Arenaria rubella, Arenaria sajanensis, Stellaria longipes, Cerastium alpinum, Silene acaulis, Ranunculus pygmaeus, Anemone parviflora, Draba crassifolia, Draba nivalis, Cardamine bellidifolia, Arabis alpina, Saxifraga cernua, Saxifraga nivalis, Saxifraga rivularis, Parnassia kotzebuei, Sibbaldia procumbens, Potentilla crantzii, Dryas integrifolia, Astragalus alpinus, Epilobium latifolium, Pyrola grandiflora, Cassiope hypnoides, Cassiope tetragona, Veronica alpina, Pedicularis labradorica, Campanula rotundifolia, Erigeron humilis, Antennaria angustata* and *Taraxacum lapponicum*. *Saxifraga oppositifolia*, curiously enough, appeared only on ledges of the original outcrop and never on the talus below. This was true also for *Sedum roseum*. These two species were found also on a second outcrop on the west side of the moraine-filled valley and at no other place throughout the region of the Merewether Crater. This phenomenon may be explained either by a specialized habitat for these two species, which is not so in other parts of their ranges, or by these two local knolls standing above the valley glacier during the final stages of glaciation in this area. The presence of a small lateral moraine at the southern base of the "Two Sisters" indicated that the ice in its final phase flowed around the knoll rather than over it.

Daly (1902) believed that general glaciation had not extended above the 1600-2100-ft contour on the mountains north of Nachvak. He also postulated that the glacial valleys were produced by lobes of a main Labrador ice-sheet. Coleman (1921) believed that glaciers were restricted to valleys rather than occurring as extensions of lobes from a central mass. Odell (see Abbe, 1938) considered that everything, including the highest mountains, had been completely covered by the ice.

The knowledge of plant distribution in the thirties revealed pronounced gaps in Cordilleran elements. Fernald (1925) had tried to explain the presence of these elements on the basis of nunataks, islands above the ice level where endemics had survived. Later work by Abbe (1936, 1938) in the Torngat and Kaumajet Mountains, the former one of Fernald's nunataks, provided abundant evidence that only the most hardy species survived at high elevation and the number of such species decreased with increase in altitude. Significant too, was the number of "endemics" appearing in apomictic genera or in taxonomically "difficult" groups. If species survived glaciation on nunataks it is more likely that such nunataks were low-elevation, ice-free coastal areas such as Simmons has shown for Greenland. Although observations at the Merewether Crater were made at the relatively low altitudes of 2400 and, at the most, 3000 ft, this altitude is sufficient to be considered as alpine at this latitude. The local distribution of species would in every case uphold the observations, of Abbe.

For the Merewether Crater the following annotated list of species is a rather complete one; for the surrounding area it is quite fragmentary. However, it may be of some interest to speculate on the origin of the flora in broad terms. Many of the plants have been mapped by Raup (1947) who made an analysis of some 271 species out of a possible total of 283 from the Brintell Lake

region of southwestern Mackenzie. Others have been mapped by Porsild (1955) who classified his species of the Western Canadian Arctic Archipelago and later mapped them in his Flora of the region (Porsild, 1957). I have mapped those species that are not included by these two authors. I have placed the species that are clear-cut into the groups employed by Porsild. Those species, in which taxonomy is confused, are omitted. The groups employed by Porsild are, of course, an extension and adaptation of the system set up by Hultén (1937). Because of the southern location of my collecting site (with respect to the true Arctic) I have added another group. The breakdown of species is given separately but the totals of types is as follows:

High-Arctic Species	5
Arctic-Alpine Species	28
Low-Arctic Species	48
North American Radiants	19
Arctic Archipelago Endemics	1
Eastern North American Endemics	13
Amphi-Atlantic Species	24
Southern Trans-Canada Species	3
Total	141
Total Species	153

The breakdown of species is as follows:

HIGH-ARCTIC. These are species ranging beyond the eightieth parallel and northward as far as land extends. Some extend as far south as the Gulf of St. Lawrence. All cross the northern part of the continent and a few follow the Rockies southward. They are of the circumboreal type and include the following species: *Phippsia algida*, *Kobresia myosuroides*, *Juncus biglumis*, *Ranunculus nivalis*, *Saxifraga nivalis*. They form a minor part of the flora.

ARCTIC-ALPINE. These are ubiquitous, wide-ranging species, circumboreal and extending over most of the northern half of the continent. The following species are included:

Equisetum arvense
Lycopodium selago
Cystopteris fragilis
Woodsia glabella
Festuca brachyphylla
Poa glauca
Poa pratensis
Trisetum spicatum
Hierochloë alpina
Carex misandra
Luzula confusa
Oxyria digyna
Polygonum viviparum
Sagina intermedia
Arenaria rubella
Stellaria longipes
Ranunculus pedatifida var. *leiocarpus*
Ranunculus pygmaeus
Draba nivalis
Cardamine bellidifolia
Saxifraga cernua
Saxifraga oppositifolia
Saxifraga rivularis
Empetrum nigrum
Epilobium latifolium
Pyrola grandiflora
Cassiope tetragona
Vaccinium uliginosum var. *alpinum*

LOW-ARCTIC. This group contains ubiquitous tundra species that differ from the above in having a northern limit to their ranges. Most species are of this type, which may be considered simply a division of arctic-alpine plants that are not restricted. This group includes the following species:

Lycopodium alpinum
Festuca rubra
Poa alpina
Elymus mollis
Calamagrostis canadensis
Calamagrostis neglecta
Agrostis borealis
Scirpus cespitosus
Eriophorum angustifolium
Carex canescens
Carex capillaris
Carex lachenalii
Carex rotundata
Carex rariflora
Juncus castaneus
Luzula parviflora
Luzula spicata
Tofieldia pusilla
Alnus crispa
Koenigia islandica
Montia laprosperma
Arenaria peploides
Arenaria sajanensis
Stellaria crassifolia
Ranunculus flammula var. *filiformis*
Ribes glandulosum
Sibbaldia procumbens
Rubus acaulis
Rubus chamaemorus
Astragalus alpinus
Epilobium anagallidifolium
Epilobium angustifolium
Hippuris vulgaris
Ledum groenlandicum
Rhododendron lapponicum
Loiseleuria procumbens
Phyllodoce caerulea
Arctostaphylos alpina
Vaccinium vitis-idaea
Mertensia maritima
Pedicularis lapponica
Pinguicula villosa
Pinguicula vulgaris
Campanula rotundifolia
Erigeron humilis
Petasites palmatus
Arnica attenuata
Artemisia borealis

NORTH AMERICAN RADIANTS. These species extend over the northern half of the continent but are not entirely circumboreal and are considered to be American. This group includes:

Agropyron latiglume
Calamagrostis purpurascens
Eriophorum callitrix
Carex aquatilis
Carex scirpoidea
Salix arctophila
Salix planifolia
Betula glandulosa
Silene acaulis
Anemone parviflora
Draba crassifolia
Cardamine pratensis
Parnassia kotzebuei
Dryas integrifolia
Ledum palustre var. *decumbens*
Veronica alpina var. *unalaschcensis*
Campanula uniflora
Solidago multiradiata
Antennaria angustata

ARCTIC ARCHIPELAGO ENDEMICS. Species confined to the Archipelago and surrounding regions. One species: *Papaver radicatum.* It must be remembered that these groupings are somewhat artificial because they depend so much upon interpretation of species by individual authors.

EASTERN AMERICAN ENDEMICS. Here I have changed Porsild's term Arctic to American because many of the species are not confined to the arctic and even range as far southward as the Appalachian system. The number of species in this group is rather high and poses the problem of their whereabouts during the glacial period. These species must have survived to some extent on ice-free fringes of the continent. They are allied with the group of North American Radiants which are species that probably survived further south on the continent rather than on fringe areas.

The following species are assigned to this group:

Dryopteris phegopteris
Deschampsia flexuosa
Carex miliaris
Salix argyrocarpa
Salix cordifolia
Salix uva-ursi
Salix vestita
Arabis arenicola
Oxytropis campestris var. *terrae-novae*
Castilleja pallida var. *septentrionalis*
Antennaria canescens
Antennaria rousseauii
Solidago macrophylla

AMPHI-ATLANTIC SPECIES. These species occupy both sides of the Atlantic Ocean and the islands between, but seldom extend west of Hudson Bay.

The presence of such a large number of these species with this type of distribution is most interesting because it points to a survival of these species on the American continent rather than to a postpleistocene migration. There is no evidence that there has been any land connection since a period long before the glaciation. Species have no doubt survived chiefly on land fringes in the same manner that they persist today on the shores of Greenland, and modern distribution has been a result of expansion of populations from these fringe areas after deglaciation. From the work of Abbe in the Torngat we know that these species did not persist at high elevations. Furthermore, from the annotated list we see that there are more species at the coast than there are in the interior. Twenty-two species were found to have a coastal distribution only. Some of these, of course, would normally be coastal and the difference in number can be largely attributed to higher altitude. However, the altitude at the junction of the Hebron Rivers is not over 200 feet, a height that is scarcely significant even at this latitude. This species gradient may be real enough to lend support to the idea of a marginal refugium along the coast. The species included in this class are:

Carex bigelowii
Carex nardina
Carex novegica
Deschampsia atropurpurea
Juncus trifidus
Salix herbacea
Cerastium alpinum
Cerastium cerastioides
Lychnis alpina
Arabis alpina
Sedum roseum
Saxifraga aizoon
Potentilla crantzii
Potentilla nivea
Cassiope hypnoides
Diapensia lapponica
Armeria maritima var. *labradorica*
Gentiana nivalis
Euphrasia arctica
Bartsia alpina
Pedicularis flammea
Pedicularis hirsuta
Plantago juncoides
Gnaphalium supinum
Taraxacum lapponicum

SOUTHERN TRANS-CANADA. I have added this group as an entity to include those species that extend across the middle of the continent, north and south along the Rockies, and north and south along the eastern seaboard. They represent the maximum extent of southern species that have migrated northward following deglaciation. These species, too, do not extend into Baffin Island. Hudson Strait may be an extensive sea barrier to further progress. The group includes *Agropyron trachycaulum* var. *novae-angliae*, and *Schizachne purpurascens* and *Cinna latifolia* (Figure 4).

Although only a small number of species concerned in the total flora of Ungava-Labrador are discussed it would appear that the flora of northern Labrador is a composite one made up of species originating from several sources: 1. A group of species that have spread over most of the arctic regions very rapidly in the few thousand years since deglaciation. 2. A group of species that are North American in origin and have remigrated into the region or have survived on fringe areas. 3. A group of species that are common to both North America and Europe and which have either survived on fringe areas or have remigrated from Europe. 4. A small group of southern species that have extended their northern limits to this region.

The following list includes all collections made by myself at the crater, the Hebron Valley, the Quebec-Labrador height of land, Hebron Fjord and Hebron. The collections made by J. F. MacAlpine at Hebron are also included. The mosses are arranged according to Grout (1936) and were

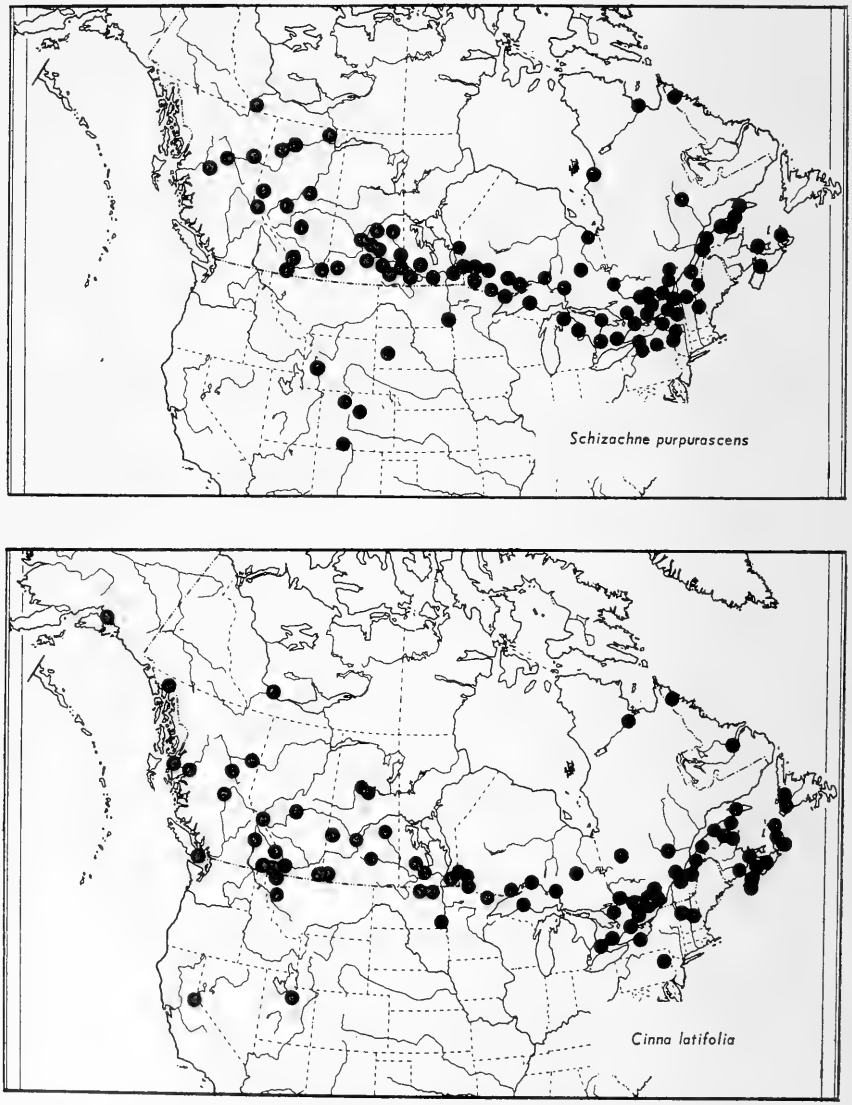

FIGURE 4. Distribution of *Schizachne purpurascens* and *Cinna latifolia*, illustrating the Trans-Canada distribution class.

identified by Dr. Howard Crum, National Museum of Canada. The vascular plants follow the customary Engler sequence. These specimens are preserved at the Botany Laboratory, Canada Department of Agriculture, Ottawa, the United States National Museum, Washington, and the University of Toronto. The first set is in the University of Toronto. Further duplicates were distributed to several institutions interested in northern species. A large collection of lichens has been sent to Dr. J. W. Thomson of the University of Wisconsin for identification, but to date no report has been received.

Abbe's list is certainly the most complete one for the region although it covers chiefly the high alpine species of the Kangalaksiorvik and Kamaktorvik portions of the Torngat and Kaumajet Mountains. Lists by earlier authors concern points far beyond our area and contain many questionable entities. It is difficult to see how such species as Labrador Tea and *Arenaria peploides* were not listed in Abbe. The latter species forms solid bands admixed with *Elymus* along Hebron Fjord and along any sheltered coastal cove. Additions to Abbe's list of species are designated here by as asterisk (excluding mosses and hepatics).

ANNOTATED LIST OF SPECIES

Andreaea rupestris Hedw. On moraine boulders.

Andreaea blyttii BSG. On stones, covering entire south-facing side of a deep ravine in boulder moraine. Rare in North America, only in Greenland and Labrador.

Pogonatum capillare (Michx.) Brid. Sparse on dry boulder tundra.

Pogonatum alpinum (Hedw.) Roehl. Dry rock sills, admixed with *Dicranum* sp., *Aulacomnium turgidum* and *Rhacomitrium lanuginosum*.

Polytrichum norvegicum Hedw. On boulder-gravel moraine. Sometimes admixed with *Dicranoweisia*.

Polytrichum juniperinum Hedw. Soil islands among very coarse ground moraine litter. The stunted alpine form constitutes Schimper's var. *alpinum*.

Ceratodon purpureus (Hedw.) Brid. On ground. Common. On moraine and exposed mountain tops.

Dicranoweisia crispula (Hedw.) Linb. Wet springy tundra, along streams, sheltered places on moraine. One of the most abundant species of the area with many collections.

Dicranum fuscescens Turn. forma. Mossy bank in a valley at about 1500 ft. associated and admixed with *Drepanocladus uncinatus*, *Ptilidium ciliare* and *Rhacomitrium lanuginosum*.

Dicranum muhlenbeckii BSG forma? Steep exposed slopes and on moraine.

Oncophorus wahlenbergii Brid. On rocks of moraine.

Grimmia alpestris Nees. On rocks of moraine.

Rhacomitrium fasciculare (Hedw.) Brid. Rocky moraine.

Rhacomitrium heterostichum (Hedw.) Brid. var. *affine* (Schleich.) C. Jens. Wet ravine in shelter of rocks.

Rhacomitrium heterostichum var. *ramulosum* (Lindb.) Jones. Rocky moraine.

Rhacomitrium lanuginosum (Hedw.) Brid. In valleys; on soil islands of moraine.

Aulacomnium turgidum (Wahl.) Schwaegr. Admixed with *Rhacomitrium lanuginosum* and *Pogonatum capillare*. Found by a rock at the junction of the North and south Hebron Rivers.

Conostomum boreale Sw. Moist sod along shore of a lake. This is a species restricted to the north.

Bryum sp. Forming dense patches at the edge of a snowfield and serving as a microhabitat for *Cerastium cerastioides* and *Saxifraga rivularis*.

Drepanocladus uncinatus (see note under *Hylocomium alaskanum*).

Drepanocladus exannulatus (Guemb.) Warnst.

Drepanocladus exannulatus f. *orthophyllus* Moenk.?

Rhytidium rugosum (Hedw.) Kindb. admixture with *Rhacomitrium lanuginosum*.

Hylocomium alaskanum (Lesq. & James) Kindb. admixture with *Drepanocladus*

uncinatus and in another collection with *Abietinella abietina* (Hedw.) C.M. and *Aulacomnium turgidum*.

Ptilidium ciliare (L.) Nees admixed with *Polytrichum juniperinum, P. piliferum, Dicranum* sp.

Preissa quadrata (Scop.) Nees.

**Equisetum arvense* L. On frost-heaved ground, sandy soil islands in moraine and sparse in boggy meadows; Merewether Crater vicinity and Hebron valleys.

**Lycopodium annotinum* L. Evenly distributed through dry sedge meadow in the upper valley of the North Hebron, 1800 ft.

Lycopodium selago L. var. *appressum* Desv. Very widely scattered on rocky slopes at even the highest altitude but never more than a few stems together.

Cystopteris fragilis (L.) Bernh. No ferns were found at the lake. Collected at Hebron by McAlpine on rock ledges.

**Dryopteris, phegopteris* (L.) Christens. Found at both Hebron and Saglek.

Woodsia glabella R. Br. One collection only by McAlpine on rocky ledges at Hebron.

**Schizachne purpurascens* (Torr.) Swallen. A medium sized patch in a clearing in birch scrub at the junction of the North and South Hebron Rivers. Restricted to ground that had been severely undermined by lemming burrows.

Festuca brachyphylla Schultes. Probably second in abundance to *Carex bigelowii*. Most dry habitats.

Festuca rubra L. f. *squarrosa* (Fries) Holmb. Sandy gravel beach of Hebron Fjord.

Poa alpina L. Rocky moraine and talus slopes occasionally at high altitude. Not conspicuous until August when the fleshy clumps of leaves begin to produce aerial culms.

Poa arctica R. Br. Abundant throughout the region in a variety of habitats; wet soil islands in coarse moraine, rocky slopes.

Poa glauca Vahl. Never an abundant species. On sandy beach and top of river terrace of the Hebron River and on Hebron Fjord. Common on north-facing ravine running out from the lake.

Poa pratensis L. In a meadow at Hebron. In quadrat 13, Merewether Crater.

Phippsia algida Br. Sparse in the area at high elevation, lake vicinity only. However, when found it is locally abundant but a frustrating plant to collect. Patches of wet sand along a lake, wet soil, alluvial fan at margin of a moraine where essentially no competition occurs except with mosses.

**Agropyron trachycaulum* (Link) Malte var. *latiglume* (Scribn. & Sm.) Beetle. Scattered widely along the upper part of a boulder-strewn beach under shade of alders. One collection from the Hebron River junction.

**Agropyron trachycaulum* (Link) Malte var. *nova-angliae* Fern. Abundant in a stream-fed gully running into a valley at elevation of about 1800 ft. Associated with *Senecio pauciflorus, Solidago macrophylla, Calamagrostis canadensis, Luzula parviflora, Salix vestita* which form a lush meadow, one of the few in the area.

Elymus mollis Trin. ssp. *mollis*. Coastal species along Hebron Fjord, at Hebron and Saglek. Frequently forming a continuous band along sandy gravelly beaches, restricted to sandy coves along rocky shores.

Trisetum spicatum (L.) Richter var. *maidenii* (Gand.) Fern. Common throughout the area, widely scattered on slopes, moraines and rock outcrops.

Trisetum spicatum (L.) Richter var. *psilosiglume* Fern. Really a pubescent form. One collection from the junction of the Hebron Rivers.

Deschampsia atropurpurea (Wahlenb.) Scheele On rocky slopes at Saglek; on river beach at Quebec border.

Deschampsia flexuosa (L.) Trin. Sparse in the upper reaches of the North Hebron tributaries but more common at the South Hebron junction. In the North Hebron associated with the only stand of *Epilobium angustifolium* found.

Calamagrostis canadensis (Michx.) Nutt. At low altitude, usually in meadows and at all stations.

Calamagrostis neglecta (Ehrh.) Gaertn. Meadow in a stream-fed gully.

**Calamagrostis purpurascens* R. Br. Quebec border only, in shelter of a hill on a river terrace.

Agrostis borealis Hartm. Margin of a pool on the Quebec-Labrador height of land. Crater Lake vicinity, a cliff face; Hebron Junction on sandy beach; at Saglek mixed with *Deschampsia atropurpurea*.

**Cinna latifolia* (Trev.) Griseb. One collection from the river beach at the Hebron junction.

Hierochloë alpina (Sw.) R. & S. Common throughout the region, the dried culms of the previous year a conspicuous feature of the landscape. On a terrace on the Quebec border forming clumps interspersed with lichen, a little *Vaccinium vitis-idaea* and *Lycopodium selago*.

Scirpus cespitosus L. var. *callosus* Bigel. Sparse in the Crater Lake area restricted to meadows of the valleys.

Eriophorum angustifolium Honck. Sparse everywhere, chiefly because of lack of habitats.

**Eriophorum callitrix* Cham. Sparse about shore of a lake in dense sod. In Crater area.

Kobresia myosuroides (Villars) Fiori & Paeol. Coarse moraine in the lake vicinity and occasional on the surrounding hills.

Carex aquatilis Wahlenb. One collection from the edge of a stream in the North Hebron valley is referable to this species.

Carex bigelowii Torr. The most abundant species of flowering plant in the area. Found in all habitats and exhibiting much variation in height of plant, density and manner of growth.

Carex canescens L. Sparse. Restricted to sheltered places at either coastal or inland stations.

Carex capillaris L. One collection on a steep slope near the camp area but seen on a number of occasions on gravel moraine.

**Carex lachenalii* Schk. Relatively common. Preferring sandy or sod lake margins but also on rocky slopes.

Carex marina Dewey On ledges of cliff overlooking the sea and on talus below; Saglek only.

Carex miliaris Michx. Occasional in wet marshy gravels or margins of pools in the interior.

Carex misandra R. Br. Wet places on rocky slopes near the lake.

**Carex nardina* Fries Collected on the exposed end of a ridge associated and admixed with *Kobresia*.

Carex norvegica Retz. Sparse in the lake area on steep slopes. Only one collection.

**Carex rotundata* Wahlenb. One collection from the Quebec-Labrador border along a bog-margined stream.

Carex rariflora (Wahlenb.) Sm. North Hebron valley, dense sod at margin of a pool. Occasional here only.

Carex scirpoidea Michx. Rather common along the coast and seen in the crater area only at low elevations of the upper tributaries of the North Hebron River.

Juncus biglumis L. Occasional in depressions at high altitude, talus slopes, sandy-gravel lake shores.

Juncus castaneus Sm. Wet sedge meadows.

Juncus trifidus L. Sparse in the area but in dense clumps when it does occur; sheltered rocky slopes and valleys, sandy beaches.

Luzula confusa Lindl. Abundant about our lake and forming a major portion of the dry habitat vegetation. A highly variable species.

Luzula groenlandica Böcher Sedge meadow in a valley near the lake and at the Hebron junction.

Luzula parviflora (Ehrh.) Desv. Occasional in sedge meadows and in *Calamagrostis* under alders; valleys in sheltered places.

Luzula spicata (L.) DC. Apparently rare, one collection in the lake area on dry gravel stream bank.

Tofieldia pusilla (Michx.) Pers. Extremely sparse. Only one locality found in a slightly springy patch in the valley of the North Hebron tributary.

Salix argyrocarpa Anderss. Sparse in the valleys, now and then forming a low patch in taller *Betula glandulosa*.

Salix arctophila Cockerell Very abundant throughout the area, usually prostrate but occasionally ascending. Shiny leaves quite characteristic but extremely variable in form. Perhaps hybridizing with *S. planifolia*.

Salix cordifolia Pursh Highly variable species. Many of the varieties described are probably no more than phases or forms.

Salix cordifolia Pursh var. *callicarpaea* (Trautv.) Fern. Common at Saglek; scattered in Crater area and in the North Hebron valley associated with *S. vestita*.

Salix cordifolia var. *macounii* Fern. Saglek only.

Salix herbacea L. Abundant amid coarse moraine litter on soil islands. A pioneer plant on disturbed gravel.

Salix planifolia Pursh This species generally has more lanceolate or narrowly elliptic leaves than *S. arctophila*, and, of course, is a 3- to 6-ft shrub. Valleys in the interior, sparse.

Salix uva-ursi Pursh Closely associated with *Diapensia* on gravel moraine. Also on gravel slopes of the Hebron valley.

Salix vestita Pursh Lower slopes of valleys at the point where steep slopes are beginning to level off. Not on the valley floor and tapering off suddenly to the upper slopes.

Betula glandulosa Michx. Common in the Hebron valleys at about 1700 ft and on the coast.

Alnus crispa (Ait.) Pursh Not found at the higher elevations even in the sheltered Hebron valley (1800 ft) but at low elevations it is a 10-ft shrub forming bands along streams at inland and coastal stations.

Oxyria digyna (L.) Hill Common throughout the area. Usually present on the most barren exposed places.

Polygonum viviparum L. Sunny hillsides in gravel moraine at all altitudes.

Koenigia islandica L. One collection only from the Hebron valley on a hummock along a stream. Probably rather common but because it is not conspicuous it tends to be overlooked.

Montia laprosperma Cham. One specimen from Hebron collected by McAlpine and Sterns in a meadow near a stream.

Sagina intermedia Fenzl. One collection from a west-facing slope of moraine. Perhaps common; it is not conspicuous.

**Arenaria peploides* L. A marine beach species, usually associated with *Elymus mollis* L. Very common on sandy shores of Hebron Fjord.

**Arenaria rubella* (Wahlenb.) Sm. One collection from widely scattered plants on river beach at the Hebron Rivers junction.

Arenaria sajanensis Willd. Very sparse. Usually on talus slopes in the vicinity of the crater.

Stellaria crassifolia Ehrh. Rocky slopes near the sea. Saglek only.

Stellaria longipes Goldie Very common at all elevations and localities throughout the region. The glaucous leaves and later the black capsules form a very striking vegetation feature. Found on valley hillsides, talus slopes, dry gravel stream banks, soil islands on moraine slopes.

Cerastium alpinum L. Very abundant on moraine and slopes, flowering early in the season but persisting late.

Cerastium cerastioides (L.) Britton Sheltered damp patches on rocky and talus slopes and soil islands in moraine. Easily distinguished from *C. alpinum* in the field by the later although somewhat overlapping flowering dates and the glaucous vegetative condition.

Lychnis alpina L. var. *americana* Fern. A rarity inland but rather frequent at coastal stations.

Silene acaulis L. var. *exscapa* (All.) DC. Common, almost abundant, at coastal stations and at high elevations inland. On July 25 the species was in flower at 3000 ft but in fruit at 2000 ft. The species appears to be an efficient soil binder on exposed gravel moraine and is frequently mixed with *Diapensia lapponica*.

Ranunculus nivalis L. Steep banks and ridges, sparse in our lake area.

Ranunculus pedatifidus J. E. Sm. var. *leiocarpus* (Trautv.) Fern. One collection near the Merewether Crater.

Ranunculus pygmaeus Wahl. Relatively common on moist rocky slopes and moraine rock fields.

Ranunculus flammula L. var. *filiformis* (Michx.) Hooker At Saglek on level meadow mixed with *R. pygmaeus;* on the Quebec-Labrador height of land on dried caked organic matter over sand bottom of an evaporated pool.

Anemone parviflora Michx. Fairly common on steep banks and slopes.

Papaver radicatum Rottb. Occasional in the Merewether Crater area on loose coarse talus slopes. Sparse at Hebron.

Draba crassifolia Grah. Only three plants collected on a soil island on rock-strewn slopes near the Crater.

Draba hirta L. Occurs at Hebron and on the river beach at the Hebron junction; from these occurrences we might expect it to be a low elevation plant.

Draba nivalis Lilj. Common but widely scattered on steep rocky slopes, Merewether Crater vicinity.

Cardamine bellidifolia L. A high elevation plant. Scattered widely on slopes and persisting with altitude to the highest and most exposed places.

**Cardamine pratensis* L. One collection only by McAlpine from a dried-up pond bed at Hebron. Vegetative condition only, no flowers.

Arabis alpina L. Abundant at costal stations but in the Merewether area restricted to talus slopes or occasional on lower valley floors.

Arabis arenicola (Rich.) Gelert. One colony found at the Hebron junction on boulder-strewn sand beach at the margin of a band of alder. The divergent siliques are distinctive.

**Sedum roseum* (L.) Scop. Common along the coast but sparse inland even in the valleys. At the lake found only on disintegrating rock of cliff faces. Abbe considered the reports of its presence by Delabarre as dubious and apparently did not come across the species himself. According to Abbe it is a low-elevation plant although I did not find it in the Hebron valleys several hundred feet lower in elevation.

Saxifraga aizoon Jacq. var. *neogaea* Butters. Only one plant was found after a diligent search on the sandy beach at the junction of the Hebron Rivers.

Saxifraga cernua L. Chiefly occurring on west-facing slopes but occasionally on soil islands on the moraine. So widely scattered that it was difficult to collect even a single adequate herbarium sheet.

Saxifraga nivalis L. Very widely scattered in the area on steep slopes.

Saxifraga oppositifolia L. On biotite-schist outcrops only.

Saxifraga rivularis L. Common in wet places on rocky slopes everywhere at higher elevations. Frequently the only flowering plant in a habitat.

Parnassia kotzebuei Cham. The only species seen in the region. Grassy meadows and rocky slopes frequently associated with *Anemone parviflora*.

**Ribes glandulosum* Grauer Abundant under shelter of willow and alder in the sheltered Hebron River valleys. Not seen on the coast.

**Sibbaldia procumbens* L. Not in the immediate vicinity of the Merewether Crater, rather common about slopes of a lake to the west. Also on ledges of cliffs.

Potentilla crantzii Beck. Common everywhere on slopes, ledges, rarely in meadows.

Potentilla nivea L. At the Hebron junction only, on steep river terrace slopes.

Dryas integrifolia Vahl Sparse in the interior, more common on the coast.

Rubus acaulis Michx. Occasional in moist habitats, valleys and at coastal stations.

Rubus chamaemorus L. Sparse at Saglek, chiefly sterile plants.

Astragalus alpinus L. A high elevation plant. Biotite-schist outcrops, occasional on gravel eskers.

Oxytropis campestris L. var. *terrae-novae* (Fern.) Barneby Preferring dry river terrace plains but also found on sand-gravel beach on Hebron Fjord. Occasional.

Empetrum nigrum L. In the lake area much less common than expected, but it is abundant at lower levels. Scattered widely in small patches on coarse moraine.

**Viola adunca* Sm. var. *minor* (Hook.) Fern. Low elevation plant, sparse in sheltered wet places.

**Viola conspersa* Reichenb. One collection made by McAlpine at Hebron on a sunny protected bank.

**Epilobium anagallidifolium* Lam. Restricted to sandy beaches, abundant there.

Epilobium angustifolium L. Locally common in the valleys but never abundant. Such sparsity is in striking contrast to its abundance in other northern regions further west.

Epilobium latifolium L. Common throughout the area.

**Hippuris vulgaris* L. Found at Hebron by McAlpine. Definitely does not occur in the Merewether area and at higher altitudes but may turn up in the valleys where suitable habitats exist.

Pyrola grandiflora Radius Scattered throughout the area but forming patches on slopes of gravel moraines. Collected at Hebron. On July 28 the species was seen in flower on the east side of an outcrop and at the same time was in fruit on the west side of the same outcrop.

**Ledum groenlandicum* Oeder Definitely low-altitude species in this region although both species may occur together at low altitude.

Ledum palustre L. var. *decumbens* Ait. When we arrived at the crater in July, the plants were nearing the end of their flowering period. At higher elevations and exposed places everywhere.

Rhododendron lapponicum (L.) Wahlenb. Sparse near the Merewether Crater and more frequent on gravel ridges and river terrace plains.

**Loiseleuria procumbens* (L.) Desv. One collection only from Saglek mixed with *Diapensia*. Not seen inland, although it was watched for.

**Phyllodoce caerulea* (L.) Bab. Coastal stations only on rocky slopes.

Cassiope hypnoides (L.) D. Don Relatively common on soil islands in very coarse ground moraine litter but seldom in sufficient quantity to make a collection.

Cassiope tetragona (L.) D. Don Occasional on generally east- or north-facing slopes.

Arctostaphylos alpina (L.) Spreng. Rather common at Saglek on the rocky slopes. In the lake vicinity almost restricted to caribou trails along the top of the eskers. Because of this restricted habitat one might consider the introduction of this species through the agency of the caribou as a distinct possiblity.

**Vaccinium uliginosum* L. var. *alpinum* Bigel. Abundant everywhere on rocky slopes and gravel moraines.

Vaccinium vitis-idaea L. var. *minus* Lodd. Never luxurious but always common on dry rocky and gravelly moraine. The rhizomes of this species sometimes extend 3 to 4 feet from the parent plant.

**Diapensia lapponica* L. Quite common on dry barren gravel moraines but seldom on disturbed soils and always at higher elevations.

**Trientalis borealis* Raf. A collection from the Hebron River and the village of Hebron consists of smaller plants than our southern Canadian material although small plants are found among the southern material occasionally. There is a definite tendency for northern plants to exhibit smaller size of all parts than the southern ones.

Armeria maritima L. var. *labradorica* (Wallr.) Lawr. Occasional at both coastal and interior stations. In the North Hebron valley it was found on the east side but not the west side, although the habitats seemed the same. No explanation is offered.

Gentiana nivalis L. I had asked McAlpine to look for this plant at Hebron where it had been reported by Macoun and others. He brought back a fine collection of this handsome species which is found in this portion of North America only. It does not occur inland.

Mertensia maritima (L.) S.F. Gray One collection on ledges of a cliff along the coast at Saglek.

Veronica alpina L. var. *unalaschcensis* C.&S. Widely distributed at all locations and in many habitats. Most luxurious where there is an ample water supply. I found this plant equally abundant in the Mealy Mountains of southern Labrador.

Euphrasia arctica Lange. Abundant in sheltered glacial valleys and slopes.

Bartsia alpina L. On east-facing slopes of the North Hebron valley and common at Saglek. Not in our lake area.

**Rhinanthus borealis* (Stern.) Chab. Hebron only, not inland. Meadows.

Pedicularis flammea L. Common on rocky tundra and especially in protected places in the region.

Pedicularis hirsuta L. Sparse and occasionally admixed with *P. flammea* L.

Pedicularis labradorica Wirsing Abundant on rocky tundra at high elevations and on sandy river terrace plains.

Pedicularis lapponica L. Wet meadows and occasional on rocky tundra.

Castilleja pallida (L.) Spreng. var. *septentrionalis* (Lindl.) Gray Apparently common at Hebron, but not seen inland.

Pinguicula villosa L. Hebron only, frequently admixed with *P. vulgaris* L.

Pinguicula vulgaris L. Definitely not found inland but was collected by both McAlpine and myself at Hebron. Not seen at Saglek but probably occurs there.

Plantago juncoides Lam. var. *glauca* (Hornem.) Fern. Coastal species only, on cliffs and sand beaches.

Campanula rotundifolia L. Quite common at most altitudes, forming gay clumps among the rocks.

Campanula uniflora L. Relatively common on moraine and talus slopes at high elevation.

Solidago macrophylla Pursh var. *thyrsoidea* (E. Mey.) Fern. Becoming increasingly common with lower elevation but not occurring beyond the lush valleys. At Saglek closely associated and admixed with the other species, *S. multiradiata*.

Solidago multiradiata Ait. Rocky slopes of the coastal stations. Not seen inland.

Erigeron humilis Grah. Steep rocky alpine slopes and talus slopes. Quite abundant everywhere, dwarfed at higher altitude but not in sheltered places.

Antennaria angustata Greene A common species in most drier habitats as river terraces and morainic slopes.

Antennaria canescens (Tge.) Malte The Quebec-Labrador watershed yielded a few plants referable to this species.

Antennaria rousseauii Porsild One collection from Saglek is referred to this species.

Gnaphalium supinum L. On soil islands, rock outcrops and gravel slopes of the interior frequently mixed with *Antennaria* species.

**Petasites palmatus* (Ait.) Gray A few sterile leaves were found in a rich meadow in a gully in the North Hebron valley.

Arnica attenuata Greene At slightly lower elevations than the Merewether Crater and on the sides and in meadows on the floor of the valley of the North Hebron.

Senecio pauciflorus Pursh Found only once, in a sheltered gully in the North Hebron valley, associated with *Agropyron trachycaulum*. Probably it is more common in the lower valleys where I was unable to visit. McAlpine collected it at Hebron.

Artemisia borealis L. f. *wormskioldii* (Bess.) Vict. & Rouss. A few plants found on a sandy boulder-strewn beach along the South Hebron River, elevation about 300 ft.

Taraxacum lapponicum Kihlman Abundant everywhere on sunny alpine slopes. Most of the material can be referred to this species.

Taraxacum torngatense Fern. One specimen from the area is referred to this species. There are a few unconvincing morphological differences.

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Received for publication 17 July 1958

CHRISTMAS BIRD CENSUS, 1959-1960

Edited by W. EARL GODFREY

NEWFOUNDLAND

Badger, Nfld. (Exploit R. runs through area. 60% young cutover and burnover of black spruce, balsam fir, white birch; 30% bog, 10% town area, which contains a few exotic poplar and scotch pine).—26 Dec. 1959; 8 a.m. to 2 p.m.; temp. 0° to 20°; wind NW, 0-5 m.p.h.; clear and cold, 13 in. snow, river open, ponds frozen. 5 observers in 2 parties. Total party hours, 12; total party miles, 45 (13 on foot, 32 by car).

Sharp-shinned Hawk, 1; Ruffed Grouse, 2 (introduced); Willow Ptarmigan, 1; Hairy Woodpecker, 1; Gray Jay, 5; Common Raven, 4; Black-capped Chickadee, 3; Boreal Chickadee, 4; Starling, 17; House Sparrow, 41; Snow Bunting, 1. Total, 11 species; 80 individuals.

Henrik Deichmann (compiler), Thomas Foulkes, Harry Hayden, William Noseworthy, Albert Williams.

St. John's, Nfld. (City, harbor, 3 m. suburbs).—26 Dec. 1959; 8 a.m. to 3.30 p.m.; temp. 22° to 30°; wind E, 0-10 m.p.h.; one foot snow. 12 observers in 4 parties. Total party hours, 22 (on foot); total party miles, 16 (on foot).

Pigeon Hawk, 3; Glaucous Gull, 63; Iceland Gull, 78; Great Black-backed Gull, 49; Herring Gull, 378; Ring-billed Gull, 2; Black-headed Gull, 4; Rock Dove, 129; Mourning Dove, 5; Yellow-shafted Flicker, 1; Hairy Woodpecker, 1; Blue Jay, 1; Common Raven, 10; Common Crow, 61; Black-capped Chickadee, 17; Boreal Chickadee, 15; Am. Robin, 3; Golden-crowned Kinglet, 12; Cedar Waxwing, 9; Northern Shrike, 1; Starling, 1184; House Sparrow, 456; Brown-headed Cowbird, 1; Evening Grosbeak, 9; Purple Finch, 15; Pine Grosbeak, 7; Common Redpoll, 150; Red Crossbill, 16; White-winged Crossbill, 22; Slate-colored Junco, 35; Snow Bunting, 10. Total, 31 species; 2642 individuals.

C. W. Andrews, John Green, S. Peters, Florence Peters, John Macgillivray, Darroch Macgillivray, Harold Horwood, Charles Richardson, P. B. Rendell, Malcolm Maclaren, Leslie M. Tuck (compiler).

PRINCE EDWARD ISLAND

Mt. Stewart, P.E.I. (Hillsborough R. between Mt. Stewart and Cherry Hill and Savage Harbour. Fresh water 10%, salt water 15%, coniferous woods 25%, fresh water marsh 25%, farmland 25%).—25 Dec. 1959; 8 a.m. to 4 p.m.; temp 20° to 30°; wind light N; cloudy but fine. 1 observer. Total hours, 8 (7 on foot, 1 by car); total miles, 20 (10 on foot, 10 by car).

Canada Goose, 68; Black Duck, 49; Pintail, 13; Green-winged Teal, 8; Common Merganser, 38; Common Snipe, 1; Great Black-backed Gull, 4; Herring Gull, 14; Mourning Dove, 3; Blue Jay, 6; Common Raven, 8; Common Crow, 9; Black-capped Chickadee, 7; Boreal Chickadee, 7; Golden-crowned Kinglet, 2; Starling, 35; House Sparrow, 65; Common Redpoll, 62; Tree Sparrow, 3; Swamp Sparrow, 2; Song Sparrow, 2; Snow Bunting, 23. Total, 22 species; 429 individuals. Seen in count period: Brown-headed Cowbird, 5; Redwinged Blackbird, 1; Evening Grosbeak, 12.

Bruce C. Pigot.

NOVA SCOTIA

Boylston, N.S. (Circle with 7½-mile radius centered on Boylston).—26 Dec. 1959; 9 a.m. to 4 p.m.; temp. 32° to 35°; wind SW, light. 1 observer. Total hours, 7 (4 on foot, 3 by car); total miles, 25 (8 on foot, 17 by car).

Horned Grebe, 40; Black Duck, 18; Common Goldeneye, 25; Bufflehead, 15; Oldsquaw, 220; Common Eider, 45; Red-breasted Merganser, 150; Rough-legged Hawk, 1; Great Black-headed Gull, 28; Herring Gull, 50; Belted Kingfisher, 1; Common Raven, 60; Common Crow, 80; Boreal Chickadee, 12; Starling, 115; House Sparrow, 90; Redwinged Blackbird, 1; Pine Grosbeak, 9; Slate-colored Junco, 6. Total, 19 species; 956 individuals.

D. D. Findlay.

Cole Harbour—Chezzetcook, N.S. (15-mile circle centered on Mineville; Eastern Shore Highway, Porter's Lake, Cole Harbour, Lawrencetown, Wedge Island, Three-fathom Harbour, Seaforth and Chezzetcook; mixed second-growth woods 45%, salt water 30%, fresh water 10%, salt and brackish ponds and marshes 10%, farms and settlements 5%).—29 Dec. 1959; 7.45 a.m. to 4.30 p.m.; temp. 30°; wind ENE, 30-50 m.p.h.; continuous driving snow, conditions and visibility very poor. 7 observers in 3 parties. Total party hours, 22 (4 on foot, 18 by car); total party miles, 120 (7 on foot, 113 by car).

Common Loon, 2; Horned Grebe, 5; Canada Goose, 165; Black Duck, 350; Common Goldeneye, 10; Bufflehead, 19; Oldsquaw, 12; Common Merganser, 3; Red-breasted Merganser, 10; Goshawk, 1; Sharp-shinned Hawk, 1; Bald Eagle, 1; Common Snipe, 1; Great Black-backed Gull, 44; Herring Gull, 230; Ring-billed Gull, 12; Black-headed Gull, 1; Razorbill, 1; Mourning Dove, 1; Yellow-shafted Flicker, 1; Hairy Woodpecker, 2; Horned Lark, 2; Blue Jay, 1; Common Raven, 46; Common Crow, 49; Black-capped Chickadee, 14; Boreal Chickadee, 13; Red-breasted Nuthatch, 4; Brown Creeper, 1; Golden-crowned Kinglet, 11; Starling, 140; House Sparrow, 44; Brown-headed Cowbird, 185; Evening Grosbeak, 2; Common Redpoll, 725; Pine Siskin, 15; Am. Goldfinch, 5; White-winged Crossbill, 11; Lark Bunting, 1; Ipswich Sparrow, 2; Savannah Sparrow, 1; Slate-colored Junco, 165; Tree Sparrow, 8; White-throated Sparrow, 32; Fox Sparrow, 5; Song Sparrow, 39. Total, 46 species; about 2393 individuals. Seen in count period: Common Eider, Ruffed Grouse, Ring-necked Pheasant, Vesper Sparrow.

C. R. K. Allen, John Comer, Fred Dobson, Mrs. John W. Dobson, Clive Macdonald, L. B. Macpherson (compiler), Carl Wellish (Nova Scotia Bird Society).

Halifax, N.S. (15-mile circle centered on Henry Lake on Old Sambro Road; city, harbor, Northwest Arm, roads to Herring Cove, Sambro Harbour and Timberlea; mixed second-growth woods, conifer 50%, open barrens 15%, salt water 15%, fresh water 7%, small farms 7%, city and villages 6%).—3 Jan. 1960; 8 a.m. to 4 p.m.; temp. 30° to 40°; wind SSW, 35-70 m.p.h.; ground mostly bare, lakes frozen, visibility poor in p.m., overcast, heavy rain. 7 observers, in 3 parties 10 at feeding stations. Total party hours, 23 (6 on foot, 17 by car); total party miles, 33 (8 on foot, 25 by car).

Horned Grebe, 1; Great Cormorant, 4; Common Eider, 165; Sharp-shinned Hawk, 1; Purple Sandpiper, 3; Glaucous Gull, 2; Iceland Gull, 12; Great Black-backed Gull, 500; Herring Gull, 4000; Black-headed Gull, 5; Thick-billed Murre, 1; Dovekie, 3; Black Guillemot, 3; Rock Dove, 750; Hairy Woodpecker, 6; Downy Woodpecker, 7; Blue Jay, 19; Common Raven, 24; Common Crow, 27; Black-capped Chickadee, 36; Boreal Chickadee, 5; White-breasted Nuthatch, 6; Red-breasted Nuthatch, 8; Brown Creeper, 2; Am. Robin, 4; Golden-crowned Kinglet, 2; Starling, 7000; House Sparrow, 2000; Common Grackle, 2; Brown-headed Cowbird, 83; Evening Grosbeak, 108; Pine Grosbeak, 2; Common Redpoll, 39; Pine Siskin, 1; Slate-colored Junco, 52; Tree Sparrow, 2; Song Sparrow, 3. Total, 37 species; about 14,888 individuals. Seen in area during count period, but not on count day: Common Loon, Red-necked Grebe, Redshank (studied for half hour at 80-100 feet through 25 × telescope, L.B.M., F.D.), Ring-billed Gull, Snowy Owl, Yellow-shafted Flicker, Mockingbird, Yellow-breasted Chat, Baltimore Oriole, American Goldfinch.

C. R. K. Allen, Mrs. C. R. K. Allen, Mrs. G. P. Backman, Mrs. Ernest Bell, Mrs. P. S. Christie, W. J. Chute, Mrs. A. D. M. Curry, Fred Dobson, Mrs. John W. Dobson, Mrs. Clive Macdonald, L. B. Macpherson (compiler), William Menchions, W. J. Mills, David Stewart, Mrs. C. L. Torey, Richard Ward (Nova Scotia Bird Society).

West Middle Sable, N.S. (West Middle Sable to Hemeon Head, also Head of Port l'Hebert, all within 7½ miles of West Middle Sable schoolhouse).—26 Dec. 1959; 8.30 a.m. to 5.30 p.m.; temp. 5° to 28°; wind calm; 3 in. snow; light shore ice on sheltered water; cloudy, snow flurries. 2 observers in 2 parties and 3 feeding stations. Total party hours, 9 (8 on foot, 1 by car); total party miles, 16 (13 on foot, 3 by car).

Horned Grebe, 4; Great Cormorant, 13; Canada Goose, 788; Black Duck, 373; Common Goldeneye, 8; Bufflehead, 38; Common Eider, 6; Common Merganser, 10; Great Black-backed Gull, 4; Herring Gull, 68; Dovekie, 1; Great Horned Owl, 1; Hairy Woodpecker, 3; Downy Woodpecker, 1; Horned Lark, 1; Gray Jay, 6; Blue Jay, 12; Common Raven, 2; Common Crow, 15; Black-capped Chickadee, 19; Boreal Chickadee, 17; Red-breasted Nuthatch, 6; Am. Robin, 1; Golden-crowned Kinglet, 5; Starling, 11; Myrtle Warbler, 5; House Sparrow, 15; Baltimore Oriole, 1; Evening Grosbeak, 2; Pine Grosbeak, 3; Common Redpoll, 9; Savannah Sparrow, 3; Slate-colored Junco, 44; Tree Sparrow, 6; White-throated Sparrow, 9; Song Sparrow, 4; Snow Bunting, 1. Total, 37 species; 1515 individuals.

Mrs. R. J. Dingwall, Mrs. Harrison F. Lewis, Harrison F. Lewis (compiler), Mrs. Cecil Thompson, Dr. Harold F. Tufts.

Wolfville, N.S. (Within a radius of about 7½ miles of Acadia University).—27 Dec. 1959; 8 a.m. to 4.30 p.m.; temp. 22° at start, 24° at finish; wind W, light; ground practically bare of snow. 12 observers, 5 in parties, and 3 at feeding trays. Total party hours 40, (1 on foot, 33 by car); total party miles 100, (22 on foot, 78 by car).

Great Blue Heron, 1; Black Duck, 131; Common Goldeneye, 23; Red-tailed Hawk, 5; Rough-legged Hawk, 4; Bald Eagle, 6; Marsh Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 2; Ring-necked Pheasant, 13; Great Black-backed Gull, 92; Herring Gull, 182; Rock Dove, 93; Mourning Dove, 25; Short-eared Owl, 4; Yellow-shafted Flicker, 3; Hairy Woodpecker, 6; Downy Woodpecker, 2; Horned Lark, 23; Blue Jay, 59; Common Raven, 26; Common Crow, 188; Black-capped Chickadee, 42; Boreal Chickadee, 4; White-breasted Nuthatch, 3; Red-breasted Nuthatch, 3; Long-billed Marsh Wren, 1; Mockingbird, 1; Am. Robin, 1; Golden-crowned Kinglet, 12; Cedar Waxwing, 3; Starling, 630; Yellowthroat, 1; House Sparrow, 701; Brown-headed Cowbird, 2; Evening Grosbeak, 213; Purple Finch, 13; Pine Grosbeak, 37; Common Redpoll, 526; Pine Siskin, 6; Am. Goldfinch, 26; Savannah Sparrow, 6; Slate-colored Junco, 103; Tree Sparrow, 27; White-throated Sparrow, 4; Song Sparrow, 22; Snow Bunting, 1. Total, 47 species; 3185 individuals. Seen during count period: Canada Goose, 25; Green-winged Teal, 2; Common Merganser, 2; Gray Partridge, 5; Brown Creeper, 1; Yellow-breasted Chat, 1; Swamp Sparrow, 1; Lapland Longspur, 3.

J. Sherman Bleakney, John S. Erskine, Mrs. Rachel Erskine, Mrs. Mary Forbes, Mrs. Margaret Miller, Ralph Mosher, Eric Mullen, Mrs. Mulloch, Peter Smith, Christopher Thurrott, R. W. Tufts (compiler), Mrs. Eva Urban.

NEW BRUNSWICK

Fredericton, N.B. (Mixed woods mostly coniferous 50%, open fields 25% and urban residential 25%).—26 Dec. 1959; 8.45 a.m. to 4.30 p.m.; temp. 10° to 25°; wind NW, 0-10 m.p.h. 16 observers in 7 parties. Total party hours, 31 (8 on foot, 23 by car); total party miles, 116½ (17½ on foot, 99 by car).

Common Goldeneye, 4; Common Merganser, 6; Red-breasted Merganser, 1; Sharp-shinned Hawk, 2; Ruffed Grouse, 1; Ring-necked Pheasant, 1; Rock Dove, 53; Hairy Woodpecker, 6; Downy Woodpecker, 3; Blue Jay, 43; Common Raven, 2; Common Crow, 17; Black-capped Chickadee, 63; Boreal Chickadee, 6; White-breasted Nuthatch, 4; Red-breasted Nuthatch, 1; Brown Creeper, 1; Starling, 255; House Sparrow, 440; Common Grackle, 1; Evening Grosbeak, 33; Purple Finch, 1; Common Redpoll, 25; Pine Siskin, 5; Am. Goldfinch, 3; Slate-colored Junco, 11; Tree Sparrow, 25; White-throated Sparrow, 1; Song Sparrow, 1; Snow Bunting, 3. Total, 30 species; 1018 individuals. Also seen during count period: Canada Goose, Snow Goose, Bald Eagle, Pileated Woodpecker.

Jean Brown, Rae Brown, A. Dean, G. Eagles, Elizabeth C. Hagmeier, E. M. Hagmeier, Jane McNeill, Marguerite McNair, Nettie Moore, Peter Pearce, Richard Savage, Helen Squires, Robert Squires, W. A. Squires (compiler), Wm. Tait, I. W. Varty.

Saint John, N.B. (Saint John, Lancaster, Rothesay, tidal waters of lower Saint John and Kennebecasis rivers, harbor and seashore. Part covered was 20% sea coast, 70% city and residential area, 10% mixed woods).—29 Dec. 1959; 7.30 a.m. to 6.30 p.m.; temp 20° to 30°; wind E, 0-20 m.p.h.; snowed all day, 7 inches; visibility very poor especially along water. 8 observers in 8 parties. Total party hours, 28 (23 on foot, 5 by car); total party miles, 40 (21 on foot, 19 by car).

Common Loon, 1; Black Duck, 102; Common Goldeneye, 151; Common Merganser, 2; Ruffed Grouse, 2; Gray Partridge, 21; Great Black-backed Gull, 233; Herring Gull, 1212; Rock Dove, 73; Hairy Woodpecker, 4; Downy Woodpecker, 15; Blue Jay, 3; Common Raven, 52; Common Crow, 137; Black-capped Chickadee, 72; Boreal Chickadee, 7; Red-breasted Nuthatch, 14; Brown Creeper, 3; Robin, 2; Golden-crowned Kinglet, 17; Ruby-crowned Kinglet, 1 (Christie at feeder); Starling, 161; House Sparrow, 195; Eastern Meadowlark, 8; Common Grackle, 1; Brown-headed Cowbird, 35; Evening Grosbeak, 3; Common Redpoll, 41; Slate-colored Junco, 35; Tree Sparrow, 31; White-throated Sparrow, 2; Song Sparrow, 3; Snow Bunting, 15. Total, 33 species; 2653 individuals. Also seen during count period: Red-breasted Merganser, Bald Eagle, Mourning Dove, Gray Jay, Purple Finch, Snowy Owl.

Mrs. C. H. Cameron, David Christie, Jane Hazen, Stuart MacFarlane, Mrs. J. E. McKinney, Mrs. A. R. Marr, W. Austin Squires (compiler), Murray Watters.

QUEBEC

Arvida, Que. (All points within a circle of 15-mile diameter, center 2 miles northwest of Chute à Caron Dam; mixed woods 68%, farmland 22%, residential and industrial 3%, fresh water 6%, tidal water 1%).—Dec. 26, 1959; 7.45 a.m. to 4.15 p.m.; fine with high cloud; temp. 5° to 16°; wind variable, very light; 12 in. powdered snow; all water frozen except swift rivers. Fourteen observers in 11 parties. Total party hours, 29 (18 on foot, 11 by car); total party miles, 147 (17 on foot, 130 by car).

Common Goldeneye, 8; Common Merganser, 20; Great Horned Owl, 1; Snowy Owl, 1; Hairy Woodpecker, 4; Downy Woodpecker, 1; Blue Jay, 11; Common Crow, 14; Black-capped Chickadee, 63; Am. Robin, 1; Northern Shrike, 1; Starling, 92; House Sparrow, 129; Evening Grosbeak, 52; Pine Grosbeak, 33; Common Redpoll, 20; White-winged Crossbill, 20; Snow Bunting, 4. Total, 18 species, about 475 individuals. (Seen in area during count period but not on count day: Ruffed Grouse, Red-breasted Nuthatch.)

P. W. P. Browne (compiler), Jon Collins, Sylvio Girolami, Peter Gummer, W. K. Gummer, Anthony Miller, Gunter Moeller, Uwe Moeller, B. R. Pathak, D. Pearson, Nelson Renouf, D. M. Stokes, E. Stokes, Aime Trudel.

Hudson Heights, Que. (Center St. Lazare, area from Lake of Two Mountains to St. Lawrence R. between Coteau du Lac and Cedars; 29% woods, 70% farmlands, 1% villages; 2 sanctuaries, several feeders included).—2 Jan. 1960; 7.30 a.m. to 4.30 p.m.; temp. 6° to 20° ; wind NE, 8-10 m.p.h.; mainly cloudy, 8 in. snow, lake and streams frozen, open areas in St. Lawrence. 21 observers in 10 parties. Total party hours, 57 (25 on foot, 9 on skis, 13 by car); total party miles, 134 (28 on foot, 106 by car).

Black Duck, 30; Common Goldeneye, 68; Common Merganser, 1; Rough-legged Hawk, 3; Sparrow Hawk, 1; Ruffed Grouse, 9; Gray Partridge, 68; Herring Gull, 1; Rock Dove, 19; Barred Owl, 1; Pileated Woodpecker, 2; Hairy Woodpecker, 20; Downy Woodpecker, 19; Blue Jay, 76; Common Crow, 5; Black-capped Chickadee, 269; White-breasted Nuthatch, 41; Red-breasted Nuthatch, 6; Brown Creeper, 4; Am. Robin, 2; Starling, 82; House Sparrow, 318; Common Grackle, 1; Evening Grosbeak, 270; Pine Grosbeak, 21; Common Redpoll, 170; Am. Goldfinch, 1; Slate-colored Junco, 4; Oregon Junco, 1; Tree Sparrow, 26; Song Sparrow, 1. Total, 31 species; 1513 individuals. Seen in count period: Hooded Merganser, 1; Ring-necked Pheasant, 1; Northern Shrike, 1; Lapland Longspur, 1; Snow Bunting, 125.

Miss Phyllis Abbott, Miss Ruth Abbott, Ole Anderson, Mrs. B. Brosseau, Mrs. A. Bryan, Mr. and Mrs. E. Chambers, Miss Amy Clarke, Mr. and Mrs. R. Cundill, Mr. and Mrs. G. Golden (compilers), Dr. Alan Hickey, A. Kelly, R. Leverette, R. Lepingwell, Mrs. D. Macaulay, Mr. and Mrs. R. MacDuff, H. Marpole, K. Pitcairn, Mrs. R. W. Wright.

Montreal, Que. (Circle of 15-mile diameter with center at intersection of Sherbrooke St. W. and Decarie Blvd., St. Lawrence R., islands and inland parks).—26 Dec. 1959; 8.30 a.m. to 4.30 p.m.; temp. 17° to 30°; wind SW, 10 m.p.h.; some fog and smoke, otherwise clear and sunny. Land with 3 in. crusted snow and light fresh fall; river ice-covered except for rapids and main currents. 36 observers in 7 parties. Total party hours, 38 (31 on foot, 7 by car); total party miles, 105 (31 on foot, 74 by car).

Mallard, 25; Black Duck, 1266; Canvasback, 1; Common Goldeneye, 2433; Bufflehead, 2; Common Merganser, 107; Red-breasted Merganser, 1; Rough-legged Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 2; Ring-necked Pheasant, 20; Great Black-backed Gull, 4; Herring Gull, 74; Ring-billed Gull, 2; Rock Dove, 284; Screech Owl, 2; Snowy Owl, 1; Hairy Woodpecker, 5; Downy Woodpecker, 24; Common Crow, 13; Black-capped Chickadee, 128; White-breasted Nuthatch, 13; Brown Creeper, 1; Brown Thrasher, 1; Northern Shrike, 2; Starling, 544; House Sparrow, 633; Red-winged Blackbird, 3; Baltimore Oriole, 1; Evening Grosbeak, 11; Pine Grosbeak, 4; Common Redpoll, 2; Tree Sparrow, 1; Song Sparrow, 3. Total, 34 species; 5605 individuals.

Mr. and Mrs. J. Black, G. Carter, A. Corbeil, J. D. Delafield, J. Earthrowl, D. Garneau, R. Garnett, M. Gmur, L. A. G. Gray, C. Hare, Dr. A. Hickey, Miss G. Hibbard, A. W. B. Kelly, A. R. Lepingwell, Miss R. MaHille, Mr. and Mrs. I. A. McLaren, D. Mess, Mr. Justice Montgomery, Mrs. M. O. Montgomery, J. M. Montgomery, G. Parsons, Mrs. A. Reekie, Mrs. F. C. P. Roberts, J. W. Robinson, J. A. Rolland, D. Ryan, L. Segal, D. E. Sergeant (compiler), Miss M. Smith, J. Spence-Sales, Mr. D. and Mrs. Betty Westerborg, Miss F. Wong, R. Yates (Province of Quebec Society for the Protection of Birds).

Quebec, Que. (Ste. Foy to Quebec bridge, Plains of Abraham, Quebec seaport to Island of Orleans bridge, Montmorency R., Lévis, Charlesbourg, Orsainville and Quebec Zoological Garden; suburbs 22%, fields 14%, coniferous forests 8%, deciduous woods 4%, mixed woodlands 39%, shores 13%).—26 Dec. 1959; 7 a.m. to 4 p.m.; partly cloudy; temp. 13° to 23°; wind W, 1-3 m.p.h.; 8-21 in. snow, streams partly open, moderately abundant ice fields on St. Lawrence R. 28 observers in 8 parties. Total party hours, 46 (39 on foot, 7 by car); total party miles, 91 (32 on foot, 59 by car).

Goshawk, 1; Ruffed Grouse, 5; Iceland Gull, 2; Herring Gull, 30; Ring-billed Gull, 1; Hairy Woodpecker, 7; Downy Woodpecker, 4; Black-backed Three-toed Woodpecker, 2; Blue Jay, 29; Common Crow, 8; Black-capped Chickadee, 126; Boreal Chickadee, 4; White-breasted Nuthatch, 3; Red-breasted Nuthatch, 3; Cedar Waxwing, 48; Northern Shrike, 1; Starling, 620; House Sparrow, 972; Evening Grosbeak, 46; Pine Grosbeak, 60; Common Redpoll, 49; White-winged Crossbill, 31. Total, 22 species; 2052 individuals. Seen in count period: Bohemian Waxwing, 20; Purple Finch, 1.

Benoit Asselin, Nicole Barry, Jean Bédard, Pierrette Bouffard, Guy Breton, Brother Charles-Aimé, Jacques Cayouette, Raymond Cayouette (compiler), Roger Chamberland, Pierre Dupuis, Jean-M. Gauvreau, Denys Hamel, François Hamel, Lise Henry, Nicole Henry, Robert Henry, Jean Huot, Hélène Lemieux, Louis Lemieux, Gaston Lepage, Ronald Lepage, Louis-A. Lord, Richard Lord, Gaston Moisan, Hortense Roy, Lucie Samson, Henri Talbot, Céline Vézina (Club des Ornithologues, Québec).

Vale Perkins, Que. (Lakeside mountainous country, wooded roadsides).—26 Dec. 1959; 1.30 p.m. to 4 p.m.; temp. 28° to 30°; wind N, very still. 6 observers in 2 parties. Total party hours, 4 (2 on foot, 2 by car); total party miles, 17 (2 on foot, 15 by car).

Common Loon, 2; Lesser Scaup, 4; Herring Gull, 3; Hairy Woodpecker, 4; Downy Woodpecker, 3; Blue Jay, 24; Black-capped Chickadee, 13; White-breasted Nuthatch, 1; Tree Sparrow, 2; White-throated Sparrow, 2. Total, 10 species; 58 individuals.

Mrs. Leverett Jewett, Miss Cheryl Jewett, Mr. and Mrs. Lyle Tibbets, Mr. and Mrs. Sullivan (compilers).

Lennoxville, Que. Open fields and hedgerows along 2 miles of Magog R.; three woods, from mature hemlock to scrub-mixed, totaling 1½ square miles; along Coaticook and Massawippi rivers in open fields and scrub, about 2 miles; along 110 miles of road near woods; 11 feeding stations in Lennoxville and North Hatley. All within 7½-mile radius).—26 Dec. 1959; 7.30 a.m. to 4 p.m.; temp. 23° to 28°; wind SE, 0-5 m.p.h.; ground frozen, 2 in. snow; light fall of dry snow. 23 field observers in 4 parties. Total party hours, 34 (26 on foot, 8 by car); total party miles, 176 (66 on foot, 110 by car).

Common Goldeneye, 212; Hooded Merganser, 6; Common Merganser, 101; Ruffed Grouse, 3; Herring Gull, 56; Belted Kingfisher, 1; Hairy Woodpecker, 10; Downy Woodpecker, 13; Blue Jay, 46; Common Crow, 2; Black-capped Chickadee, 128; White-breasted Nuthatch, 12; Starling, 14; House Sparrow, 195; Common Grackle, 2; Brown-headed Cowbird, 3; Evening Grosbeak, 109; Common Redpoll, 22; Am. Goldfinch, 24; Tree Sparrow, 3; Snow Bunting, 6. Total, 21 species; 968 individuals.

(In field):—D. M. Bennett, R. Berlyn, Mrs. R. Berlyn, G. E. Biard, A. P. Campbell (compiler), F. Clowery, Mrs. F. Clowery, C. Dobell, H. Doheny, K. R. Lane, Miss E. LeBaron, F. G. LeBaron, Miss J. A. LeBaron, E. R. McLenahan, Mrs. E. R. McLenahan, G. H. Moffat, D. C. Patriquin, J. G. Patriquin, Mrs. F. R. Pattison, H. A. Simons, D. Simons, D. Tector, B. Tilley.
(At feeders):—Mrs. A. P. Campbell, Mrs. C. L. Cate, Mrs. J. D. Jefferis, Miss E. LeBaron, Mrs. J. G. Patriquin, Mrs. E. B. Pilgrim, Mrs. G. P. St. Pierre, Mrs. E. B. Sims, Mrs. K. Y. Stanton, Mrs. N. H. Welsh, Mrs. John York.

ONTARIO

Bancroft, Ont. (7½-mi. radius of town; mixed woods 40%; spruce bogs 30%; farmland and open fields 20%, town 10%).—26 Dec. 1959; 7.30 a.m. to 4 p.m.; temp. 20° to 30°; wind none; 5 in. to 6 in. snow in bush; cloudy a.m., snow p.m. 1 observer. Total hours, 8½ (6 on foot, 2½ by car); total miles, 70 (6 on foot, 64 by car).

Red-tailed Hawk, 1; Ruffed Grouse, 1; Barred Owl, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 8; Downy Woodpecker, 8; Blue Jay, 47; Black-capped Chickadee, 49; White-breasted Nuthatch, 14; Red-breasted Nuthatch, 5; Starling, 6; House Sparrow, 42; Red Crossbill, 9. Total, 13 species; 192 individuals.

Earl Stark.

Barrie, Ont. (City of Barrie and district of about 7½-mile radius. Surrounding district mainly farmland. Kempenfeldt Bay frozen over).—3 Jan. 1960; 8.30 a.m. to 4.30 p.m.; temp. 32° to 28°; wind NW, still to 25 m.p.h. 25 observers in 6 parties. Total party hours, 32; total party miles, 290 (7 on foot, 283 by car).

Red-tailed Hawk, 2; Rough-legged Hawk, 1; Marsh Hawk, 1; Sparrow Hawk, 2; Ruffed Grouse, 15; Rock Dove, 90; Pileated Woodpecker, 2; Hairy Woodpecker, 12; Downy Woodpecker, 17; Blue Jay, 50; Common Crow, 2; Black-capped Chickadee, 185; White-breasted Nuthatch, 19; Red-breasted Nuthatch, 10; Brown Creeper, 1; Brown Thrasher, 1; Golden-crowned Kinglet, 1; Northern Shrike, 6; Starling, 79; House Sparrow, 587; Eastern Meadowlark, 2; Common Grackle, 6; Cardinal, 9; Evening Grosbeak, 602; Purple Finch, 1; Pine Grosbeak, 30; Common Redpoll, 198; Pine Siskin, 12; Am. Goldfinch, 39; White-winged Crossbill, 10; Rufous-sided Towhee, 1; Slate-colored Junco, 91; Tree Sparrow, 117, White-throated Sparrow, 2; Song Sparrow, 1; Snow Bunting, 6. Total, 36 species; 2210 individuals.

Lucille Bascom, Mr. and Mrs. W. A. Bell, Grace Crooks, Mrs. Childs, Mr. and Mrs. R. Freeman, Mr. and Mrs. A. Fisher, Dorothy Falconer, Jen. Gillespie, Anastasia Hughes (compiler), Blanch Hiltz, Gordon Johns, Mr. and Mrs. H. Morren, Alf. Mitchener, Mr. and Mrs. J. MacLean, Harold Richards, Hope Ronald, Edna West, Mr. and Mrs. J. Westman and family.

Brockville, Ont. (Area within a circle of 7½-mile radius centered at King and Broad streets. 20% open water, 50% open farmland, 7% coniferous woodlands, 20% deciduous woodland, 1½% marsh, 1½% urban).—27 Dec. 1959; 7.55 a.m. to 5 p.m.; temp. 24° to 30°; wind ENE, 5-20 m.p.h.; sky overcast throughout the day, some light snow during the day turning to freezing rain late p.m. 14 observers in 6 parties. Total party hours, 76½ (52 on foot, 20 by car); total party miles, 358½ (58½ on foot, 300 by car).

Black Duck, 58; Pintail, 1; Greater Scaup, 2; Common Goldeneye, 1886; Common Merganser, 15; Goshawk, 1; Red-tailed Hawk, 2; Rough-legged Hawk, 2; Sparrow Hawk, 1; Ruffed Grouse, 34; Gray Partridge, 8; Great Black-backed Gull, 5; Herring Gull, 64; Rock Dove, 100 (est.); Hairy Woodpecker, 13; Downy Woodpecker, 16; Blue Jay, 75; Black-capped Chickadee, 208; White-breasted Nuthatch, 33; Red-breasted Nuthatch, 5; Golden-crowned Kinglet, 1; Northern Shrike, 2; Starling, 76; House Sparrow, 411; Redwinged Blackbird, 1; Evening Grosbeak, 604; Pine Grosbeak, 8; Common Redpoll, 249; Pine Siskin, 1; Am. Goldfinch, 4; Slate-colored Junco, 19; Tree Sparrow, 63; White-throated Sparrow, 1; Song Sparrow, 5; Snow Bunting, 94. Total, 35 species; 4068 individuals.

Walter Ashworth, William Barraclough, James Bayley (compiler), Arthur Bell, Kenneth Buell, Mrs. Carolyn Dutka, Martin Edwards, David Hurrie, Mrs. Ivy Jarvie, Matthew Jarvie, Howard Lapp, Miss Mary L'Etrange, Ernest Merrikin, William Miller.

Carleton Place, Ont. (Circle 7½-mile radius centered on Carleton Place Town Hall).—2 Jan. 1960; 9 a.m. to 3 p.m.; temp. 5° to 30°; wind none to SW, 10 m.p.h. 26 observers in 9 parties. Total party hours, 24 (9 on foot, 15 by car); total party miles, 339 (24 on foot, 315 by car).

Great Blue Heron, 1; Mallard, 1; Black Duck, 7; Hooded Merganser, 1; Common Merganser, 2; Goshawk, 1; Rough-legged Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 6; Rock Dove, 167; Belted Kingfisher, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 17; Downy Woodpecker, 4; Blue Jay, 100; Common Crow, 2; Black-capped Chickadee, 108; White-breasted Nuthatch, 18; Brown Creeper, 3; Am. Robin, 1; Bohemian Waxwing, 23; Northern Shrike, 5; Starling, 80; House Sparrow, 658; Evening Grosbeak, 259; Pine Grosbeak, 109; Common Redpoll, 34; Tree Sparrow, 20; Snow Bunting, 92. Total, 29 species; 1723 individuals. Seen in count period: Winter Wren, Jan. 1, 1960.

Garry Aitken, Mr. and Mrs. A. E. Bourguignon, Donald Brown, Alan Bland, H. M. Brown, Mr. and Mrs. G. E. Findlay, Dan. Findlay, Mr. and Mrs. D. H. Findlay, Mr. and Mrs. W. F. Findlay, Mr. and Mrs. Rowley Frith, D. D. Findlay (compiler), Gerald Griffiths, Col. R. C. Hodgson, Bruce Kennedy, Robert Lighthart, David Prime, William Root, E. H. Ritchie, A. D. Relf, Miss Beverly Stanzel, Dr. George Stirrett.

Collingwood, Ont. (Wooded area 40%, open country fields, etc. 40%, lake and lake shore 20%).—28 Dec. 1959; 9 a.m. to 4.30 p.m.; temp. 15° to 20°; wind SE, 15 m.p.h. 6 observers in 1 party. Total party hours, 18 (3 on foot, 15 by car); total party miles, 18 (3 on foot, 15 by car).

Mallard, 1; Common Goldeneye, 24; Bufflehead, 30; Oldsquaw, 1; Common Merganser, 10; Ruffed Grouse, 1; Glaucous Gull, 3; Iceland Gull, 2; Herring Gull, 2000; Ring-billed Gull, 150; Mourning Dove, 3; Snowy Owl, 1; Hairy Woodpecker, 1; Downy Woodpecker, 4; Blue Jay, 8; Black-capped Chickadee, 61; Red-breasted Nuthatch, 2; Brown Creeper, 3; Am. Robin, 1; Starling, 60; House Sparrow, 200+; Cardinal, 2; Evening Grosbeak, 58; Purple Finch, 2; Common Redpoll, 78; Am. Goldfinch, 2; Slate-colored Junco, 7; Tree Sparrow, 52; Snow Bunting, 150+. Total, 28 species; 2915+ individuals. Seen during count period: Goshawk, Rough-legged Hawk, Bohemian Waxwing, Pine Grosbeak.

Mr. John Baird, L. A. Holbrook, A. J. Mitchener (compiler), Mr. George Walmsley, Mr. and Mrs. L. Wambold.

Dryden, Ont. (Road north from Dryden to Centrefire Lake, 10 miles south of Lac Seul and 12 miles southwest of Hudson, Ont).—3 Jan. 1960; 1.20 p.m. to 4.15 p.m.; temp. —10°; wind W, 15 m.p.h. 4 observers in 2 parties. Total party hours, 6 (45 min. on foot, 5¼ hrs. by car); total party miles, 120 (2 on foot, 118 by car).

Spruce Grouse, 2; Ruffed Grouse, 1; Hairy Woodpecker, 2; Downy Woodpecker, 2; Black-backed Three-toed Woodpecker, 1; Gray Jay, 1; Blue Jay, 2; Common Raven, 20; Black-capped Chickadee, 1; Pine Grosbeak, 6; Common Redpoll, 4. Total, 11 species; 42 individuals.

J. H. Godden (compiler), Miss Linda Godden, Norman I. Howe, Mrs. Laura A. Howe.

Hamilton, Ont. (7½-mile radius from York and Dundurn streets, including Hamilton, Burlington, Waterdown, Dundas, Ancaster, Hannon and Stoney Creek).—27 Dec. 1959; 6 a.m. to 5.30 p.m.; temp. 33° to 37°; wind NE, 2 m.p.h.; overcast, fog, rain; visibility 100 to 1000 yd.; ground bare; harbor open. 52 observers in 27 parties. Total party hours, 135 (114 on foot, 21 by car); total party miles, 336 (176 on foot, 160 by car).

Horned Grebe, 2; Great Blue Heron, 2; Mallard, 139; Black Duck, 148; Pintail, 1; Green-winged Teal, 1; Redhead, 1; Ring-necked Duck, 1; Greater Scaup, 164; Common Goldeneye, 213; Bufflehead, 48; Oldsquaw, 27; White-winged Scoter, 9; Common Merganser, 4050; Red-breasted Merganser, 21; Red-tailed Hawk, 14; Red-shouldered Hawk, 1; Sparrow Hawk, 5; Ruffed Grouse, 10; Ring-necked Pheasant, 56; Gray Partridge, 10; Glaucous Gull, 5; Great Black-backed Gull, 162; Herring Gull, 5200; Ring-billed Gull, 800; Mourning Dove, 13; Screech Owl, 4; Great Horned Owl, 6; Snowy Owl, 1; Long-eared Owl, 3; Belted Kingfisher, 3; Yellow-shafted Flicker, 2; Pileated Woodpecker, 2; Hairy Woodpecker, 15; Downy Woodpecker, 87; Blue Jay, 90; Common Crow, 315; Black-capped Chickadee, 472; White-breasted Nuthatch, 87; Red-breasted Nuthatch, 8; Brown Creeper, 32; Winter Wren, 12; Long-billed Marsh Wren, 1; Brown Thrasher, 1; Am. Robin, 8; Golden-crowned Kinglet, 15; Cedar Waxwing, 73; Northern Shrike, 1; Starling, 900; Yellowthroat, 1; House Sparrow, 1250; Eastern Meadowlark, 9; Redwinged Blackbird, 6; Rusty Blackbird, 17; Common Grackle, 5; Brown-headed Cowbird, 16; Cardinal, 149; Evening Grosbeak, 5; Hoary Redpoll, 1; Common Redpoll, 52; Pine Siskin, 13; Am. Goldfinch, 93; Savannah Sparrow, 1; Slate-colored Junco, 700; Tree Sparrow, 630; Field Sparrow, 3; White-throated Sparrow, 7; Swamp Sparrow, 17; Song Sparrow, 162; Snow Bunting, 8. Total, 70 species; about 16,386 individuals.

Ross Anderson, Mrs. E. C. Baker, Eric W. Bastin, David Bissell, R. D. F. Bourne, Etta Bourne, Donald Campbell, William I. Campbell, James Cox, Kenneth J. Cox, Robert Curry, Ted Dinniwell, James A. N. Dowall, V. J. Duff, Robert O. Elstone, Albert Gorman, Peter Hamel, Audrey Hawkes, John Hencher, Robert Henry, George Holland, Ralph Idema, Angus B. Jackson, Margaret Lamb, Woodburn Lambe, Alice Lamoureux, W. John Lamoureux, Suzanne Lawrie, Thomson C. Lawrie, James Lemon, A. Elizabeth LeWarne, Kenneth Lindsay, Eleanor Malcolm, George V. McBride, George O. McMillan, John B. Miles, Paul Milne, Dorothy Jane Miller, John J. Miller, John A. Moule, Albert B. Nind, George W. North (compiler), Laurel E. North, John Olmsted, David K. Powell, Robert K. Sargeant, Alfred Senior, Douglas A. Smith, Robert Stamp, Laura Stewart, Mabel Watson, Annette Zealand (Hamilton Naturalists' Club).

Huntsville, Ont. (10-mile radius from town of Huntsville; typical mixed forest of Great Lakes-St. Lawrence association, containing one town and some half dozen villages; about 10% farmland. No open water except on fast-flowing streams).—27 Dec. 1959; 8 a.m. to 5 p.m.; temp. 32° to 36°; wind E, light; freezing rain intermittently all day. 33 observers in 12 parties. Total party hours, 30; total party miles, 273 (21 on foot, 252 by car).

Common Loon, 3; Common Goldeneye, 10; Ruffed Grouse, 7; Herring Gull, 1; Pileated Woodpecker, 3; Hairy Woodpecker, 39; Downy Woodpecker, 42; Black-backed Three-toed Woodpecker, 2; Gray Jay, 1; Blue Jay, 144; Common Raven, 8; Black-capped Chickadee, 294; Boreal Chickadee, 1; White-breasted Nuthatch, 45; Red-breasted Nuthatch, 33; Brown Creeper, 2; Golden-crowned Kinglet, 2; Starling, 29; House Sparrow, 86; Brown-headed Cowbird, 1; Cardinal, 1; Evening Grosbeak, 233; Purple Finch, 1; Pine Grosbeak, 18; Common Redpoll, 60; Pine Siskin, 4; White-winged Crossbill, 20; Slate-colored Junco, 1; White-throated Sparrow, 2; Snow Bunting, 145. Total, 30 species; 1238 individuals.

Mrs. Edgar Brook, Mr. and Mrs. Abbott Conway, Patricia Conway, Paul Conway, Mrs. Emerson Farnsworth, Mary Elizabeth Haigh, Richard Helsel, Mrs. J. M. Heron, Mrs. Gordon Hill, Mrs. Bert Horton, Mr. and Mrs. Frank Johnston, James Kay, Mr. and Mrs. Gerald Keetch, Mr. and Mrs. Ross McFarland, Aubrey May, Nancy May, Mrs. John Mills, Mrs. Jean Olan, Kenneth Perrin, Dr. and Mrs. H. L. Reazin, Mr. and Mrs. E. G. R. Rogers, Dr. and Mrs. Ross Rogers, R. J. Rutter (compiler), Mr. and Mrs. Wilfred Waters, Mrs. George Wilson (Huntsville Nature Club and Limberlost Nature Club).

Ingersoll, Ont. (Along Thames R. from Ingersoll west to Middlesex County. Southwest from Ingersoll to Middlesex County through wooded area of deciduous and white cedar trees).—27 Dec. 1959; 8 a.m. to 6 p.m.; temp. 32° to 39°; very foggy all day with a light wind for most of the day, very little snow on the ground. Thames R. open. 8 observers in 4 parties. Total party hours, 37 (30 on foot, 7 by car); total party miles, 71 (41 on foot, 30 by car).

Cooper's Hawk, 1; Red-tailed Hawk, 1; Ruffed Grouse, 2; Ring-necked Pheasant, 1; Herring Gull, 1; Great Horned Owl, 1; Belted Kingfisher, 3; Hairy Woodpecker, 1; Downy Woodpecker, 19; Blue Jay, 15; Black-capped Chickadee, 79; White-breasted Nuthatch, 9; Brown Creeper, 3; Winter Wren, 2; Golden-crowned Kinglet, 16; Starling, 78; Yellowthroat, 1; House Sparrow, 478; Cardinal, 23; Purple Finch, 4; Common Redpoll, 4; Am. Goldfinch, 168; Slate-colored Junco, 12; Tree Sparrow, 104; Field Sparrow, 1; Swamp Sparrow, 1; Song Sparrow, 4. Total, 27 species; 1030 individuals.

D. Bucknell, J. Layton, Mrs. B. McDiarmid, B. McKay, B. Parker (compiler), K. Ridge, H. Shelton, H. Sivyer.

Kingston, Ont. (All points within a circle of 15-mile diameter, center ¼ mile west of Garden Island, including Cataraqui R. and Creek, Lake Ontario, St. Lawrence R., Wolfe Island; urban 5%, farmland 25%, mixed woods 15%, marsh 10%, open water 45%).—23 Dec. 1959; 7.30 a.m. to 5 p.m.; temp. —5° to 18°; wind N, 0-5 m.p.h.; cloudy, 2 in. ice-covered snow on ground, most bays frozen. 20 observers in 6 parties. Total party hours, 64 (33 on foot, 29 by car, 2 by boat); total party miles, 377 (49 on foot, 319 by car, 9 by boat).

Horned Grebe, 1; Mallard, 3; Black Duck, 17; Greater Scaup, 63; Common Goldeneye, 358; Oldsquaw, 20; Common Merganser, 60; Rough-legged Hawk, 1; Bald Eagle, 1; Marsh Hawk, 1; Sparrow Hawk, 6; Ruffed Grouse, 4; Gray Partridge, 14; Am. Coot, 1; Glaucous Gull, 21; Iceland Gull, 1; Great Black-backed Gull, 77; Herring Gull, 1350; Ring-billed Gull, 16; Rock Dove, 100 (estimated); Mourning Dove, 1; Screech Owl, 3; Snowy Owl, 7; Pileated Woodpecker, 1; Hairy Woodpecker, 21; Downy Woodpecker, 29; Blue Jay, 131; Common Crow, 6; Black-capped Chickadee, 230; White-breasted Nuthatch, 85; Brown Creeper, 5; Am. Robin, 2; Golden-crowned Kinglet, 2; Ruby-crowned Kinglet, 2; Bohemian Waxwing, 1; Northern Shrike, 2; Starling, 900+; Myrtle Warbler, 1; House Sparrow, 1035; Brown-headed Cowbird, 3; Cardinal, 1; Evening Grosbeak, 27; Am. Goldfinch, 24; Slate-colored Junco, 2; Tree Sparrow, 210; White-throated Sparrow, 1; Song Sparrow, 8; Lapland Longspur, 1; Snow Bunting, 150. Total, 49 species; about 4906 individuals. Seen in count period: Common Loon, Great Blue Heron, Pintail, Short-eared Owl, Belted Kingfisher, Winter Wren, Cedar Waxwing, Rusty Blackbird, Common Redpoll.

D. T. Austin, J. Baxter, J. C. Bayly, A. E. S. Bell, D. M. Crawford, R. W. Davidson, C. Dutka, K. F. Edwards, M. H. Edwards (compiler), F. N. Hainsworth, A. M. Hutchison, A. E. Hyde, W. G. Lamb, M. L'Estrange, P. E. Little, L. H. Lowther, H. R. Quilliam, A. M. Strong, J. A. Warren, G. Woods (Kingston Nature Club).

Kirkland Lake, Ont. (Area covered by a circle, 15 miles in diameter, with center at golf club, taking in Kirkland Lake, Swastika, Chaput Hughes, King Kirkland and surroundings).—3 Jan. 1960; 6 a.m. to 5 p.m.; temp. 10° to 20°; wind N, 10-25 m.p.h. 11 observers in 3 parties. Total party hours, 23½ (8½ on foot, 15 by car); total party miles, 157½ (14½ on foot, 143 by car).

Common Goldeneye, 1; Common Merganser, 1; Ruffed Grouse, 1; Great Horned Owl, 2; Snowy Owl, 1; Hawk-owl, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 4; Downy Woodpecker, 7; Gray Jay, 23; Blue Jay, 29; Common Raven, 8; Black-capped Chickadee, 47; Boreal Chickadee, 6; Starling, 9; House Sparrow, 30; Evening Grosbeak, 13; Pine Grosbeak, 1; Common Redpoll, 2; White-throated Sparrow, 1; Snow Bunting, 3. Total, 21 species; 191 individuals.

Jim Bayly, Mrs. Leonard Bouchard, Ralph Carlson, K. C. Gray, Fred Helleiner, Mr. Lapp, George Timmins Jr., Mrs. George Timmins, Ian Robertson, Percy Richter, Frank Washington (Kirkland Lake Nature Club).

Kitchener, Ont. (Kitchener and Waterloo in a circle with radius of 7½ miles from southwest boundary of Kitchener; cattail marsh 2%, open farmland 23%, deciduous woods 25%, coniferous woods 25%, swamp 21%, town suburbs 2%, open water 2%).—20 Dec. 1959; 8 a.m. to 4.30 p.m.; temp. 17° to 28°; wind NE, 10-15 m.p.h.; mostly clear. 33 observers in 6 parties. Total party hours, 33¼ (27¼ on foot, 5¾ by car); total party miles, 176 (32 on foot, 144 by car).

Great Blue Heron, 1; Black Duck, 4; Common Goldeneye, 27; Sharp-shinned Hawk, 1; Red-tailed Hawk, 4; Marsh Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 7; Ring-necked Pheasant, 3; Herring Gull, 105; Ring-billed Gull, 1; Rock Dove, 83; Belted Kingfisher, 4; Hairy Woodpecker, 9; Downy Woodpecker, 37; Blue Jay, 28; Black-capped Chickadee, 299; White-breasted Nuthatch, 26; Red-breasted Nuthatch, 2; Brown Creeper, 8; Golden-crowned Kinglet, 6; Ruby-crowned Kinglet, 4; Northern Shrike, 1; Starling, 48; House Sparrow, 480; Cardinal, 49; Evening Grosbeak, 8; Purple Finch, 11; Common Redpoll, 74; Pine Siskin, 42; Am. Goldfinch, 100; Slate-colored Junco, 93; Tree Sparrow, 122; White-throated Sparrow, 4; Song Sparrow, 4. Total, 35 species; 1697 individuals.

F. H. Bender (compiler), B. Boegel, J. Bindernagel, A. Bekerman, H. Boldt, F. Cooper, Miss Ella Cressman, Mr. and Mrs. R. Capling, H. Dahmer, F. W. R. Dickson, J. Detwiler, H. Ellenton, N. Friedman, P. Gruber, K. Gruber, R. Hilborn, R. D. Hendry, Mrs. R. Lamb, Dr. and Mrs. Mackenzie, R. Pickering, H. Russell, W. Schaefer, Dr. J. Sanders, C. Squire, P. Shoemaker, W. Schenk, F. Shantz, N. Shantz, S. Underhill, Jim Wolfe, Roger Wolfe.

Lindsay, Ont. (Area east of Scugog Lake, eastward to Bethany, north to Janetville and Omemee, being chiefly in Durham County, much of it rugged as well as swampy; open farmland and village 55%, deciduous woods and swamp 35%, coniferous woods 10%).—26 Dec. 1959; 7.25 a.m. to 4.35 p.m.; temp. 26° to 30°; wind SE, none to light; overcast, light snow and sleet most of day; about 3 in. snow; open water only where fast-flowing. 2 observers in 1 party. Total party hours, 9 (4 on foot, 5 by car); total party miles, 65 (11 on foot, 54 by car).

Cooper's Hawk, 1; Rough-legged Hawk, 1; Ring-necked Pheasant, 1; Great Horned Owl, 2; Pileated Woodpecker, 1 or 2; Hairy Woodpecker, 4; Downy Woodpecker, 2; Blue Jay, 18; Black-capped Chickadee, 61; Northern Shrike, 2; Starling, 52; House Sparrow, 97; Evening Grosbeak, 7; Pine Grosbeak, (heard, probably several); Common Redpoll, 150; Pine Siskin, 21; Am. Goldfinch, 10; Slate-colored Junco, 1; Tree Sparrow, 13. Total, 19 species; 445 individuals. Seen in count period: Common Crow and Song Sparrow.

David Calvert, E. W. Calvert (compiler).

London, Ont. (Cedar swamp 10%, pasture 10%, woodlot 15%, farmland 15%, marsh 20%, river valley 25%, town and suburbs 5%).—26 Dec. 1959; 8 a.m. to 4.30 p.m.; temp. 36° to 38°; wind E, 8 m.p.h.; cloudy, mild, drizzle; ground bare, river and streams open. 27 observers in 11 parties. Total party hours, 91 (76 on foot, 15 by car); total party miles, 202 (95 on foot, 107 by car).

Mallard, 17; Black Duck, 349; Common Goldeneye, 51; Common Merganser, 20; Cooper's Hawk, 1; Red-tailed Hawk, 13; Rough-legged Hawk, 13; Bald Eagle, 2; Marsh Hawk, 1; Sparrow Hawk, 2; Ruffed Grouse, 1; Ring-necked Pheasant, 20; Herring Gull, 38; Ring-billed Gull, 15; Mourning Dove, 90; Screech Owl, 2; Great Horned Owl, 2; Long-eared Owl, 5; Short-eared Owl, 1; Belted Kingfisher, 9; Yellow-shafted Flicker, 1; Yellow-bellied Sapsucker, 1; Hairy Woodpecker, 26; Downy Woodpecker, 113; Blue Jay, 46; Common Crow, 9; Black-capped Chickadee, 320; Tufted Titmouse, 1; White-breasted Nuthatch, 52; Red-breasted Nuthatch, 2; Brown Creeper, 30; Winter Wren, 3; Carolina Wren, 1; Mockingbird, 1; Brown Thrasher, 1; Golden-crowned Kinglet, 53; Ruby-crowned Kinglet, 1; Cedar Wax-

wing, 20; Northern Shrike, 1; Starling, 321; Yellowthroat, 2; Yellow-breasted Chat, 1; House Sparrow, 1259; Cardinal, 247; Purple Finch, 16; Common Redpoll, 7; Am. Goldfinch, 67; Slate-colored Junco, 288; Oregon Junco, 1; Tree Sparrow, 268; White-throated Sparrow, 4; Swamp Sparrow, 11; Song Sparrow, 33; Lapland Longspur, 10; Snow Bunting, 270. Total, 55 species; 4138 individuals. Seen in count period: Ring-necked Duck, Great Blue Heron, American Coot, Horned Lark, American Robin, Pine Siskin, Evening Grosbeak, Field Sparrow.

A. E. Clendenning, Mrs. Aileen Cline, M. E. Comfort, Dr. F. S. Cook, Dr. G. Cummings, Walter Day, Douglas Dow, Wm. Girling, Brian Hobbs, Miss Carolyn Hobbs, S. G. Hueston, Wm. Jarmain, Mrs. Margaret Johnston, Dr. W. W. Judd, J. C. Laughton, James W. Leach (compiler), Mrs. M. E. Leahy, Charles Maddeford, Ted Maddeford, Wm. Maddeford, Peter Middleton, Dr. H. A. U. Monro, Gerd Muller, Miss Beryl Thompson, Tony Verboom, V. Vickers, Brian Whitelaw (McIlwraith Ornithological Club).

Manotick, Ont. (Garden, feeding station and small section of river).—27 Dec. 1959; 1 observer.

Common Merganser, 2; Rock Dove, 3; Hairy Woodpecker, 2; Downy Woodpecker, 2; Blue Jay, 5; Black-capped Chickadee, 4; Starling, 10; House Sparrow, 28; Common Grackle, 1; Evening Grosbeak, 25. Total, 10 species; 82 individuals.

H. A. C. Jackson.

Melbourne, Ont. (A circle with 7½-mile radius centered 1 mile north of West Lorne, including about 5 miles Lake Erie shoreline, part of the Thames R. and the Duncan Marsh).—2 Jan. 1960; 6.30 a.m. to 5.30 p.m.; temp. 30° to 40°; wind SW, 3 to 8 m.p.h.; overcast, rain p.m. 20 observers in 5 parties. Total party hours, 43 (28 on foot, 15 by car); total party miles, 220 (42 on foot, 178 by car).

Great Blue Heron, 1; Mallard, 1; Common Goldeneye, 374; Bufflehead, 22; Old-squaw, 1; Common Merganser, 1; Red-breasted Merganser, 1; Sharp-shinned Hawk, 2; Cooper's Hawk, 1; Red-tailed Hawk, 15; Rough-legged Hawk, 1; Bald Eagle, 5; Marsh Hawk, 4; Sparrow Hawk, 1; Ruffed Grouse, 5; Bobwhite, 66; Ring-necked Pheasant, 2; Herring Gull, 166; Ring-billed Gull, 15; Bonaparte's Gull, 1; Rock Dove, 57; Mourning Dove, 77; Screech Owl, 3; Great Horned Owl, 1; Snowy Owl, 1; Long-eared Owl, 1; Short-eared Owl, 2; Belted Kingfisher, 1; Yellow-shafted Flicker, 5; Pileated Woodpecker, 4; Red-bellied Woodpecker, 2; Hairy Woodpecker, 7; Downy Woodpecker, 90; Horned Lark, 31; Blue Jay, 23; Common Crow, 3; Black-capped Chickadee, 274; White-breasted Nuthatch, 28; Red-breasted Nuthatch, 3; Brown Creeper, 7; Winter Wren, 1; Mockingbird, 1; Am. Robin, 3; Golden-crowned Kinglet, 29; Ruby-crowned Kinglet, 1; Cedar Waxwing, 1; Starling, 42; House Sparrow, 451. Common Grackle, 19; Brown-headed Cowbird, 15; Cardinal, 190; Evening Grosbeak, 5; Purple Finch, 21; Common Redpoll, 186; Am. Goldfinch, 233; Rufous-sided Towhee, 4; Slate-colored Junco, 284; Oregon Junco, 1; Tree Sparrow, 447; Field Sparrow, 1; White-throated Sparrow, 12; Swamp Sparrow, 1; Song Sparrow, 29; Lapland Longspur, 2; Snow Bunting, 1057. Total, 65 species; about 4341 individuals.

L. Aukland, W. Baker, T. Durnford, C. Field, M. Field, F. Graff, S. Glidden, R. Hopper, D. Johnson, J. Lemon, R. E. Lemon, V. E. Lemon, D. Murray (compiler), D. Mylrea, B. Poag, P. Prevett, R. Prevett, J. Shostock, B. Stanley, T. Stanley, G. Vogan.

North Bay, Ont. (West Ferris Twp. from village of Ferris to Nipissing Jct. and La Vase R., about 30 acres of second-growth bushland, the remainder along village and township roads and highway, approximately 80% of which was settlements, remainder flanked by bushland, alder and willow swamps, open fields, and river).—31 Dec. 1959; 7.15 a.m. to 6 p.m.; temp. 7° to 17°; wind NNE to NW, 3-7 m.p.h.; sunny and cloudless; ground covered with 8 to 18 in. snow; lake, river and all creeks frozen. 1 observer. Total hours, 9 (6½ on foot, 2½ at feeding station); total miles, about 12 (all on foot).

Hairy Woodpecker, 3; Downy Woodpecker, 4; Blue Jay, 11; Black-capped Chickadee, 71; White-breasted Nuthatch, 3; Red-breasted Nuthatch, 3; Starling, 2;

Evening Grosbeak, 25; Pine Grosbeak, 4. Total, 9 species; about 124 individuals. Seen in area during count period: Ruffed Grouse, Gray Jay, and Boreal Chickadee.
Hazel Petty.

Oshawa, Ont. (Radius of 20 miles from the main corners of Oshawa; 40% open fields, 25% reforested land, 25% farmland, 10% marsh).—27 Dec. 1959; 8 a.m. to 4 p.m.; temp. 30° to 35°; wind E, 10 m.p.h.; about 4 in. snow; roads and country all iced badly. 16 observers in 6 parties. Total party hours, 80 (20 on foot, 60 by car); total party miles, 260 (43 on foot, 217 by car).

Great Blue Heron, 2; Mallard, 24; Black Duck, 116; Green-winged Teal, 5; Greater Scaup, 1; Common Goldeneye, 67; Bufflehead, 4; Oldsquaw, 206; Goshawk, 1; Red-tailed Hawk, 1; Sparrow Hawk, 3; Ruffed Grouse, 9; Ring-necked Pheasant, 10; Virginia Rail, 1; Glaucous Gull, 1; Great Black-backed Gull, 12; Herring Gull, 552; Ring-billed Gull, 50; Rock Dove, 88; Belted Kingfisher, 1; Hairy Woodpecker, 15; Downy Woodpecker, 22; Blue Jay, 17; Common Crow, 2; Black-capped Chickadee, 379; White-breasted Nuthatch, 12; Brown Creeper, 3; Winter Wren, 3; Golden-crowned Kinglet, 2; Starling, 99; House Sparrow, 588; Common Grackle, 1; Cardinal, 7; Evening Grosbeak, 429; Purple Finch, 15; Common Redpoll, 195; Pine Siskin, 10; Am. Goldfinch, 183; Savannah Sparrow, 1; Slate-colored Junco, 96; Oregon Junco, 2; Tree Sparrow, 216; White-crowned Sparrow, 1; Song Sparrow, 9; Snow Bunting, 475. Total, 45 species; 3936 individuals.

M. Armstrong, D. J. Brockman, A. Bunker (compiler), F. Dilling, Miss B. Henry, Miss M. Henry, W. Laird, Miss S. Laird, W. Neal, G. Owen, Mrs. K. Sands, G. Scott, J. Theberge, R. Tozer, T. Tozer, G. Tunnicliffe.

Ottawa, Ont. (7½-mile radius from Parliament Hill, town and suburbs, coniferous and deciduous woods, farmland, and open water in rapids).—27 Dec. 1959; 7.30 a.m. to 5 p.m.; temp. 22° all day; wind E to ENE, 5-12 m.p.h.; light snow after 10 a.m. 41 observers in 13 parties. Total party hours, 79; total party miles, 385½ (69½ on foot, 316 by car).

Black Duck, 14; Greater Scaup, 3; Common Goldeneye, 150; Hooded Merganser, 1; Common Merganser, 57; Red-breasted Merganser, 1; Rough-legged Hawk, 4; Pigeon Hawk, 1; Sparrow Hawk, 9; Ruffed Grouse, 24; Ring-necked Pheasant, 13; Gray Partridge, 64; Glaucous Gull, 1; Rock Dove, 527; Screech Owl, 1; Great Horned Owl, 2; Snowy Owl, 3; Hairy Woodpecker, 16; Downy Woodpecker, 37; Black-backed Three-toed Woodpecker, 1; Blue Jay, 46; Common Crow, 22; Black-capped Chickadee, 322; Boreal Chickadee, 5; White-breasted Nuthatch, 55; Red-breasted Nuthatch, 3; Brown Creeper, 9; Bohemian Waxwing, 16; Northern Shrike, 2; Starling, 945; House Sparrow, 937; Redwinged Blackbird, 1; Common Grackle, 3; Cardinal, 1; Evening Grosbeak, 206; Pine Grosbeak, 70; Hoary Redpoll, 6; Common Redpoll, 369; Pine Siskin, 4; Am. Goldfinch, 14; Red Crossbill, 8; Slate-colored Junco, 1; Tree Sparrow, 70; Song Sparrow, 5; Snow Bunting, 37. Total, 45 species; 4087 individuals. Seen in census period: Cedar Waxwing.

Dr. and Mrs. A. W. F. Banfield, Miss A. Banning, D. R. Beckett, A. Bland, Mr. and Mrs. A. E. Bourguignon, E. L. Bousfield, A. Bowles, K. Bowles, H. M. Brown, Miss S. Clark, Mr. and Mrs. D. K. Findlay, Dr. and Mrs. C. Frankton, R. Frith, W. E. Godfrey, Dr. and Mrs. G. R. Hanes, R. H. C. Hodgson, Miss V. Humphries, H. Lloyd, S. Macdonald, D. A. MacLulich, G. H. McGee, A. McPhalen, E. Mills, F. Munro, Mr. and Mrs. W. K. St. John, Dr. and Mrs. D. B. O. Savile, H. A. Savile, K. Scobie, Dr. and Mrs. D. A. Smith, W. J. Smith, G. L. Stevenson, G. F. M. Stirrett, J. S. Tener. Compiler: V. E. F. Solman.

Pakenham, Ont. (Open fields, one feeding station, river bank, roadside and mixed woodland).—1 Jan. 1960; 8.30 a.m. to 4.30 p.m.; temp. —5° to 22°; wind very slight to none; bright sunshine all day; one foot snow. 6 observers in 5 parties. Total party hours, 18 (15 on foot, 3 by car); total party miles, 35 (15 on foot, 20 by car).

Gray Partridge, 12; Rock Dove, 15; Great Horned Owl, 2; Hairy Woodpecker, 6; Blue Jay, 10; Black-capped Chickadee, 18; White-breasted Nuthatch, 8; Starling, 62; Evening Grosbeak, 15; House Finch, 73; Pine Grosbeak, 28; Common Redpoll, 26; Slate-colored Junco, 2; Snow Bunting, 25. Total, 14 species; 302 individuals.

C. Fishenden, H. Fishenden, R. M. McKenzie, Edna G. Ross (compiler), T. W. Ross, C. P. Russell.

Peterborough, Ont. (Open farmland 45%, marsh (frozen) 15%, water 5%, coniferous woods 5%, deciduous woods 10%, mixed woods 20%).—26 Dec. 1959; 8.30 a.m. to 5 p.m.; temp. 28° to 37°; wind SE, 5-10 m.p.h.; visibility poor, light snow falling; lakes and swamps frozen; Otonabee R. partly frozen; one to three in. snow. 15 observers in 6 parties. Total party hours, 42 (12 on foot, 30 by car); total party miles, 431 (20 on foot, 411 by car).

Pied-billed Grebe, 1; Mallard, 1; Black Duck, 1; Wood Duck, 1; Common Goldeneye, 9; Common Merganser, 5; Red-tailed Hawk, 1; Sparrow Hawk, 1; Ruffed Grouse, 14; Am. Coot, 1; Pileated Woodpecker, 1; Hairy Woodpecker, 15; Downy Woodpecker, 14; Blue Jay, 42; Black-capped Chickadee, 236; White-breasted Nuthatch, 11; Brown Creeper, 7; Cedar Waxwing, 20; Northern Shrike, 2; Starling, 105; House Sparrow, 281; Cardinal, 1; Evening Grosbeak, 210; Pine Grosbeak, 7; Common Redpoll, 152; Pine Siskin, 35; Am. Goldfinch, 31; Slate-colored Junco, 30; Tree Sparrow, 114; Song Sparrow, 1. Total, 30 species; 1350 individuals.

S. Bond, King Baker, Paul Bristow, Mr. and Mrs. V. G. Chandler, Reg. Chandler, G. Cobb, F. Heilingbrunner, J. H. Johnston, S. J. Pammett, F. R. Pammett and J. L. McKeever (compiler), W. Smith, Miss Audrey Wilson, M. V. Powell.

Pickering, Ont. (20 acres mixed woodland, chiefly maple, hornbeam, cedar and hemlock; 3 miles suburban roads bordered by fields, mixed woodland and houses, some with feeding stations).—26 Dec. 1959; 7.30 a.m. to 4.30 p.m.; temp. about 32°; wind E, about 10 m.p.h.; snow pellets changing to freezing drizzle. 3 observers in 2 parties. Total party hours, 9 (9 on foot, 0 by car); total party miles, 4(4 on foot, 0 by car).

Sparrow Hawk, 1; Ruffed Grouse, 1; Long-eared Owl, 1; Hairy Woodpecker, 2; Downy Woodpecker, 4; Blue Jay, 5; Black-capped Chickadee, 20; White-breasted Nuthatch, 3; Cedar Waxwing, 1; House Sparrow, 57; Cardinal, 5; Purple Finch, 15; Am. Goldfinch, 3; Slate-colored Junco, 2; Tree Sparrow, 17; White-throated Sparrow 1. Total, 16 species; 138 individuals. Also seen in area in count period: Sharp-shinned Hawk, Great Horned Owl, Brown Thrasher, Hermit Thrush, Starling, Evening Grosbeak, Common Redpoll, Pine Siskin, and Oregon Junco.

Doris H. Speirs, J. Murray Spiers (compiler), Laszlo Szijj.

Port Arthur-Fort William, Ont. (7½-mile radius; 8% lake mainly frozen, 12% peat and muck bog, 12% residential and industrial areas, 25% farmlands, 43% woodlands, mainly second growth aspen, birch, and jack pine).—26 Dec. 1959; 8 a.m. to 5 p.m.; temp. 34° to 35°; wind E, 9 m.p.h.; drizzly and dull; up to 6 in. snow and ice on ground; rowan berries scarce but weed seeds easily available. 15 observers in 10 parties. Total party hours, 32 (5 on foot, 27 by car); total party miles, 263 (5 on foot, 258 by car).

Common Goldeneye, 4; Pigeon Hawk, 1; Ruffed Grouse, 1; Herring Gull, 669; Ring-billed Gull, 2; Rock Dove, 496; Snowy Owl, 2; Hairy Woodpecker, 3; Downy Woodpecker, 16; Gray Jay, 3; Blue Jay, 25; Common Raven, 106; Black-capped Chickadee, 66; Boreal Chickadee, 3; White-breasted Nuthatch, 1; Am. Robin, 1; Bohemian Waxwing, 30; Northern Shrike, 1; Starling, 1095; House Sparrow, 1813; Evening Grosbeak, 19; Pine Grosbeak, 55; Common Redpoll, 103. Total, 23 species; 4515 individuals. Seen during census period: Mockingbird on Dec. 25 and 27 and Jan. 3 at feeding tray in Port Arthur; Snow Bunting on Jan. 2.

Dr. and Mrs. A. E. Allin, Mrs. Eva Beckett, K. Denis (compiler), Miss Joan Hebden, W. Hunt, D. B. McKillop, T. Perron, Dr. H. Quackenbush, R. Robb, S. Robb, Ian Robb, Mr. and Mrs. C. R. Rogers, Miss Marion Smith.

Richmond Hill, Ont. (7½-mile radius from Richmond Hill; fields, woods, streams, ponds, small lakes).—26 Dec. 1959; 9.30 a.m. to 3 p.m.; temp. 35°; wind none; fog, drizzle rain, cloud, poor visibility. 18 observers in 6 parties. Total party hours, 21 (21 on foot, 0 by car); total party miles, 111 (21 on foot, 90 by car).

Great Blue Heron, 1; Red-tailed Hawk, 1; Ring-necked Pheasant, 11; Belted Kingfisher, 1; Yellow-shafted Flicker, 1; Hairy Woodpecker, 13; Downy Woodpecker, 16; Blue Jay, 18; Black-capped Chickadee, 262; White-breasted Nuthatch, 19; Red-breasted Nuthatch, 2; Brown Creeper, 4; Carolina Wren, 1; Golden-crowned

Kinglet, 2; Northern Shrike, 1; Starling, 36; House Sparrow, 200; Cardinal, 20; Evening Grosbeak, 12; Purple Finch, 1; Common Redpoll, 5; Pine Siskin, 3; Am. Goldfinch, 140; Slate-colored Junco, 94; Tree Sparrow, 95; White-throated Sparrow, 2; Swamp Sparrow, 1; Song Sparrow, 5. Total, 27 species; 965 individuals.

Mrs. Peter Addison, P. Addison, Mr. and Mrs. T. Boardman, Mr. and Mrs. Bishop, D. Gibson, James Hogg, Lyn Jackman, Lillian C. Langstaff (compiler), Mr. and Mrs. John Lunn, J. W. Large, Robt. Risebrough, John Sherbarth, R. Stanfiled, John Sedden, S. Tuck, G. Yaky.

St. Thomas, Ont. (All points within a circle of 15-mile diameter centering about 2 miles SE of St. Thomas).—26 Dec. 1959; 7.30 a.m. to 5.30 p.m.; overcast, rain and fog; temp. 35° to 40°; wind SW; 10 m.p.h.; ground bare, streams partly frozen, Lake Erie mostly clear of ice. 45 observers in 11 parties. Total party hours, 88 (22 on foot, 66 by car); total party miles, 275 (100 on foot, 175 by car).

Canada Goose, 1232; Mallard, 228; Black Duck, 1395; Common Goldeneye, 26; Hooded Merganser, 1; Sharp-shinned Hawk, 3; Red-tailed Hawk, 13; Bald Eagle, 1; Marsh Hawk, 1; Sparrow Hawk, 4; Ruffed Grouse, 36; Bobwhite, 18; Ring-necked Pheasant, 4; Herring Gull, 347; Ring-billed Gull, 11; Rock Dove, 280; Mourning Dove, 40; Screech Owl, 1; Long-eared Owl, 8; Belted Kingfisher, 5; Yellow-shafted Flicker, 3; Pileated Woodpecker, 2; Hairy Woodpecker, 18; Downy Woodpecker, 143; Horned Lark, 9; Blue Jay, 84; Common Crow, 7; Black-capped Chickadee, 532; White-breasted Nuthatch, 47; Red-breasted Nuthatch, 7; Brown Creeper, 12; Winter Wren, 3; Carolina Wren, 7; Catbird, 1; Brown Thrasher, 1; Am. Robin, 4; Hermit Thrush, 1; Golden-crowned Kinglet, 106; Starling, 1025; Myrtle Warbler, 1; Yellow-throat, 1; House Sparrow, 1014; Eastern Meadowlark, 1; Redwinged Blackbird, 1; Common Grackle, 4; Brown-headed Cowbird, 5; Cardinal, 224; Purple Finch, 5; Common Redpoll, 15; Am. Goldfinch, 305; Rufous-sided Towhee, 1; Vesper Sparrow, 12; Slate-colored Junco, 363; Oregon Junco, 1; Tree Sparrow, 527; Field Sparrow, 27; White-crowned Sparrow, 3; White-throated Sparrow, 8; Swamp Sparrow, 1; Song Sparrow, 40. Total, 60 species; 8227 individuals.

Eric Allan, Lloyd Auckland, Marshall Field (compiler), Russel Foster, Mrs. M. Kennedy, John Lemon, Fred Lewis, Ruth Marr, Ron Prevett, Verne Smith, George Thorman; at feeding station: Fred Bell.

Terra Cotta, Ont. (Around feeding station in wooded area 1 mile from Terra Cotta and feeding station in village of Terra Cotta).—27 Dec. 1959; 8 a.m. to 7 p.m.; temp. 30° to 25°; wind E, very little wind, 7 m.p.h.; very heavy freezing rain; prevented observers from traveling any distance. 3 observers in 2 parties.

Great Horned Owl, 2; Hairy Woodpecker, 4; Downy Woodpecker, 6; Blue Jay, 6; Black-capped Chickadee, 35+; White-breasted Nuthatch, 3; Starling, 40; House Sparrow, 30; Evening Grosbeak, 8; Common Redpoll, 30+; Slate-colored Junco, 2; Tree Sparrow, 6. Total, 12 species; 172 individuals.

(Mrs. L. E.) Barbara Jaquith (compiler), Dr. L. Everett Jaquith, Morris Puckering.

Toronto, Ont. (Routes many years established in the circle bounded by Clarkson, Schomberg and Whitby).—27 Dec. 1959; 8 a.m. to 5 p.m.; temp. 32° to 36°; wind E, 12 m.p.h. at noon; drizzle all day, roads icy. 121 observers in 28 parties.

Great Blue Heron, 4; Brant, 2; Mallard, 1086; Black Duck, 1120; Green-winged Teal, 1; Am. Widgeon, 5; Redhead, 1; Greater Scaup, 5586; Lesser Scaup, 13; Common Goldeneye, 572; Bufflehead, 109; Oldsquaw, 732; Common Merganser, 6; Red-breasted Merganser, 1; Goshawk, 1; Sharp-shinned Hawk, 1; Red-tailed Hawk, 23; Red-shouldered Hawk, 1; Rough-legged Hawk, 6; Marsh Hawk, 1; Sparrow Hawk, 26; Ruffed Grouse, 4; Ring-necked Pheasant, 181; Killdeer, 2; Glaucous Gull, 11; Iceland Gull, 2; Great Black-backed Gull, 12; Herring Gull, 2395; Ring-billed Gull, 681; Mourning Dove, 69; Screech Owl, 2; Great Horned Owl, 9; Long-eared Owl, 32; Belted Kingfisher, 6; Yellow-shafted Flicker, 2; Pileated Woodpecker, 2; Red-bellied Woodpecker, 1; Hairy Woodpecker, 96; Downy Woodpecker, 159;

Blue Jay, 121; Common Crow, 23; Black-capped Chickadee, 877; White-breasted Nuthatch, 133; Red-breasted Nuthatch, 4; Brown Creeper, 12; Winter Wren, 6; Carolina Wren, 2; Mockingbird, 1; Brown Thrasher, 3; Am. Robin, 4; Hermit Thrush, 7; Golden-crowned Kinglet, 21; Cedar Waxwing, 1; Northern Shrike, 1; Starling, 1260; Myrtle Warbler, 5; House Sparrow, 2591; Redwinged Blackbird, 15; Baltimore Oriole, 1; Rusty Blackbird, 2; Common Grackle, 5; Brown-headed Cowbird, 5; Cardinal, 146; Evening Grosbeak, 6; Purple Finch, 14; Common Redpoll, 38; Pine Siskin, 21; Am. Goldfinch, 478; Rufous-sided Towhee, 2; Savannah Sparrow, 1; Vesper Sparrow, 1; Slate-colored Junco, 609; Oregon Junco, 4; Tree Sparrow, 572; White-throated Sparrow, 24; Swamp Sparrow, 6; Song Sparrow, 82; Snow Bunting, 200. Total, 78 species; 20,267 individuals.

J. Baillie (compiler), H. Bare, H. Barnett, G. Bennett, Ralph Brown, Robert Brown, Ruth Brown, Dolly Bunker, E. Bunker, F. Bunston, D. Burton, L. Butcher, P. Carey, R. Chittendon, D. Clarke, L. Clarke, S. Clarke, E. Cobb, R. Cook, F. Crawford, V. Crich, A. Dawe, O. Devitt, J. Dex, D. Elder, M. Ellis, F. Emery, G. Fairfield, Mrs. R. A. Fairhead, B. Falls, T. Farley, D. Fowle, S. Fowle, G. Francis, A. Gatti, B. Geale, J. Geale, Christopher Goodwin, Clive Goodwin, D. Gunn, H. Halliday, R. Hansell, N. Hawkrigg, P. Higgins, W. Higgins, D. Hussell, R. James, B. Jones, J. Keenleyside, R. Knights, G. Lambert, L. Langstaff, J. Large, H. Lawrence, B. LeVay, F. LeVay, Jane LeVay, John LeVay, N. LeVay, J. Livingston, F. Lovesy, M. Lovesy, H. Lumsden, J. Lunn, B. Mackay, D. Mackay, P. Mackay, J. Mackintosh, R. Maclellan, R. Marshall, W. Martin, A. Mason, K. Mayall, K. McAlister, M. McCleary, T. McIlwraith, L. Miller, C. Molony, T. Murray, P. Nelson, G. Norris, D. O'Brien, D. Pace, G. Page, R. Pannell, J. Parker, R. Pepall, D. Perks, L. Pritchard, J. Purkis, W. Renison, H. Richards, R. Ritchie, J. Satterly, R. Saunders, D. Scovell, J. Sherrin, T. Shortt, F. Smith, J. Smith, Pat Smith, W. Smith, M. Spiers, D. Strickland, R. Taylor, A. Telfer, W. Tovell, R. Trowern, V. Trowern, J. Walty, E. Wasserfall, W. Wasserfall, E. West, J. D. West, B. Westcott, H. Whyte, J. Woodford, P. Woodford, R. Woods, R. Woods, Jr. (Members and friends of the Toronto Ornithological Club).

Westport, Ont. (7½-mile radius; farmland 15%, lakes 20%, marshes 5%, deciduous woodland 40%, mixed woodland 18%, red cedar groves 2%).—3 Jan. 1960; 7.30 a.m. to 4.30 p.m.; temp. 38° to 30°; wind SW, 5-10 m.p.h.; overcast; 2 feet snow, lakes frozen. 11 observers in 4 parties. Total party hours, 28 (16 on foot, 12 by car); total party miles, 191 (22 on foot, 169 by car).

Mallard, 1; Common Goldeneye, 1; Common Merganser, 1; Goshawk, 1; Rough-legged Hawk, 2; Bald Eagle, 1; Pileated Woodpecker, 2; Hairy Woodpecker, 6; Downy Woodpecker, 10; Blue Jay, 38; Common Crow, 1; Black-capped Chickadee, 145; White-breasted Nuthatch, 13; Winter Wren, 1; Starling, 17; House Sparrow, 126; Evening Grosbeak, 56; Pine Grosbeak, 71; Common Redpoll, 40; Am. Goldfinch, 8; Slate-colored Junco, 10; Tree Sparrow, 34; Song Sparrow, 1; Snow Bunting, 17. Total, 24 species; 603 individuals.

L. Cliff, M. Edwards, F. Hainsworth, G. Hainsworth, M. L'Estrange, P. Little, L. Lowther, N. Mansfield, D. Morra, D. Roberts, A. Strong (compiler).

SASKATCHEWAN

Prince Albert, Sask. 27 Dec. 1959; 1.30 p.m. to 4 p.m.; temp. 15° to 25°; overcast; about 1 foot snow. 4 observers in 1 party. Total party hours, 2½ (0 on foot, 2½ by car); total party miles, 6 (0 on foot, 6 by car).

Rock Dove, 2; Boreal Owl, 1; Black-billed Magpie 1; Boreal Chickadee, 6; House Sparrow, 2; Evening Grosbeak, 2; Pine Grosbeak, 6; Common Redpoll, 9. Total, 8 species; 29 individuals.

E. Brooman, Tony Capusten, Elias Evasiuk, Don Karusiuk.

Regina, Sask. (7½-mile radius circle centering 3 miles north of Regina; prairie farmland 90%, woodland 5%, city and suburbs 5%).—26 Dec. 1959; 8 a.m. to 4.15 p.m.; temp. 26° to 24°; wind NE, 10 m.p.h.; 10 in. snow; roads blocked by drifted snow; powerhouse water open and foggy. 11 observers in 3 parties. Total party hours, 77 (32 on foot, 45 by car); total party miles, 179 (44 on foot, 135 by car).

Horned Grebe, 1; White Pelican, 2; Whistling Swan, 3; Mute Swan, 4; Canada Goose, 185; Mallard, 300; Pintail, 1; Prairie Falcon, 1; Peregrine Falcon, 1; Gray Partridge, 8; Am. Coot, 1; Yellow-shafted Flicker, 2; Downy Woodpecker, 3; Black-billed Magpie, 27; Black-capped Chickadee, 16; Am. Robin, 3; Bohemian

Waxwing, 26; Cedar Waxwing, 3; Northern Shrike, 1; House Sparrow, 1520+; Western Meadowlark, 1; Common Grackle; Evening Grosbeak, 1. Total, 23 species; 2112+ individuals.

F. Brazier, E. Cruickshank, H. Erikson, E. L. Fox (compiler), R. Fox, R. Knutson, G. Ledingham, R. McCall, J. Moore, R. Nero, C. Willway.

Saskatoon, Sask. (Circle 15 miles in diameter, centered 2 miles south of Saskatoon, including the city, wooded banks of the Saskatchewan R., three golf courses, the Forestry Farm, and surrounding fields and pastures).—26 Dec. 1959; 8 a.m. to 2.30 p.m.; temp. 22° (constant); wind NW, 10 m.p.h.; overcast; snowing; 8 in. snow. 23 observers in 6 parties. Total party hours, 21¾ (10 on foot, 11¾ by car); total party miles, 123 (9 on foot, 114 by car).

Mallard, 9; Pigeon Hawk, 1; Gray Partridge, 23; Rock Dove, 22; Blue Jay, 2; Black-billed Magpie, 35; Black-capped Chickadee, 17; Bohemian Waxwing, 148; Northern Shrike, 2; Starling, 2; House Sparrow, 775; Brewer's Blackbird, 1; Pine Grosbeak, 19; Hoary Redpoll, 2; Common Redpoll, 523; Snow Bunting, 1. Total, 16 species; 1581 individuals. Seen in census period: Yellow-shafted Flicker, 1.

A Binnie, Dr. R. M. Bremner, Murray Cox, Betty Gerrard, Dr. J. Gerrard, Jonathan Gerrard, George Gerrity, Ross Gerrity, J. B. Gollop, Michael Gollop, Mrs. V. Harper, Grace Hogg, Jim Hogg, Jean MacKenzie, H. McLennan, Michael Miller, A. Plumstead (Toronto), W. Plumstead, J. F. Roy (compiler), John Shadick, Lindy Lou Wedge, Terry Wedge, T. Wedge (Members and friends of the Saskatoon Natural History Society).

ALBERTA

Banff, Alta. (All points within 7½-mile radius centered on Banff townsite; park entrance west to Johnston Canyon Rd. including Bow Falls, Vermilion Lakes, Upper Hot Springs, Cave and Basin, Tunnel Mountain road).—2 Jan. 1960; 8.30 a.m. to 4.30 p.m.; temp. 5° to 10°; wind NNW, 5 increasing to 20 m.p.h.; overcast, snow flurries; 6 in. snow; Bow R. and Bow Falls partly open, Vermilion Lakes frozen, with open hot springs. 8 observers in 3 parties. Total party hours, 20 (6 on foot, 14 by car); total party miles, 90 (8 on foot, 82 by car).

Mallard, 10; Common Goldeneye, 10; Golden Eagle, 1; Common Snipe, 1; Gray Jay, 7; Black-billed Magpie, 31; Clark's Nutcracker, 10; Black-capped Chickadee, 6; Mountain Chickadee, 9; Boreal Chickadee, 5; Am. Dipper, 4; Townsend's Solitaire, 2; Bohemian Waxwing, 2; House Sparrow, 71; Common Redpoll, 1; Snow Bunting, 200 est. Total, 16 species; 370 individuals.

E. D. Beacham (compiler), J. Beacham, O. D. Boggs, D. Dekker, I. Halladay, C. Hitchen, Miss K. Hodges, Miss I. Vickery (Calgary Bird Club).

Calgary, Alta. (7½-mile radius centered on Bow R. and Louise Bridge, including Inglewood Bird Sanctuary, Bowness Park, Spruce Cliff, Ogden, Glenmore Reservoir, open sections Bow and Elbow rivers, and prairie farmland within the area).—3 Jan. 1960; 8.30 a.m. to 4.30 p.m.; temp. —12° to 25°; wind N, 8 m.p.h.; 6 in. snow, drifted to 3 feet; rivers partly open, reservoir and prairie sloughs frozen. 8 observers in 5 parties. Total party hours, 29 (14 on foot, 15 by car); total party miles, 173 (9 on foot, 162 by car).

Mallard, 1727; Pintail, 3; Common Goldeneye, 45; Common Merganser, 6; Rough-legged Hawk, 1; Gyrfalcon, 1; Pigeon Hawk, 2; Ruffed Grouse, 1; Ring-necked Pheasant, 18; Gray Partridge, 47; Snowy Owl, 2; Short-eared Owl, 2; Yellow-shafted Flicker, 1; Downy Woodpecker, 1; Northern Three-toed Woodpecker, 1; Black-billed Magpie, 94; Black-capped Chickadee, 20; Golden-crowned Kinglet, 2; Bohemian Waxwing, 204; Northern Shrike, 1; Starling, 17; House Sparrow, 849; Common Redpoll, 162; Snow Bunting, 106. Total, 24 species; 3314 individuals. Also seen during count period: Sparrow Hawk, Hoary Redpoll.

E. D. Beacham (compiler), F. Bell, I. Halladay, C. Hitchen, W. E. McKay, Miss V. Morrisson, Miss I. Vickery, D. Dekker (Calgary Bird Club).

Edmonton, Alta. (15-mile circle centered on municipal airport; area includes St. Albert, east end Big Lake, Winterburn, Whitemud Creek, Clover Bar, southwest corner Namao airport, N. Saskatchewan R. valley).—27 Dec. 1959; 8.30 a.m. to 5.30 p.m.; temp. 20° to 31°; wind SE, 8 m.p.h. 24 observers in 9 parties. Total party hours, 41½ (28 on foot, 13½ by car); total party miles, 169½ (35½ on foot, 134 by car).

Mallard, 45; Common Goldeneye, 3; Common Merganser, 1; Pigeon Hawk, 2; Ruffed Grouse, 14; Ring-necked Pheasant, 29; Gray Partridge, 21; Rock Dove, 65; Great Horned Owl, 1; Yellow-shafted Flicker, 2; Pileated Woodpecker, 1; Hairy Woodpecker, 4; Downy Woodpecker, 11; Gray Jay, 2; Blue Jay, 25; Black-billed Magpie, 190; Common Crow, 1; Black-capped Chickadee, 157; Boreal Chickadee, 9; White-breasted Nuthatch, 2; Red-breasted Nuthatch, 1; Brown Creeper, 7; Am. Robin, 1; Golden-crowned Kinglet, 1; Bohemian Waxwing, 2950; Starling, 25; House Sparrow, 325; Evening Grosbeak, 11; Pine Grosbeak, 17; Hoary Redpoll, 44; Common Redpoll, 194; Red Crossbill, 4; White-winged Crossbill, 49; Slate-colored Junco, 1. Total, 34 species; 4215 individuals.

A. Allan, A. Blades, M. Boyd, L. Burgess, H. Campbell, M. Clarke, M. Forge, C. Hampson, M. Hampson, R. Heath, P. Demulder, E. T. Jones, B. Lang, Laubental, R. Lister, R. Lumsden, A. MacGregor, H. J. Montgomery, H. C. Pegg, M. B. Steele (compiler), P. H. Thompson, R. W. Turner, R Walker, J. D. Williams (Edmonton Bird Club)

Glenevis, Alta. (Mostly wooded spruce-poplar country; around farmyard; 20% open fields).—29 Dec. 1959; 8 a.m. to 5 p.m.; temp. 22° to 31°; wind S, 10 m.p.h. 1 observer. Total hours, 9 (7 on foot, 2 by car); total miles, 20 (10 on foot, 10 by car).

Goshawk, 1; Ruffed Grouse, 9; Great Horned Owl, 4; Pileated Woodpecker, 1; Hairy Woodpecker, 7; Downy Woodpecker, 6; Northern Three-toed Woodpecker, 2; Gray Jay, 8; Blue Jay, 10; Black-billed Magpie, 34; Black-capped Chickadee, 34; Boreal Chickadee, 7; White-breasted Nuthatch, 2; Brown Creeper, 1; Golden-crowned Kinglet, 2; House Sparrow, 5; Pine Grosbeak, 6; Common Redpoll, 4; Slate-colored Junco, 1. Total, 19 species; 144 individuals.

George Pegg.

BRITISH COLUMBIA

Comox, B.C. (From upper river bridge in Courtenay, following river to mouth and along shore line to head of Comox Bay, taking in adjacent farmlands).—27 Dec. 1959; 9 a.m. to 4 p.m.; temp. 46°; calm. 4 observers in 2 parties. Total party hours, 20 (mainly on foot); total party miles, 12 (on foot).

Common Loon, 20; Red-throated Loon, 3; Red-necked Grebe, 1; Horned Grebe, 2; Double-crested Cormorant, 2; Pelagic Cormorant, 2+; Great Blue Heron, 6; Mallard, 200+; Pintail, 4; Am. Widgeon, 450+; Greater Scaup, 230+; Common Goldeneye, 270+; Barrow's Goldeneye, 21; Bufflehead, 30+; White-winged Scoter, 165+; Surf Scoter, 120; Common Scoter, 5; Common Merganser, 37; Red-breasted Merganser, 36+; Ducks (unidentified but mainly White-winged and Surf Scoters) 3000+ est.; Gray Partridge; Am. Coot, 70; Common Snipe, 6; Thayer's Gull, 3+; Glaucous-winged Gull, 675+; Ring-billed Gull; Mew Gull, 25+; Belted Kingfisher, 8; Red-shafted Flicker, 24; Hairy Woodpecker, 5; Downy Woodpecker, 2; Common Raven, 20; Northwestern Crow, 125; Chestnut-backed Chickadee, 9; Winter Wren, 12; Bewick's Wren, 10; Am. Robin, 53; Golden-crowned Kinglet, 2; Ruby-crowned Kinglet, 11; Northern Shrike, 2; Western Meadowlark, 41; Purple Finch, 5; Pine Siskin, 320 est.; Rufous-sided Towhee, 22; Oregon Junco, 100; Fox Sparrow, 1; Song Sparrow, 29. Total, 44 species; 6184 individuals. Seen in count period: Trumpeter Swan, 6; Sharp-shinned Hawk, 1; Bald Eagle, 1; California Quail, flock; House Sparrow, 2; Redwinged Blackbird, 10; Brewer's Blackbird, flock 100+.

D. Guthrie, T. W. C. Hilliar (part time), Ralph Hilliar, Theed Pearse (compiler).

Crescent Beach, B.C. (Shoreline of Crescent Beach from end of Blackie's Spit to the South Point).—30 Dec. 1959; 9.30 a.m. to 12.30 p.m.; temp. 34° to 38°; calm with slight mist. 1 observer. Total hours, 3 (on foot); total miles, 3.

Common Loon, 2; Red-necked Grebe, 1; Horned Grebe, 4; Western Grebe, 2; Brandt's Cormorant, 3; Great Blue Heron, 2; Black Brant, 20; Mallard, 4; Pintail, 55; Green-winged Teal, 8; Am. Widgeon, 10; Greater Scaup, 40; Common Goldeneye, 18; Bufflehead, 6; Oldsquaw, 6; White-winged Scoter, 22; Surf Scoter, 26; Common

Scoter, 8; Red-breasted Merganser, 2; Dunlin, 150+; Northwestern Crow, 4. Total, 21 species; 393 individuals.

Miller Lougheed.

Ladner, B.C. (Circle of 15-mile diameter centered at intersection on Goudy Rd. 1¾ miles south of Ladner Trunk Rd., including peninsula of Pt. Roberts, Wash., shores of Georgia Strait, Boundary Bay, and Fraser R.; salt water 40%, dyked farmland 20%, peat bog 15%, marshes and shores 15%, upland conifer 5%, suburban 5%).—2 Jan. 1960; 7.20 a.m. to 4.40 p.m.; temp. 31° to 42°; wind varying, light; snow and rain a.m., clearing p.m.; ground briefly snow covered a.m., bare later; standing water frozen, sea, river, and running water open. 14 observers in 11 parties. Total party hours, 89½ (76½ on foot, 10 by bicycle, 3 by car); total party miles, 174 (109½ on foot, 49 by bicycle, 15½ by car).

Loon (sp.?), 55; Common Loon, 24; Arctic Loon, 5; Red-throated Loon, 21; Red-necked Grebe, 26; Horned Grebe, 49; Eared Grebe, 1; Western Grebe, 150; Cormorant (sp.?), 93; Double-crested Cormorant, 51; Brandt's Cormorant, 5; Pelagic Cormorant, 29; Great Blue Heron, 69; Black Brant, 511; Snow Goose, 17; Mallard, 627; Pintail, 5580; Green-winged Teal, 1807; Am. Widgeon, 13,611; Greater Scaup, 1024; Lesser Scaup, 4; Common Goldeneye, 75; Barrow's Goldeneye, 64; Bufflehead, 130; Oldsquaw, 198; Harlequin Duck, 17; White-winged Scoter, 112; Surf Scoter, 352; Common Scoter, 65; Duck (sp.?), 8000; Common Merganser, 7; Red-breasted Merganser, 69; Sharp-shinned Hawk, 4; Cooper's Hawk, 4; Red-tailed Hawk, 3; Rough-legged Hawk, 1; Bald Eagle, 2; Marsh Hawk, 10; Peregrine Falcon, 2; Sparrow Hawk, 3; Ruffed Grouse, 4; California Quail, 8; Ring-necked Pheasant, 99; Gray Partridge, 14; Am. Coot, 20; Killdeer, 248; Black-bellied Plover, 74; Black Turnstone, 90; Common Snipe, 39; Dunlin, 26,814; Sanderling, 143; Glaucous-winged Gull, 2354; Herring Gull, 9; Mew Gull, 879; Bonaparte's Gull, 2; Common Murre, 123; Pigeon Guillemot, 28; Marbled Murrelet, 11; Rock Dove, 29; Mourning Dove, 1; Short-eared Owl, 25; Belted Kingfisher, 4; Red-shafted Flicker, 126; Pileated Woodpecker, 4; Hairy Woodpecker, 3; Downy Woodpecker, 15; Horned Lark, 24; Common Raven, 2; Northwestern Crow, 303; Black-capped Chickadee, 187; Chestnut-backed Chickadee, 11; Common Bushtit, 46; Red-breasted Nuthatch, 12; Brown Creeper, 10; Winter Wren, 67; Bewick's Wren, 25; Long-billed Marsh Wren, 1; Am. Robin, 974; Varied Thrush, 1; Golden-crowned Kinglet, 179; Ruby-crowned Kinglet, 54; Water Pipit, 6; Cedar Waxwing, 18; Northern Shrike, 8; Starling, 5475; Crested Myna, 16; Audubon's Warbler, 1; House Sparrow, 1409; Western Meadowlark, 133; Redwinged Blackbird, 16; Brewer's Blackbird, 2107; Brown-headed Cowbird, 1; Purple Finch, 63; House Finch, 561; Common Redpoll, 13; Pine Siskin, 243; Am. Goldfinch, 42; Red Crossbill, 18; Rufous-sided Towhee, 188; Oregon Junco, 648; White-crowned Sparrow, 134; Golden-crowned Sparrow, 22; Fox Sparrow, 18; Song Sparrow, 792; Lapland Longspur, 44; Snow Bunting, 6. Total, 103 species; 77,921+ individuals.

J. Cartwright, R. Drent, A. J. Erskine (compiler), F. Gornall, Mr. and Mrs. W. H. Hesse, W. M. Hughes, G. Mackay, W. Merilees, A. Muir, R. Ross, J. G. Sarles, E. Wise, G. Wright.

North Surrey, B.C. (Area bounded on north and west by Fraser R., on south by Townline Rd., on east by Roebuck Rd.).—26 Dec. 1959; 7.30 a.m. to 3.30 p.m.; temp. 32° to 45°; sunshine, light wind. 1 observer. 8 hours (on foot); about 14 miles (on foot).

Great Blue Heron, 4; Mallard, 10; Greater Scaup, 9; Bufflehead, 7; Ring-necked Pheasant, 8; Common Snipe, 6; Glaucous-winged Gull, 128; Mew Gull, 31; Rock Dove, 8; Red-shafted Flicker, 6; Downy Woodpecker, 1; Northwestern Crow, 13; Black-capped Chickadee, 13; Winter Wren, 1; Bewick's Wren, 8; Am. Robin, 2; Golden-crowned Kinglet, 21; House Sparrow, 39; Brewer's Blackbird, 1; Evening Grosbeak, 2; Purple Finch, 11; Pine Siskin, 13; Am. Goldfinch, 5; Rufous-sided Towhee, 4; Oregon Junco, 18; Fox Sparrow, 1; Song Sparrow, 29. Total, 27 species; 399 individuals.

John Vooys.

Penticton, B.C. (Circle of 7½-mile radius, including Penticton and Summerland North to Crescent Beach, 15 miles of lake front, river bottom, small marshes, several creeks, orchards and pine-covered hills).—26 Dec. 1959; 8 a.m. to 4.30 p.m.; temp. 21° to 32°; calm; clear, sunny. 15 observers in 3 parties. Total party hours, 14 (6 on foot, 8 by car); total party miles, 162 (12 on foot, 150 by car).

Western Grebe, 6; Mallard, 17; Gadwall, 5; Redhead, 10; Canvasback, 21; Lesser Scaup, 10; Common Goldeneye, 6; Barrow's Goldeneye, 1; Bufflehead, 21; Sharp-shinned Hawk, 2; Sparrow Hawk, 1; California Quail, 35; Ring-necked Pheasant, 5; Am. Coot, 3450; Killdeer, 1; Herring Gull, 3; Rock Dove, 36; Belted Kingfisher, 2; Red-shafted Flicker, 19; Pileated Woodpecker, 1; Lewis' Woodpecker, 4; Black-billed Magpie, 43; Common Crow, 6; Clark's Nutcracker, 2; Black-capped Chickadee, 5; Mountain Chickadee, 11; White-breasted Nuthatch, 14; Red-breasted Nuthatch, 15; Pygmy Nuthatch, 16; Winter Wren, 1; Canyon Wren, 1; Western Bluebird, 7; Golden-crowned Kinglet, 2; Bohemian Waxwing, 490; Starling, 52; House Sparrow, 240; House Finch, 8; Am. Goldfinch, 3; Oregon Junco, 45; White-crowned Sparrow, 3; Song Sparrow, 10. Total, 41 species; 4630 individuals. Observed also in count period: Common Raven, Bald Eagle, Saw-whet Owl, Steller's Jay, Am. Robin, Northern Shrike, Redwinged Blackbird, Common Redpoll, White-winged Crossbill, Western Meadowlark.

S. R. Cannings (compiler), J. Cannings, R. Cannings, E. Cannings, J. Holman, M. Holman, D. Holman, P. Holman, L. Hill, P. Hill, M. Hill, J. McDougald, E. Tait, D. Tait, J. Woolliams.

Port Kells, B.C. (Area between Port Kells and Fry's Corner on Trans-Canada Highway including Serpentine R. flats).—29 Dec. 1959; 8.30 a.m. to 11.40 a.m.; temp. 24° to 31°; overcast, no wind. 1 observer. 3 hours on foot and bicycle; 7 miles on foot and bicycle.

Ring-necked Pheasant, 2; Killdeer, 7; Glaucous-winged Gull, 1; Red-shafted Flicker, 2; Black-capped Chickadee, 10; Bewick's Wren, 2; House Sparrow, 5; Brewer's Blackbird, 300; Purple Finch, 75; Rufous-sided Towhee, 1; Oregon Junco, 18; Song Sparrow, 15. Total, 12 species, 438 individuals.

Mrs. F. K. Munro.

Prince Rupert, B.C. (Vicinity of Prince Rupert and harbor; 5-mile radius).—31 Dec. 1959; 11 a.m. to 1 p.m.; temp. 25° to 35°; wind NE, 1-5 m.p.h.; clear, sunny, 1 in. new snow. 1 observer. Total hours, 2 (1 on foot, 1 by car); total miles, 10 (1 on foot, 9 by car).

Common Loon, 2; Red-necked Grebe, 35; Barrow's Goldeneye, 4; White-winged Scoter, 1; Surf Scoter, 24; Hooded Merganser, 3; Common Merganser, 5; Glaucous-winged Gull, 775; Mew Gull, 70; Rock Dove, 15; Belted Kingfisher, 1; Common Raven, 54; Northwestern Crow, 49; Winter Wren, 1; Golden-crowned Kinglet, 5; Starling, 25; House Sparrow, 32. Total, 17 species; 1001 individuals.

H. B. Hammer.

Vancouver, B.C. (Within circle 7½-mile radius centering on Broadway West and Granville St. including City of Vancouver, North Vancouver, part of Municipality of Burnaby, West Vancouver, Richmond, part of Burrard Inlet and North Arm of Fraser R.; salt water 30%, shores 3%, marsh 3%, open fields 8% built-up areas 42%, city parks 7%, coniferous forests 7%).—27 Dec. 1959; 7.30 a.m. to 4.30 p.m.; temp. 42° to 48°; wind SE to NE, light; light drizzle 8 to 8.30 a.m. and 9.30 to 11 a.m., rain 8.30 a.m. to 9.30 a.m., 95% to 100% overcast all day. 41 observers in 16 parties. Total party hours, 113½ (88 on foot, 2½ on bicycle, 40 by car, 3 by canoe); total party miles, 247½ (157 on foot, 10½ on bicycle, 75 by car, 5 by canoe).

Common Loon, 71; Arctic Loon, 2; Red-throated Loon, 3; Red-necked Grebe, 27; Horned Grebe, 63; Eared Grebe, 14; Western Grebe, 2003; Pied-billed Grebe, 1; Double-crested Cormorant, 72; Pelagic Cormorant, 67; Great Blue Heron, 35; Canada Goose, 60; Mallard, 1641; Pintail, 7; Green-winged Teal, 4; Am. Widgeon, 166; Shoveler, 6; Wood Duck, 3; Canvasback, 4; Greater Scaup, 4706; Lesser Scaup, 3;

Ring-necked Duck, 1; Common Goldeneye, 75; Barrow's Goldeneye, 438; Bufflehead, 229; Oldsquaw, 144; Harlequin Duck, 10; White-winged Scoter, 243; Surf Scoter, 2968; Common Scoter, 110; Ruddy Duck, 5; Hooded Merganser, 3; Common Merganser, 33; Red-breasted Merganser, 477; Turkey Vulture, 1; Sharp-shinned Hawk, 4; Cooper's Hawk, 2; Rough-legged Hawk, 1; Bald Eagle, 3; Marsh Hawk, 4; Peregrine Falcon, 1; Pigeon Hawk, 1; Sparrow Hawk, 2; Blue Grouse, 2; Ruffed Grouse, 1; Ring-necked Pheasant, 49; Am. Coot, 367; Black-bellied Plover, 4; Killdeer, 74; Black Turnstone, 175; Common Snipe, 2; Dunlin, 2220; Sanderling, 81; Glaucous-winged Gull, 35,442; Herring Gull, 558; Mew Gull, 8043; Bonaparte's Gull, 2; Common Murre, 31; Pigeon Guillemot, 75; Marbled Murrelet, 5; Ancient Murrelet, 3; Rock Dove, 311; Short-eared Owl, 11; Saw-whet Owl, 1; Belted Kingfisher, 6; Yellow-bellied Sapsucker, 4; Red-shafted Flicker, 139; Pileated Woodpecker, 2; Hairy Woodpecker, 8; Downy Woodpecker, 5; Horned Lark, 17; Steller's Jay, 7; Common Raven, 4; Northwestern Crow, 539; Black-capped Chickadee, 240; Chestnut-backed Chickadee, 28; Red-breasted Nuthatch, 2; Brown Creeper, 12; Winter Wren, 72; Bewick's Wren, 21; Am. Robin, 1160; Varied Thrush, 3; Golden-crowned Kinglet, 92; Ruby-crowned Kinglet, 31; Cedar Waxwing, 78; Northern Shrike, 2; Starling, 39,671; Crested Myna, 312; House Sparrow, 1666; Hutton's Vireo, 1; Western Meadowlark, 36; Redwinged Blackbird, 1; Brewer's Blackbird, 1731; Evening Grosbeak, 7; Purple Finch, 270; House Finch, 629; Pine Grosbeak; Pine Siskin, 2931; Am. Goldfinch, 6; Red Crossbill, 31; Rufous-sided Towhee, 127; Slate-colored Junco, 4; Oregon Junco, 621; White-crowned Sparrow, 69; Golden-crowned Sparrow, 17; Fox Sparrow, 14; Song Sparrow, 701. Total, 106 species; 112,487 individuals. Seen in count period: 1 Townsend's Warbler.

Bill Adams, Mr. and Mrs. John Bain, Mr. and Mrs. Stewart Bradley, Col. William Bird, Miss Sheila Buchanan, Mrs. Noel Copping, Rudi Drent, Mr. and Mrs. A. J. Erskine, Carl Gough, Mr. and Mrs. Werner Hesse, W. M. Hughes (compiler), J. Hobson, Mrs. Hazel Hubbard, Miss Heather Levison-Gower, Mr. and Mrs. J. Ross Mackay, Allister Muir, Wm. Merilees, Miss Doris Nye, Miss Verna Newson, R. F. Oldaker, Mrs. Dominic Point, Norman Precious, Murray Rombough, Miss Rosamond Ross, David Reese-Thompson, Frank Sanford, Mr. and Mrs. H. Sieburth, P. St. John, Mr. and Mrs. G. B. H. Stevens, Mr. and Mrs. Foote Waugh, Ron Webber, Miss Betty Wise.

Vernon, B.C. (North to Buckerfield's Ranch, west to Okanagan Landing, south to Rattlesnake Point, Kalamalka Lake, and east to Coldstream Ranch).—20 Dec. 1959; 8 a.m. to 3.30 p.m.; temp. 30 to 35°; wind S, 5-10 m.p.h.; overcast; light rain ending at noon; Okanagan and Kalamalka lakes clear of ice, Swan Lake frozen over; no snow except for patches in sheltered woods. 22 observers in 4 parties. Total party hours, 26 (15 on foot, 11 by car); total party miles, 100 (24 on foot, 76 by car).

Common Loon, 2; Red-necked Grebe, 3; Horned Grebe, 2; Western Grebe, 16; Pied-billed Grebe, 5; Mallard, 612+; Green-winged Teal, 7; Am. Widgeon, 56; Redhead, 25; Ring-necked Duck, 10; Canvasback, 4; Greater Scaup, 12; Common Goldeneye, 2; Barrow's Goldeneye, 2; Bufflehead, 3; Ruddy Duck, 35 (J.G., B.A.S.); Common Merganser, 14; Goshawk, 1; Cooper's Hawk, 1; Rough-legged Hawk, 1; Marsh Hawk, 4; Sparrow Hawk, 1; Ruffed Grouse, 1; California Quail, 5; Ring-necked Pheasant, 116; Gray Partridge, 5; Am. Coot, 1653±; Killdeer, 4; Common Snipe, 5; Herring Gull, 1; Rock Dove, 4; Mourning Dove, 17; Pygmy Owl, 2; Short-eared Owl, 3; Saw-whet Owl, 1; Belted Kingfisher, 4; Red-shafted Flicker, 38; Pileated Woodpecker, 3; Hairy Woodpecker, 2; Downy Woodpecker, 3; Black-billed Magpie, 22; Common Raven, 10; Clark's Nutcracker, 3; Black-capped Chickadee, 89; Mountain Chickadee, 19; Chestnut-backed Chickadee, 6; White-breasted Nuthatch, 2; Red-breasted Nuthatch, 46; Pygmy Nuthatch, 13; Am. Dipper, 4; Winter Wren, 1; Townsend's Solitaire, 3; Golden-crowned Kinglet, 20; Bohemian Waxwing, 180; Northern Shrike, 8; Starling, 162; House Sparrow, 342; Western Meadowlark, 3; Redwinged Blackbird, 9; Brewer's Blackbird, 10; Evening Grosbeak, 3; House Finch, 1; Common Redpoll, 9; Am. Goldfinch, 60; Red Crossbill, 16; Rufous-sided Towhee, 2; Slate-colored Junco, 5; Oregon Junco, 202; Tree Sparrow, 4;

White-crowned Sparrow, 18; Song Sparrow, 32. Total, 71 species, 3989 individuals. Seen during count period: Common Crow, 60±; American Robin, 4; Pigeon Hawk, 1.

E. S. Alderman, Miss K. Bartholomew, Miss M. Beley, D. K. Campbell, Mrs. K. Dobson, J. T. Fowle, J. Grant (compiler), K. G. Gruener, A. N. Humphreys,, P. G. Legg, P. F. Mackie, K. Nevile-Smith, J. Y. Obana, J. Phillips, R. Pickering, Mrs. T. Pickering, J. R. Quirk, D. A. Ross, I. Ross, B. A. Sugden, E. van Blaricom, E. P. Venables (North Okanagan Naturalists' Club).

Victoria, B.C. (Circle of 7½-mile radius; 40% salt water shoreline, 30% coniferous woodland, 15% farmland, 10% suburban, 3% lakes (70% frozen), 1% marsh, 1% tidal flats; Witty's lagoon to Island view beach, Malahat, Beaver and Elk lakes).—2 Jan. 1960; 8 a.m. to 5 p.m.; temp. 38° to 41°; wind NNW, 10 m.p.h.; snowing; 2 in. snow, poor visibility. 25 observers in 11 parties. Total party hours, 85 (71 on foot, 14 by car); total party miles, 277 (55½ on foot, 221½ by car).

Common Loon, 40; Arctic Loon, 7; Red-throated Loon, 15; Red-necked Grebe, 37; Horned Grebe, 186; Eared Grebe, 123; Western Grebe, 1696; Pied-billed Grebe, 16; Double-crested Cormorant, 58; Brandt's Cormorant, 26; Pelagic Cormorant, 92; Great Blue Heron, 10; Canada Goose, 73; White-fronted Goose, 2; Mallard, 1359; Pintail, 174; Green-winged Teal, 454; European Widgeon, 1; American Widgeon, 4590; Shoveler, 476; Wood Duck, 1; Ring-necked Duck, 288; Canvasback, 57; Greater Scaup, 1661; Lesser Scaup, 35; Common Goldeneye, 181; Barrow's Goldeneye, 3; Bufflehead, 543; Oldsquaw, 72; Harlequin Duck, 83; White-winged Scoter, 227; Surf Scoter, 323; Common Scoter, 8; Ruddy Duck, 46; Hooded Merganser, 36; Common Merganser, 52; Red-breasted Merganser, 94; Sharp-shinned Hawk, 3; Cooper's Hawk, 1; Red-tailed Hawk, 9; Bald Eagle, 4; Marsh Hawk, 1; Pigeon Hawk, 2; Ruffed Grouse, 1; California Quail, 428; Ring-necked Pheasant, 44; Am. Coot, 493; Black Oystercatcher, 17; Killdeer, 196; Black-bellied Plover, 33; Surfbird, 1; Black Turnstone, 71; Common Snipe, 8; Whimbrel, 2; Greater Yellowlegs, 3; Rock Sandpiper, 51; Dunlin, 54; Sanderling, 1; Glaucous-winged Gull, 3438; Herring Gull, 22; Mew Gull, 677; Common Murre, 217; Pigeon Guillemot, 20; Marbled Murrelet, 4; Rhinoceros Auklet, 1; Screech Owl, 1; Belted Kingfisher, 13; Yellow-shafted Flicker, 1; Red-shafted Flicker, 112; Pileated Woodpecker, 5; Lewis' Woodpecker, 1; Hairy Woodpecker, 3; Downy Woodpecker, 9; Skylark, 45; Steller's Jay, 3; Common Raven, 32; Northwestern Crow, 668; Chestnut-backed Chickadee, 160; Common Bushtit, 125; Red-breasted Nuthatch, 11; Brown Creeper, 11; Winter Wren, 71; Bewick's Wren, 30; Long-billed Marsh Wren, 2; Robin, 5535; Varied Thrush, 20; Hermit Thrush, 2; Western Bluebird, 55; Golden-crowned Kinglet, 323; Ruby-crowned Kinglet, 17; Cedar Waxwing, 505; Starling, 519; House Sparrow, 275; Western Meadowlark, 61; Brewer's Blackbird, 256; Purple Finch, 37; House Finch, 125; Pine Siskin, 353; Red Crossbill, 76; Rufous-sided Towhee, 62; Savannah Sparrow, 1; Oregon Junco, 523; White-crowned Sparrow, 10; Golden-crowned Sparrow, 36; Fox Sparrow, 9; Song Sparrow, 107. Total, 106 species; 29,158 individuals. Species seen in count period: Peregrine Falcon, Virginia Rail, Glaucous Gull, Ring-billed Gull, Ancient Murrelet, Cassin's Auklet, Mourning Dove, Short-eared Owl, Rufous Hummingbird, Yellow-bellied Sapsucker, Horned Lark, Rock Wren, Water Pipit, Northern Shrike, Red-winged Blackbird, American Goldfinch.

W. Adams, R. Barnes, J. Barnett, Mrs. H. M. S. Bell, Mrs. E. G. Bousefield, T. Briggs, F. Buffam, Mrs. A. R. Davidson, A. R. Dividson, R. Fryer, Mrs. A. G. Gosling, Miss J. Hannay, F. King, R. McKenzie-Grieve, Miss M. C. Melburn, Mrs. L. Monkton, Mrs. B. Morgan, B. Morgan, I. H. C. Palmer, G. A. Poynter (compiler), Miss L. Roberts, Mrs. D. Stirling, D. Stirling, Miss D. Webb, D. Welch (Victoria Natural History Society).

White Rock, B.C. (From White Rock Pier south along Great Northern Railway to International Boundary, return trip by Campbell R. Rd. to White Rock).—29 Dec. 1959; 10 a.m. to 1 p.m.; temp. 28° to 32°; wind light. 1 observer. Total hours, 3 (on foot); total miles, 8 (on foot).

Common Loon, 2; Horned Grebe, 15; Western Grebe, 1; Brandt's Cormorant, 1; Great Blue Heron, 1; Mallard, 1; Pintail, 2; Canvasback, 3; Greater Scaup, 200+;

Common Goldeneye, 10; Bufflehead, 20; Oldsquaw, 6; White-winged Scoter, 100+; Surf Scoter, 200+; Common Scoter, 6; Red-breasted Merganser, 3; Sparrow Hawk, 1; Killdeer, 1; Dunlin, 500; Glaucous-winged Gull, 50+; Hairy Woodpecker, 1; Northwestern Crow, 50; Black-capped Chickadee, 12; Bewick's Wren, 1; Golden-crowned Kinglet, 2; House Sparrow, 50; Common Redpoll, 1; Oregon Junco, 12; Song Sparrow, 15. Total, 29 species; 1267 individuals.

E. E. Woodford.

REPORT OF COUNCIL AT THE EIGHTY-FIRST ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB, DECEMBER 3, 1959

SINCE the last annual meeting there have been four council meetings at the National Museum of Canada: December 18, 1958 — 20 present; April 9 — 17 present; October 1 — 18 present; and November 19 — 13 present. The council has continued to deal with the club's business.

Appointments for 1958 offices were made as follows:

Editor, CANADIAN FIELD-NATURALIST — R. A. Hamilton
Business Manager, CANADIAN FIELD-NATURALIST — W. J. Cody
Chairman, Publications Committee — W. J. Groves
Chairman, Excursions and Lectures Committee — Miss Violet Humphreys, succeeded by D. R. Beckett
Chairman, Reserve Fund Committee — Hoyes Lloyd
Chairman, Special Lectures Committee — E. L. Bousfield
Chairman, Bird Census Committee — D. B. O. Savile
Chairman, Macoun Field Club Committee — H. J. Scoggan
Chairman, F.O.N. Affairs Committee — W. K. W. Baldwin
Representatives, Canadian Section, International Committee for bird preservation — W. E. Godfrey, D. A. Munro

REPORT OF THE PUBLICATIONS COMMITTEE

During 1959 four numbers of the CANADIAN FIELD-NATURALIST, Vol. 73, have been published. The material published in this volume is as follows:

	Papers	*Notes*	*Reviews*
Botany	7	4	2
Entomology	1	2	0
Geology	0	0	1
Herpetology	1	2	1
Ichthyology	1	0	1
Invertebrate Zoology	0	2	0
Mammalogy	2	2	6
Ornithology	8	12	7
Miscellaneous	2	0	7
	22	24	25

This comprises a total of 218 pages including 13 halftones and 12 line drawings. Accounts for the first three numbers and the fourth number of Vol. 72 totaling $3,742.13 have been approved by the committee.

There were no full sets sold, but sales of single numbers and several long runs totaled $373.29.

REPORT OF EXCURSIONS AND LECTURES COMMITTEE

During the year the committee sponsored six club meetings and eight field trips and issued two newsletters. The morning bird walks commenced on Saturday, May 9, and continued on the Tuesdays, May 12, 19 and 26. Field trips were undertaken to Almonte and Pakenham.

REPORT OF THE RESERVE FUND COMMITTEE

Two shares of Bell Telephone Company and one right to purchase additional stock were bought during the year increasing our holdings of this company to 15 shares.

REPORT OF THE MEMBERSHIP COMMITTEE

A circular letter inviting subscriptions to the CANADIAN FIELD-NATURALIST was prepared and sent, during May, to 194 libraries, as follows: Canada, 59; U.S.A., 111; Europe, 22; Australia, 1; South America, 1. Most of the Canadian addresses were public libraries, those of other countries were chiefly university libraries. It is believed that approximately 6 new subscriptions resulted from the campaign, the cost of which was $9.02.

REPORT OF SPECIAL LECTURES COMMITTEE

The following Audubon Screen Lectures were held in Glebe Collegiate Auditorium during 1959:

"Ranch and Range," by Albert Wool, Monday, Jan. 19

"Pastures of the Sea," by Bertram Cadbury, Saturday, Mar. 21

"Puerto Rico, U.S.A.," by Fran William Hall, Monday, April 20

This concludes the eleventh and final season of Audubon Screen Tour sponsorship by the Ottawa Field-Naturalists' Club.

REPORT OF THE BIRD CENSUS COMMITTEE

The 1958 Christmas Bird Census was held on December 21. A total of 35 species were seen by 36 observers. The censuses for all Canada were published in the CANADIAN FIELD-NATURALIST, Vol. 73, No. 1.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

Enrolment in the club is now eighty-one with twenty-eight juniors, twenty-five intermediates and twenty-eight seniors. Michale Hodgson, Joan Hart and Torben Hawksbridge are the new presidents of the junior, intermediate and senior groups respectively. Three field trips were held in the spring and one in the autumn. The regular weekly indoor programs featured ten visiting speakers.

REPORT OF F.O.N. AFFAIRS COMMITTEE

The committee maintained continued liaison with the Federation of Ontario Naturalists, preparing reports and making various canvasses for the F.O.N. The highlight of the season was the presentation of the first record of Sounds of Nature, Volume 5, *A Day in Flores Morades*, to the Venezuelan Ambassador.

A. W. F. Banfield, *Secretary*

FINANCIAL STATEMENT OF THE OTTAWA FIELD-NATURALISTS' CLUB, NOV. 30, 1959

CURRENT ACCOUNT

ASSETS

Cash on Hand	$ 93.22
Balance in Bank, Nov. 30, 1959	691.19
Bills receivable, separates	167.86
	$ 952.27

RECEIPTS

Balance in bank, Dec. 2, 1958		1,902.72
Fees:		
Current	$2,605.01	
Advance & Arrears	181.00	
Associate	48.00	
		2,834.01
Separates and illustrations		448.64
Sale Wilson Geology		20.19
Single and back numbers		653.45
Donation, Fed. Ont. Nat.		25.00
Sale of lodge		35.00
Return of 1958 E & L funds		42.00
Miscellaneous		19.43
		$5,980.44

LIABILITIES

Checks outstanding	20.00
Balance	932.27
	$ 952.27

EXPENDITURES

Can. Field Nat. 4 numbers		2,960.06
Separates and illustrations		774.91
Audubon Screen Tours		870.13
Editor's honorarium		100.00
Business manager's honorarium		15.00
Membership Committee		9.16
Newsletter		62.85
Excurs. & Lect. Committee		79.95
Postage and stationery		205.58
Bank discount		18.70
Foreign exchange		36.41
Miscellaneous		83.28
Cash on hand		93.22
Bank Balance, Nov. 30, 1959	691.19	
less o/s check	20.00	
		671.19
		$5,980.44

RESERVE FUND

ASSETS

$3,000 Ontario Hydro 3% bonds, market value	2,400.00
15 shares Bell Telephone stock, market value	637.50
Balance in bank, Nov. 30, 1959	109.98
	$3,147.48

RECEIPTS

Balance in bank, Dec. 2, 1958	63.76
Bank interest	.41
Bond interest	90.00
Dividends Bell Telephone	28.00
	$ 182.17

LIABILITIES

NIL

EXPENDITURES

Safety deposit box rental	5.00
Bank service charge	.15
Purchase 1 Bell right	1.04
Purchase 2 Bell shares	66.00
Balance in bank, Nov. 30, 1959	109.98
	$ 182.17

PUBLICATIONS FUND

ASSETS

$1,500 Ontario Hydro 3% bonds, market value	1,200.00
Balance in bank, Nov. 30, 1959	95.21
	$1,295.21

RECEIPTS

Balance in bank, Dec. 2, 1958	49.38
Bank interest	.83
Bond interest	45.00
	$ 95.21

LIABILITIES

NIL

EXPENDITURES

Balance in bank, Nov. 30, 1959	95.21
	$ 95.21

Audited and found correct.
November 30, 1959 (Signed) I. L. CONNORS (Signed) J. M. GILLETT, Treasurer
C. FRANKTON, Auditors

NOTES

Dragonflies and Damselflies Collected in the Vicinity of Cedar Lake, Ontario

DURING the summer of 1957 the writer had an opportunity to collect Odonata in the Cedar Lake area, 32 miles north of Vermilion Bay, in northwestern Ontario (50°10′N 93°08′W).

Tentative identifications of the Anisoptera were made by the author by means of a key, *The Dragonflies of North America*, by J. G. Needham and W. J. Westfall, Jr., University of California Press. These were later confirmed by Mr. J. E. H. Martin, Institute of Entomology, Research Branch, Canada Department of Agriculture, Ottawa, Ontario. Zygoptera specimens were kindly identified by Mrs. Lenora K. Gloyd, Assistant Taxonomist, Natural History Survey, Urbana, Illinois.

Twenty-four species were collected (Table 1). None of these were new, but the collections fill a gap in our knowledge of the distribution of otherwise well-known species. The only known earlier collections in the general area were reported by E. M. Walker (Can. Ent. 72: 4-15, 1940), who listed some 28 species captured in the region of Favourable Lake, Ontario, by Messrs. Clifford E. Hope, Leslie Prince and G. Morley Neal in 1938. In Walker's list only eleven species of Anisoptera and two of Zygoptera are from the Cedar Lake area.

TABLE 1. ODONATA COLLECTED AT CEDAR LAKE, ONTARIO, 1957

Species	Numbers		Range of collection dates
	Male	Female	
Anisoptera			
**Cordulia shurtleffi* Scudder	2	2	May 29—July 2
**Libellula quadrimaculata* Linnaeus	3	4	June 5–June 16
**Leucorrhinia hudsonica* (Selys)	1	1	June 6–June 16
**Leucorrhinia proxima* Calvert	4	3	June 15–July 31
Tetragoneuria canis McLachlan	1	3	June 16–June 24
**Tetragoneuria spinigera* Selys		1	June 20
Gomphus spicatus Hagen	5	2	June 21–July 2
Didymops transversa (Say)	3	2	June 20–June 27
Ladonia julia (Uhler)	1	2	July 5– July 14
**Basiaeschna janata* (Say)	5	3	June 16–July 13
**Ophiogomphus colubrinus* Selys	1	2	July 3–July 16
Hagenius brevistylus Selys	2	5	July 7-July 10
Macromia illinoiensis Walsh	1	1	July 5
Dorocordulia libera (Selys)	1	1	July 2
**Aeschna canadensis* Walker		1	July 26
**Aeschna interrupta* Walker	1	2	July 18–August 30
**Sympetrum obtrusum* (Hagen)	1		July 20
Sympetrum costiferum (Hagen)	1		August 6
**Aeschna umbrosa* Walker	1		August 30
Zygoptera			
Argia moesta Hagen	1		July 19–August 12
Lestes forcipatus (Rambur)	1		" "
**Lestes disjunctus* Selys		2	" "
**Lestes congener* Hagen		1	" "
Enallagma hageni Walsh		1	" "

*Present in list of Walker, 1940.

Most of the material was collected in June and early July; males and females occurred in almost equal numbers. In his book *The Odonata of Canada and Alaska* (Vol. 1, 1953; University of Toronto Press) Walker noted the presence of parasitic water mites or Hydracarina on dragonflies of still waters. Similar but undetermined mites were seen at Cedar Lake, but only on the adults of the species *Leucorrhinia hudsonica*. As many as 13 were collected on the ventral surface of adults.

A large gomphid, *Hagenius brevistylus*, was observed feeding upon smaller dragonflies of the genus *Tetragoneuria*. The empty nymphal skins of *H. brevistylus* were frequently found attached to trees as far as 35 feet from the water.

DENNIS C. WIGHTON
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13 March 1959

Revision of Some Anisian (Middle Triassic) Ammonoids*

THE writer is at present engaged in a revision of "A Middle Triassic (Anisian) Fauna . . ." Geol. Surv. Canada Pap. 46-1, 2nd ed., 1948). A new genus or subgenus is required for a group of species, including *Gymnotoceras helle* McLearn and *G. varium* McLearn referred in this paper to *Gymnotoceras* Hyatt in a broad sense. These species differ chiefly from species of true *Gymnotoceras* in lack of a ventral keel and from typical but not all *Gymnotoceras* in the possession of a semilateral or subumbilical row of bullae or tubercles. They lack the ventrolateral row of tubercles of *Frechites*. "*Ceratites*" *hayesi* McLearn has different inner whorls from those of German *Ceratites* and should be referred to a new genus, family Hungaritidae Waagen. The smooth oxycones like "*Hungarites*" *ovinus* McLearn, "*H.*" *mackenzii* McLearn and "*H.*" *nahwisi* McLearn, without the typical *Longobardites* suture line, require a new genus or *Longobardites* must be expanded to comprise them.

In species like "*H.*" *larvalis* McLearn and a recently discovered new species, carinate-ribbed tuberculate inner whorls, so characteristic of very early ontogeny of some variants of *Longobardites nevadanus* Smith, are carried to a late stage in the ontogeny before passing into a very late, smooth oxycone or near-oxycone stage and without a typical *Longobardites* suture line. These species require a new generic name, or else *Groenlandites* Kummel should be expanded to a very broad genus to receive them.

F. H. MCLEARN
Geological Survey
Ottawa, Ontario
22 October 1959

*Published with the permission of the Director of the Geological Survey of Canada.

Display of the Pelagic Cormorant

AS A description of the display of the Pelagic Cormorant *Phalacro-corax pelagicus* does not appear in Bent (Life history of North American petrels and pelicans and their allies. U.S. nat. Mus. Bull. 121, 1922) nor in any other work that I have seen, the following notes seem worth recording. Whether the birds I observed were *P. pelagicus pelagicus* or *P. p. resplendens* could not be determined. The flock showed no difference in size and it was too far away for me to see the color of the sheen. Probably they were the latter, because *P. p. resplendens* nests in the neighborhood and the date is late for the other.

On 14 May 1949 a small flock of some eight birds in Comox Bay, Vancouver Island, appeared to be acting in a rather unusual manner. When first seen they were swimming in close formation, not diving nor suggesting any hostility, despite the fact that these cormorants generally resent the presence of others of their kind in the immediate locality. Only one bird went through the form of display which consisted of first flapping the wings slowly some nine or ten times then elevating the head with neck stretched out and the beak pointed upwards. In this position there was some

movement of the head in a sideways direction but not excitedly as seen in the case of some of the ducks. The bird then flapped its wings and raised its rump well above the water level. After lowering the rump it threw the wings forward with more rapid flapping then subsided to normal.

The displaying bird did not move towards or in any way appear to be interested in any other member of the flock, none of which showed hostility or even interest. The performance was repeated three times during my observation with a 20-power telescope. After this last performance the bird joined the others, which were scattered by this time and were apparently diving after food. Later the flock came together in a loose formation and one bird wagged its head sideways as before but no other action took place.

At least one bird showed the white filaments on the head but I did not notice this until after the display so I cannot say if it was the bird that displayed.

THEED PEARSE

Comox, British Columbia
17 December 1958

Feeding Habits of the Bewick Wren

THE BEWICK WREN *Thryomanes bewickii* is regarded as an insect eater. It will, however, take other food. All through the winter and as long as the food was available, two of them, presumably a pair as there was a nest, later, close to the station, regularly frequented my feeding station, taking the only food offered: peanut hearts. It was interesting to see how ill-adapted the wren's beak is for picking up these small grain particles from a smooth floor (of the verandah). The bird had to go through two motions, first picking up the grain particle in the tip of the beak and then working it back to swallow. This action is quite different from that of the regular seedeaters, which just pick up and swallow in the one motion. Though much smaller than other feeding birds such as Juncos (*Junco oreganus*) and Towhees (*Pipilo erythrophthalmus*), the wren held its own and was never aggressive.

According to the analyses of stomach contents (Bent, Life history of North American wrens and other species. U.S. nat Mus. Bull. 186, 1958) the Bewick Wren would appear to be almost entirely insectiverous.

A peanut heart is the germ of the nut (*Arachis hypogaea*) that has to be removed before the rest of the nut can be processed. I find it an attractive food for birds the size of the Steller's Jay and smaller. It is also very cheap as it is a waste product.

THEED PEARSE

Comox, British Columbia
17 December 1958

REVIEWS

Trackways of Living and Fossil Salamanders

By FRANK E. PEABODY. Berkeley, University of California Press, 1959. $1.50 (Univ. Calif. Publ. Zool. 63:1-72)

Any information concerning extinct faunas is of great value to zoogeographers, and herpetological paleontology has contributed much in this respect. A particularly productive branch of this subject is ichnology, the study of fossil foot tracks. Many fossil trackways of salamanders are available because these animals moved with a slow and deliberate gait and tended to travel after rains when their tiny feet made fine impressions in the soft mud. The author's study is concerned with trackways from the lower Pliocene of California. He compared these tracks with a reference collection of trackways made by living salamanders. His analysis of these imprints is perfected

to a degree whereby he can identify the tracks to species. It is a great tragedy that the author died so soon after pioneering this unique aspect of paleontology.

His study established the first fossil record for the salamander family Plethodontidae, the first Tertiary record for the Salamandridae in the New World (except for one skeleton from Oligocene), and the first Tertiary record of Ambystonidae in western North America. Most significant is that an association of three modern genera can be recognized, indicating the antiquity (early Pliocene) of this modern salamander community. It follows that the endemism of west coast salamanders is of ancient origin.

J. SHERMAN BLEAKNEY
Acadia University

Field Studies of Amphibians in Colombia, South America

By ROBERT C. STEBBINS and JOHN R. HENDRICKSON. Berkeley, University of California Press, 1959. 85 cents (Univ. Calif. Publ. Zool. 56:497-540)

It is always refreshing to read the herpetological contributions of R. C. Stebbins because of his originality and penetrating thoroughness. The present work is truly a study and not merely a brief annotated list of specimens caught. The authors did not attempt to collect as many forms as possible, but concentrated on collecting data pertaining to habitat preferences, temperature preferences, behavior and habits, life histories and life colors. They studied two populations of the same lowland species separated by a mountain barrier and were able to find small differences in all species but one.

This publication is a model for field collectors who wish to gather much valuable data with their specimens. It is rather a matter of the *field list* versus the *field facts*. Certainly if we are to unravel zoogeographical problems over space and time then more knowledge must be gained of the total biology of living creatures.

J. SHERMAN BLEAKNEY
Acadia University

The Fresh-Water Fishes of British Columbia

By G. CLIFFORD CARL, W. A. CLEMENS and C. C. LINDSEY. 3d ed., rev. Victoria, Queen's Printer, 1959. (Obtainable from the Provincial Museum of Natural History and Anthropology, Victoria, B.C.) 192 p. 75 cents (B.C. Provincial Museum Handbook No. 5)

Extensive revision has added valuable material to an already useful handbook. The most noticeable addition is a series of maps portraying geographical distribution. These maps, covering most of the species, should be of interest both to the angler and to the scientist. Some of the keys have been considerably modified by the inclusion of inset illustrations and new diagnostic characters; a key to young salmonids is presented. These keys should increase the ease of identification. Improvement has also been made by the replacement of some of the illustrations. Nomenclature has been brought up to date. The sections describing life history and morphology of the fishes have been expanded.

A new feature, "diagnostic characters," found under each species, will be useful in confirming identifications. An index has also been added.

Several new species for the province have been added. This edition includes 70 fresh-water species and subspecies (as against 63 in the last edition), 2 marine species that enter fresh water and 10 possible additional species. No other information except range is given for the marine species; and it would be helpful if these species had been included in the keys.

Although the size of the handbook is convenient for pocket, fishing-gear box or packsack, the paper binding will not stand hard handling. Most users would probably be willing to pay slightly more than the low price of seventy-five cents to obtain a hard waterproof binding (perhaps similar to that of Hubbs and Laglar, *Fishes of the Great Lakes Region*).

The obvious care with which this book has been written, the new material,

the useful keys, maps and notes on each species and the reasonable price make this book a worthwhile purchase, even to those who possess the old edition. One may also learn how to catch flathead chub using soap flakes and dog food.

D. E. McALLISTER
Curator of Fishes
National Museum of Canada

Vascular Plants of the Pacific Northwest Part 4: Ericaceae through Campanulaceae By C. LEO HITCHCOCK, ARTHUR CRONQUIST and MARION OWNBEY. Seattle, University of Washington Press, 1959. 510 p. $12.00.

This is the second published volume of a five-part series of the flora of Washington, northern Oregon, Idaho north of the Snake River, the mountainous region of western Montana and southern British Columbia. The family sequence follows the Engler and Prantl system and covers the Gamopetalae with the exception of the Compositae (Part 5), written by Arthur Cronquist and published in 1955. In Part 4 the families from Ericaceae through Cuscutaceae are treated by C. Leo Hitchcock; Arthur Cronquist completed the remainder with the exception of *Castilleja* which was prepared by Marion Ownbey.

This volume, like part 5, includes descriptions for all taxa, keys for genera, species, and subspecies, and full references for the accepted names and synonyms including the citation of type collections. Under each species there are notes on ecological preference, geographic distribution, and in many of the critical genera or complexes significant discussions on species relationships. Each species has been illustrated and there are over 110 plates of line drawings.

The concept of species is on the whole conservative, a realistic approach considering that a number of the genera and critical groups are in need of a thorough revision. The keys are well prepared and workable; I have checked a number of the genera while identifying an extensive collection of plants from British Columbia. The illustrations by Jeanne R. Janish are excellent. Great care has been taken to depict accurately the floral parts, root systems, types of pubescence, habit, etc.; such characters as the markings on nutlets (Boraginaceae) and seeds (*Phacelia*), and detailed drawings of anthers (*Penstemon*) are usually glossed over in many illustrated floras. It is to be hoped that the drawings for parts 1-3 will be by the same illustrator. The generally accepted common names have been included where available and the chromosome number for many species recorded. As the book was produced by photolithography the choice of type for headings, species, new combinations, references, etc., was limited, and there is a tendency at times for these to be obscured.

The authors have included in the treatment a number of features which might well be followed in more of our manuals. A number of the species used as ornamentals in rockeries, woodland lots, or general gardens, and many more suitable for cultivation, have notes on their horticultural value following the generic descriptions. The inclusion of extensive notes, critical discussions in the taxonomically more difficult groups, and a complete synonymy for each species for the area involved will make this flora an *essential* reference book for years to come. The alphabetical listing of the genera within each family and the species within each genus is a consistent time-saver; many, however, will disagree with such an arrangement as it obscures taxonomic relationships.

The flora was obviously prepared with the professional taxonomist and serious amateur botanist in mind. It is not a hip-pocket manual to be used in the field—part 4 measures 8½ by 11 inches and weighs approximately 3½ pounds. A price of over $50.00 for the five volumes will be well beyond the means of most; however, I strongly recommend this flora to all botanists and especially those in the northwestern United States and British Columbia.

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Excursion Flora of the British Isles
By A. R. CLAPHAM, T. F. TUTIN and E. F. WARBURG. Cambridge, University Press (Toronto, Macmillan), 1959. 579 p. $3.85.

Excursion Flora of the British Isles is a more concise version of the parent book by the same authors, *Flora of the British Isles*. Designed for the use of students and amateurs, it achieves its slim lines by the use of more concise descriptions, omission of such material as pollen-mechanism, life-form, chromosome number and extra-British distribution statements. All figures except those illustrating the glossary have been deleted. Some species not included in the original *Flora* appear in the present book and many "casual" species have been omitted. There are some nomenclatural changes and a few taxonomic changes, all of which will be included in the second edition of the *Flora* when it appears. Through all these changes, the *Excursion Flora* has achieved the dimensions of a field manual so rare today. In fact, it fits quite loosely into my jacket pocket (dimensions: $7\frac{1}{2}$ x $5\frac{1}{4}$ x $\frac{3}{4}$ inches compared to $7\frac{1}{2}$ x $5\frac{1}{2}$ x $1\frac{7}{8}$ inches for the *Flora*).

The arrangement of the book is as follows: Preface, sequence of orders and families, artificial key to families, signs and abbreviations (on a special blue page) and under each family a brief description, a key to genera where required, brief generic description, a key to species, a somewhat longer species description with the scientific name given on the left and the common name on the right. At the back of the book is a glossary preceded by three pages of explanatory figures. The index includes generic, family and common names in two columns to each page.

The keys are of the strictly dichotomous type, which saves a great deal of space, but they are apt to lead the student astray if he is unfortunate enough to have before him a specimen that lacks the characters from which to choose. For example, in the genus *Salix* three keys for pistillate, staminate and leaf material, respectively, would be more practical.

The Cambridge University Press has produced the *Excursion Flora* in the same high standard of the original. The dark-green cover, printing style and paper are the same. As a result, the book is easy to read and the thin paper allows it to fall open at any page without closing, but the print of the reverse page does show through slightly.

The arrangement of families is similar to that of the *Flora*, which considerably modifies the conventional Bentham and Hooker system used widely in Britain. Personally I dislike to see a new scheme introduced into a flora of this evident importance because in recent years many such schemes have been proposed each purporting to be evolutionary and each with its respective adherents. To most professionals and serious amateurs a standard system while perhaps not up-to-date from the evolutionary point of view is nevertheless already known by memory, at least with respect to the major families.

In spite of this criticism, which is a personal one, I feel that the *Excursion Flora* meets with the same high standard of workmanship achieved by the *Flora* and it is evident that it has been pruned with constant attention to accuracy and the purpose for which it was written. Although the *Excursion Flora* is unlikely to be used as a field manual outside the British Isles, it is evidently a valuable working tool for the identification of introduced plants in Canada in the herbarium.

Now, it occurs to me, what if Canadians had a series of volumes, one for each of the ten provinces, in this style? Well, I would settle for two, one for the East and one for the West.

J. M. GILLETT
Plant Research Institute

Feathers and Flight
By CLARENCE J. HYLANDER. New York, Macmillan, 1959. 214 p. $3.95.

This book is designed to introduce young people to bird study. The first three of its seven chapters explain in simple terms such general aspects of birds as their classification, feathers, colors,

structure, flight, migration, navigation, feeding habits, habitats, courtship, and family life.

The other four chapters, collectively making up the larger part of the book, are entitled "Water Birds," "Birds of Prey," "Small Birds with Unusual Habits," and "Perching Birds". Family groups of birds found in the United States are briefly described and there are short accounts of several species selected from each family.

The information is compiled from up-to-date sources. It is interestingly written and is illustrated with many excellent photographs and drawings, the latter of very uneven quality.

Unfortunately the text is marred by far too many small errors and half-truths that never should have been written in the first place and which in any event should have been 'caught' by an ornithologist editor. The youngster, under the impetus of his new-found enthusiasm, who carefully stalks a Yellow Warbler to see its "streaked brown breast" is going to be disappointed; while the assertion that the Goldfinch has a *black* face will probably give someone a red one. Birds show no respect for international boundaries and the author's easy-way-out system of giving only the United States part of the range of the many birds that are widely distributed also in other countries is likely to mislead his young readers in the States and give beginners in Canada an erroneous idea that few birds are to be found in this country.

W. EARL GODFREY

The Ferns and other Pteridophytes of Iowa

By TOM S. COOPERRIDER. Iowa City, State University of Iowa, no date. 66 p. $1.00 (St. Univ. Ia Stud. nat. Hist.)

This publication is a useful contribution to the study of the flora of Iowa and will certainly be welcomed by both amateurs and serious students of the Pteridophyta of Iowa and adjacent regions. Keys to orders, families, genera and species are given. These are supplemented by references to the numerous line drawings and black-and-white silhouette photographs. Unfortunately not all the species are illustrated. Also, some of the illustrations are not in the same order as the text and for the most part are not adjacent to the text, which makes their consultation somewhat difficult. Synonomy and brief notes on frequency, habitat and occasionally comments on the variety which occurs in Iowa are presented. Specimens are cited only when the species is known from six or fewer stations in the state. Dot maps depicting the occurrence of each species will be most useful to the local student and the phytogeographer.

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Notes on Microscopical Technique for Zoologists

By C. F. A. PANTIN. Cambridge, University Press, 1959. 79 p. $2.00.

As stated in the preface, this little handbook of microscopical technique is designed primarily for use by students. It includes short sections on microscopy, fixation, dehydration, clearing, embedding, sectioning, and staining. There is also a short section on special methods employed for certain types of material such as protozoa and bacteria, and one on drawing, reconstruction and micrometry. Recipes for the common fixatives and stains and step-by-step schedules for dehydrating from these fixatives are given. Although profuse use is made of references to the literature, unfortunately none of the more recent developments in histological techniques are mentioned; the latest reference quoted is 1947.

This book appears to be a reprint of the 1948 edition except that it has a paperback cover, presumably for economic reasons; its life expectancy as a laboratory bench manual will be rather low. An error in the volume number of the reference given on page 4, line 2, has occurred in all three editions of the book.

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Webster's New International Dictionary is the authority for spelling.

References are made by the author-date system. They should be listed alphabetically and typed at the end of the main body of text. For titles in reference matter, abbreviations follow the rules in the *International Code for the Abbreviation of Titles of Periodicals* and the *World List of Scientific Periodicals*.

Other abbreviations should be used sparingly. The better-known terms of measurement follow CSA Specification Z85-1943 *Abbreviations for Scientific and Engineering Terms* or the equivalent of the American Standards Association (Z10.1-1941).

Tables should be titled and numbered consecutively in arabic numerals. Tables and legends for the figures should be placed after the list of references. Each table and all the legends should be on separate pages.

Notes should bear the name of one author only and references in notes should be incorporated directly in the text.

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The CANADIAN FIELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

Articles

Can. Field Nat.	Vol. 74	No. 2	p. 59-146	Ottawa, April-June 1960

THE OTTAWA FIELD-NATURALISTS' CLUB

FOUNDED IN 1879

The objects of the club are to foster an acquaintance with and a love of nature, to encourage investigation and to publish the results of original research and observations in all branches of natural history. The club is a corporate member of the Federation of Ontario Naturalists.

THE CANADIAN FIELD-NATURALIST

Editor: ROBERT A. HAMILTON
K. W. Neatby Building, Ottawa, Ontario

Business Manager: W. J. CODY
Central Experimental Farm, Ottawa, Ontario

Associate Editors: F. J. ALCOCK (Geology), JOHN W. ARNOLD (Entomology), W. A. BELL (Paleontology), J. SHERMAN BLEAKNEY (Herpetology), AUSTIN W. CAMERON (Mammalogy), WILLIAM G. DORE (Botany), J. R. DYMOND (Ichthyology), W. EARL GODFREY (Ornithology), A. G. HUNTSMAN (Marine Biology), A. LAROCQUE (Conchology).

The Canadian Field-Naturalist is published quarterly by the Ottawa Field-Naturalists' Club with the assistance of affiliated societies listed on the inside back cover. Manuscripts representing personal observations or the results of original research in any branch of natural history are invited. In the preparation of papers authors should consult the most recent issue and the information for contributors on the inside back cover. Advertising rates and prices of back numbers of this journal and its predecessors, *TRANSACTIONS OF THE OTTAWA FIELD-NATURALISTS' CLUB*, 1879-1886, and the *OTTAWA NATURALIST*, 1887-1919, are obtainable from the business manager.

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Authorized as second-class mail by the Post Office Department at Ottawa, Ontario

The Canadian Field-Naturalist

Volume 74 APRIL-JUNE 1960 Number 2

COMMENTS ON THE DISTRIBUTION AND MIGRATION OF BIRDS IN FOXE BASIN, NORTHWEST TERRITORIES

Derek V. Ellis* and John Evans†
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During the summers of 1955, 1956 and 1957, the CGMV *Calanus* carried out fishery surveys in Foxe Basin (Figure 1), and one or more of her crew was

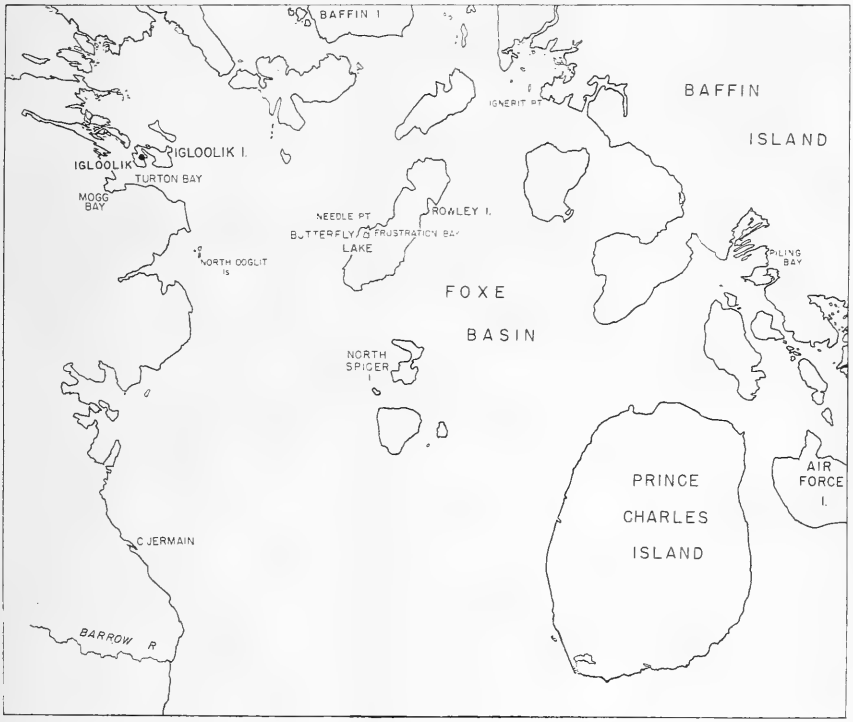

Figure 1. Map of northern Foxe Basin showing localities mentioned in the text.

sufficiently interested in birds to keep notes of the species observed. The *Calanus* is a fifty-foot ketch operated by the Fisheries Research Board of Can-

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Mailing date of this number: 11 July 1960

ada, and it has been working in the Eastern Canadian Arctic every summer since 1947 (Dunbar, 1956). The crew normally consists of between four and six men (a skipper, an engineer, one or two scientists, and one or two student assistants). This paper combines their ornithological observations through three years in Foxe Basin in an attempt to add available knowledge about the distribution and migration of birds in the area.

In September 1955 the *Calanus* was taken from Southampton Island northward along the west coast of Foxe Basin to Turton Bay in Igloolik Island, where it was permitted to freeze in for the winter. Two of the crew, Bill Black and Ian McLaren, left the ship to return to Montreal, while Ted Grainger and Skipper Hans Andersen remained on board to continue biological research through the winter. Ornithological observations in Foxe Basin during 1955 therefore covered the fall migration and the winter of 1955-1956.

The following spring John Evans arrived at Igloolik on May 27 to help in the expanding research program, and the remaining members of the 1956 expedition arrived later: Tom Wilson, Dan Perey and John Skidmore. During June and July, Evans and the others made short trips by dog sledge to the floe edge east of Igloolik Island, on foot across the island, and by whaleboat to other islands nearby. On August 4 the *Calanus* left Igloolik, and afterwards traveled to different places in northern Foxe Basin carrying out her summer program. She finally reached Frustration Bay, Rowley Island, on September 17, and was pulled onto land above high-water level a few days later. The entire expedition then left the ship and returned by air to Montreal. Ornithological observations in 1956 therefore covered the spring arrival of migrants at Igloolik Island, and include scattered records of birds in northern Foxe Basin throughout the summer.

On May 18, 1957, Andersen and Ellis flew to Frustration Bay to rejoin the ship. They were joined by Evans on June 29, and by Black and Wilson on July 24. Although the *Calanus* was pushed back into the water, she was unable to leave Frustration Bay owing to unusually dense pack ice all summer, and so had to be pulled back onto land for a second winter on Rowley Island. Wilson and Ellis flew south on August 30, Evans and Black remained at Frustration Bay until September 15, and Andersen a few days later. From mid-May to mid-September one or more of the crew was traveling daily and collecting in the bay or its immediate vicinity. The ornithological observations in this area extended from before the arrival of most migrants until after many had departed.

We have been fortunate in having the opportunity to refer to two sets of manuscript notes on birds in Foxe Basin. One was compiled by Tom Manning and Andrew MacPherson as a report to the Department of Mines and Technical Surveys, Ottawa, after the exploration cruise of the CGMV *Nauja* in 1949. The *Nauja* entered Foxe Basin from the southeast in August, took an anticlockwise course around the basin and left through the southwest in September, having stayed at the following localities en route: SW Prince Charles Island (August 16-18), NW Prince Charles Island (August 20-22),

NW Air Force Island (August 23-27), Piling (August 29-September 3), North Spicer Island (September 6), Rowley Island (September 8), Near Ignerit (September 9-11), Cape Jermain (September 17), and Barrow River (September 18). Observations were made at all these localities and at sea in between; the period of these observations coincides with the beginning of the fall migrations. The other set of notes from Foxe Basin was compiled by the scientists and officers on board HMCS *Labrador* during her 1955 and 1956 expeditions to the Canadian Arctic. A preliminary report of the expeditions has been prepared by N. J. Campbell and A. E. Collin as manuscript report No. 13 of the Fisheries Research Board of Canada.

Distribution and breeding records from the *Calanus* and *Nauja* expeditions are summarized in Table 1.

Northern Foxe Basin has hardly been investigated by professional ornithologists, although birds from the region have been described occasionally. Reports from the area include Parry (1824), Hørring (1937), and Bray (1943), plus a few brief comments in Wynne-Edwards (1952), and Ellis (1956). Manning (1943) has written a brief history of exploration of the Basin. Two recent books, *Arctic Birds of Canada* (Snyder, 1957) and *The Arctic Year* (Freuchen and Salomonsen, 1958), contain much information about the region.

Identifications have been largely based on sight records and so, with the exception of Thayer's Gull (see Table 1), are given to species, not subspecies. Names agree with the checklist of the American Ornithologists' Union (1957). Ice terminology follows Armstrong and Roberts (1956), with the exception of the term *floe edge*, which is used in this paper to mean *the edge of the winter ice bound fast to the shore.* This convenient expression is used throughout the Canadian Arctic, by residents and scientists alike, although it has not been adopted for international usage.

Finally we wish to express our gratitude to the other crew members of the *Calanus*, who have contributed data to this paper, particularly to Ian McLaren for most of the 1955 observations; and also to the other personnel of the Arctic Unit of the Fisheries Research Board of Canada for their co-operation during all phases of this work. We are also indebted to Tom Manning and Andrew MacPherson for bringing to our attention their extensive bird notes from Foxe Basin and permission to publish some of their data, and to Neil Campbell of the Atlantic Oceanographic Group for turning over to the Arctic Unit a report of bird observations from HMCS *Labrador.*

OBSERVATIONS DURING 1955

These observations are of interest in revealing some of the species which remain late in high-arctic regions as winter approaches. From September 19 to October 30 McLaren and Black recorded birds in and around Igloolik Island. At that time of year snow had covered the frozen ground, and ice was beginning to form in the bays and inlets. The birds seen were generally marine forms. A white-winged (Glaucous?) gull was seen on September 20, 4 Guillemots and 6 Dovekies on September 24, another Dovekie on October 4, at least 4 Ivory Gulls on October 7 and several more Ivory Gulls through October until the

TABLE 1. SUMMARY OF DISTRIBUTION AND BREEDING RECORDS DURING CALANUS AND NAUJA EXPEDITIONS TO FOXE BASIN

	Calanus records					*Nauja* records							
	Igloolik Island and vicinity	North Ooglit Island	Mogg Bay	Frustration Bay and Butterfly Lake	East Melville Peninsula 68° 45'N 81° 13'W	SW Prince Charles Island	NW Prince Charles Island	NW Air Force Island	Piling	North Spicer Island	NE Rowley Island	Ignerit	Cape Jermain	Barrow River
Common Loon, *Gavia immer* (Brünnich)	–	–	–	–	–	–	–	–	x	–	–	–	–	–
Arctic Loon, *Gavia arctica* (L.)	–	–	–	x	–	b	–	–	–	b	–	–	–	–
Red-throated Loon, *Gavia stellata* (Pontoppidan)	b	x	–	x	–	b	b	x	x	x	–	–	–	–
Brant, *Branta bernicla* (L.)	b	x	–	–	b	x	x	x	–	–	?	–	–	–
Snow Goose, *Chen hyperborea* (Pallas)	x	x	–	x	–	–	–	x	x	–	x	–	–	–
Blue Goose, *Chen caerulescens* (L.)	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Oldsquaw, *Clangula hyemalis* (L.)	b	b	x	b	x	x	–	x	–	–	x	–	x	–
Common Eider, *Somateria mollissima* (L.)	b	b	–	x	–	–	–	–	–	–	–	–	–	–
King Eider, *Somateria spectabilis* (L.)	b	x	–	b	?	b	x	x	?	–	?	?	?	–
Rough-legged Hawk, *Buteo lagopus* (Pontoppidan)	–	–	–	–	–	–	–	–	–	–	–	–	–	x
Gyrfalcon, *Falco rusticolus* L.	x	–	–	x	–	–	–	x	b	–	–	–	–	x
Peregrine Falcon, *Falco peregrinus* Tunstall	x	–	–	?	–	–	–	–	–	–	x	x	–	x
Willow Ptarmigan, *Lagopus lagopus* (L.)	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Rock Ptarmigan, *Lagopus mutus* (Montin)	–	–	–	–	–	b?	–	–	–	–	–	–	–	–
Semipalmated Plover, *Charadrius semipalmatus* Bonaparte	–	–	–	x	x	–	–	–	–	–	–	–	–	–
American Golden Plover, *Pluvialis dominica* (Müller)	–	–	–	x	?	b	x	x	–	–	–	–	–	–
Black-bellied Plover, *Squatarola squatarola* (L.)	b	–	–	x	?	x	–	?	–	–	–	–	–	–
Ruddy Turnstone, *Arenaria interpres* (L.)	b	x	b	x	–	–	–	–	–	–	–	–	–	–
Whimbrel, *Numenius phaeopus* (L.)	–	–	–	–	–	?	–	–	–	–	–	–	–	–
Purple Sandpiper, *Erolia maritima* (Brünnich)	x	–	–	b	–	x	x	x	–	x	–	x	–	–
Pectoral Sandpiper, *Erolia melanotos* (Vieillot)	–	–	–	–	–	x	–	–	–	–	–	–	–	–
White-rumped Sandpiper, *Erolia fuscicollis* (Vieillot)	b	–	–	x	x	x	x	x	–	x	–	–	–	–
Baird's Sandpiper, *Erolia bairdii* (Coues)	x	–	–	?b	x	–	–	–	b	–	–	–	–	–
Dunlin, *Erolia alpina* (L.)	x	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE 1. (*Continued*)

	Calanus records					*Nauja* records								
	Igloolik Island and vicinity	North Ooglit Island	Mogg Bay	Frustration Bay and Butterfly Lake	East Melville Peninsula 68° 45'N 81° 13'W	SW Prince Charles Island	NW Prince Charles Island	NW Air Force Island	Piling	North Spicer Island	NE Rowley Island	Ignerit	Cape Jermain	Barrow River
Semipalmated Sandpiper, *Ereunetes pusillus* (L.)	–	–	–	b	–	x	–	–	–	–	–	–	–	–
Hudsonian Godwit, *Limosa haemastica* (L.)	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Red Phalarope, *Phalaropus fulicarius* (L.)	b	x	–	b	?	x	x	x	x	–	x	–	x	–
Pomarine Jaeger, *Stercorarius pomarinus* (Temminck)	x	–	–	x	x	–	–	b	–	–	–	–	–	–
Parasitic Jaeger, *Stercorarius parasiticus* (L.)	b	–	b	x	–	x	x	x	x	x	x	–	–	–
Long-tailed Jaeger, *Stercorarius longicaudus* Vieillot	b	x	b	x	–	x	x	–	x	–	–	–	–	–
Glaucous Gull, *Larus hyperboreus* Gunnerus	?	–	–	x	x	–	x	–	b	–	–	x	–	x
Herring Gull, *Larus argentatus* Pontoppidan	b	?	–	x	?	x	x	x	x	x	x	x	x	–
Thayer's Gull, *Larus argentatus thayerii* Brooks*	?	?	–	?	?	–	–	–	–	–	–	–	–	–
Ivory Gull, *Pagophila eburnea* (Phipps)	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Sabine's Gull, *Xema sabini* (Sabine)	b	b	–	b	x	b	b	–	–	–	–	–	–	–
Arctic Tern, *Sterna paradisaea* Pontoppidan	b	b	–	b	–	b	b	b	–	–	x	–	–	–
Dovekie, *Plautus alle* (L.)	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Black Guillemot, *Cepphus grylle* (L.)	b	b	–	x	–	–	–	–	x	x	x	–	–	–
Snowy Owl, *Nyctea scandiaca* (L.)	–	–	–	–	–	–	–	x	x	–	x	–	–	–
Horned Lark, *Eremophila alpestris* (L.)	x	–	x	x	–	x	–	–	x	–	–	x	–	–
Water Pipit, *Anthus spinoletta* (L.)	–	–	–	–	–	x	x	–	x	–	–	x	–	–
White-crowned Sparrow, *Zonotrichia leucophrys* (Forster)	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Lapland Longspur, *Calcarius lapponicus* (L.)	x	–	–	b	x	x	x	x	x	x	x	x	–	–
Snow bunting, *Plectrophenax nivalis* (L.)	x	x	–	b	x	x	x	x	x	x	x	x	–	–

*Thayer's gull is called *Larus argentatus thayerii* here in agreement with the A.O.U. checklist, although Thayer's gull may be considered a distinct species from the Herring gull. They can usually be distinguished in the field.

x—presence recorded. ?—tentative indentification . b—nests or juveniles recorded.

27th. By that time the sea around the island was covered by surface ice and the nearest open water was at the floe edge to the east of Igloolik Island.

On October 30, McLaren saw a white-phase Gyrfalcon in Igloolik village and this bird, when flying away, disturbed a flock of 7 Snow Buntings.

OBSERVATIONS DURING 1956

The arrival of birds at Igloolik Island

The only birds seen near Igloolik Island during the winter of 1955-1956 were Black Guillemots at the floe edge east of the island. The first spring arrivals were eider ducks (probably King Eiders), which were first seen on April 11 in large flocks at the floe edge and often afterwards. On April 17 Snow Buntings were seen near the *Calanus* but were not noticed again until June 8 at the floe edge. Common Eiders were seen on June 5, and the next day birds were seen in large numbers. There was a flock of about 300 gulls belonging to the Herring - Thayer's Gull complex (see page 66) and many Oldsquaws at the floe edge. A Peregrine Falcon, Baird's Sandpipers, one Dunlin, and Lapland Longspurs were seen on June 8 and Glaucous Gulls tentatively identified. On June 14 groups of Long-tailed Jaegers and a pair of Black-bellied Plovers were seen. Red-throated Loons, Brant, Snow Geese, Ruddy Turstones, Parasitic and Pomarine Jaegers, Sabine's Gulls, and flocks of Arctic Terns were seen on June 18, and Red Phalaropes on June 20.

The spring arrival of birds was therefore spread over several weeks. The eiders arrived early in April, but most other sea birds during the second and third weeks of June. Snow Buntings also arrived about the middle of April, with other land birds almost two months later.

Most sea birds arrive in the arctic regions before the land clears sufficiently of snow to permit them to nest. After their arrival they may spend several weeks swimming and flying along the floe edge, making short flights inland or over the shore-fast ice. Some species, such as King Eiders, Oldsquaws and Arctic Terns, spend much of this period sitting or standing on the ice at the floe edge. The first signs of birds moving inland at Igloolik Island were noticed on June 18 when Evans saw Turnstones and Long-tailed Jaegers. By June 25 and 26 King Eiders and Oldsquaws had started to settle on small pools; pairs of these birds were first noticed on June 29. During the last week of June many different species were seen inland. In addition to the species already mentioned they included Red-throated Loons, Black-bellied Plovers, Red Phalaropes, Herring Gulls, Sabine's Gulls, and Arctic Terns.

North Ooglit Island

Evans traveled to this island on July 4 in an Eskimo whaleboat. At the island's floe edge he saw about 100 Black Guillemots and between 1,000 and 2,000 male King Eiders. Inland on gravel patches he saw a pair of Ruddy Turnstones, about 200 Sabine's Gulls and the same number of Arctic Terns; scattered over the tundra about 30 Common Eiders, 40 Oldsquaws, and 20 Snow Buntings; on ponds 10 Brant, 2 Snow Geese, 2 Red-throated Loons, and 6 Red Phalaropes. He also noticed single Long-tailed Jaegers, and Herring

(or Thayer's) Gulls flying, plus nests of Common Eiders, Oldsquaws, Sabine's Gulls, Arctic Terns, and Black Guillemots (under boulders).

Mogg Bay

Evans visited Mogg Bay by Eskimo whaleboat on July 18 and 19 and saw about 50 Oldsquaws in the mouth of the bay, a single Horned Lark, a single pair of nesting Parasitic Jaegers, Long-tailed Jaegers, and Ruddy Turnstones.

OBSERVATIONS DURING 1957

The arrival of birds at Frustration Bay, Rowley Island

Andersen and Ellis arrived at Frustration Bay on May 19. Some migrant birds had preceded them. There were enormous flocks of large ducks flying along the floe edge on the west coast of Foxe Basin at latitude 68°30'N. Presumably these were King Eiders. In Frustration Bay itself the only signs of birds were a few ptarmigan tracks in the snow. The tracks were probably made by Willow Ptarmigan, which was the only species of ptarmigan seen during the summer.

The next arrivals were Snow Buntings, which were first heard on May 21, and finally seen on May 29. Flocks were seen repeatedly until June 6, but afterwards the buntings occurred only singly, in pairs, or in small groups. On May 29 a large dark bird flew rapidly by the ship and was tentatively identified as a Peregrine Falcon. This early record for a predatory bird is not improbable; many arctic residents maintain that "hawks" are amongst the first spring arrivals.

The next day, May 30, Ellis saw 2 gulls circling over his sledge as he traveled overland by the Butterfly River. Two days later numbers of gulls were seen in different places near the ship. Most of them were either Herring or Thayer's gulls but there were also a few Glaucous Gulls. A single Sabine's Gull was seen on June 3, but no more until June 10.

On June 5 Andersen and Ellis reached the floe edge for the first time and saw King Eiders and Oldsquaws there. Jaegers were first seen on June 7 and 8 but could not be identified to species on those days. On June 10 after 4 days of strong southerly winds, Andersen and Ellis again collected at the floe edge and saw literally thousands of birds. King Eiders and Oldsquaws were most numerous, occurring in countless flocks of up to several hundred birds. The two species were usually separate, but mixed flocks were seen. At least 2 male Common Eiders were seen in one flock of Kings. There were flocks of up to several hundred Red Phalaropes, and smaller, looser groups of Arctic Terns with occasional Sabine's Gulls. Black Guillemots occurred singly or in small groups flying and swimming amongst drifting ice. A single Ruddy Turnstone was also seen.

After the first mass arrival of sea birds on June 10, others appeared in a less spectacular fashion. An unidentified goose was seen on June 12, loons were first seen on June 14, Lapland Longspurs on June 15, White-rumped Sandpipers on June 16, Semipalmated Plovers, Black-bellied Plovers and Purple Sandpipers on June 17. A number of other species were seen later, but June 17 was the last date that probably agreed with the arrival date of any species.

Most of the smaller birds seemed to arrive during the week of June 10-17, shortly after the sea birds appeared at the floe edge.

Frustration Bay

The winter cover of snow and ice in Frustration Bay started to melt early in June; and, as the sea ice began to crack later in the month, large pieces of it broke away from the floe edge. In July the fast ice melted along the shores and the ice cover floated freely in the bay. It was prevented from drifting away immediately by very close pack ice which had pressed into the floe edge in the middle of June. This pack ice and the bay ice remained in Frustration Bay until late August, preventing the *Calanus* from leaving her winter quarters.

Shortly after the spring arrival of sea birds on June 10 the number of species and individuals at the floe edge began to decrease. In particular, the flocks of Red Phalaropes left the floe edge and were afterwards seen only in pairs or small groups inland.

Ducks remained longer at the floe edge. Flocks of Oldsquaws were seen in Frustration Bay until July 17, although many moved inland during late June. Evans and Wilson also saw large flocks, apparently immatures, on August 9 south of the bay. Breeding pairs of this species left the floe edge during June, although returning intermittently to feed, and the flocks seen afterwards were possibly nonbreeding or immature birds.

Pairs of King Eiders were seen inland during late June, but in July there were still flocks of them in Frustration Bay and offshore. In the middle of July these flocks changed their character. Up to that time they had consisted of several hundred birds or less of both sexes, but they were replaced by vast flocks consisting of several thousand males in breeding plumage. The big flocks of males were last seen on July 20 although a few smaller groups were noticed until July 31. Afterwards only small groups of brown eiders (immatures, nonbreeding females or juveniles) were seen. The general pattern of King Eider distribution during the summer therefore seemed to be as follows. Flocks of up to several hundred male and female birds occupied the floe edge during May and June. Pairs of breeding birds moved inland at the end of the latter month. Males returned to the sea in July and assembled in large flocks offshore. They left at the end of the month. Nonbreeding birds and immatures remained offshore throughout August and were joined by juveniles and females towards the end of the month.

A few species of sea birds remained constantly in Frustration Bay throughout the summer. Every day screeching flocks of Arctic Terns could either be seen or heard in the bay, particularly at Needle Point where the turbulent water provided a continuous supply of marine food. Loons were fairly common throughout the summer. A few Red-throated Loons were seen almost every day, but Pacific Loons were rarer.

At least 3 species of gulls occurred in Frustration Bay. Sabine's Gulls were the rarest, being seen only occasionally. The majority of large gulls had a dark mantle with black or brown primaries and belonged to the Herring-Thayer's Gull complex. One adult specimen, which was collected, had glaring

yellow eyelids and was identified as a Herring Gull, while another collected specimen was an immature bird with flesh-colored eyelids; it was tentatively called a Thayer's Gull. Most of the gulls were not identified specifically. They concentrated in late May and early June at the garbage dump, but later around the fish-drying racks near the ship and at the small fishing lake. A pair of these gulls was seen frequently along the lower part of Butterfly River and may have nested there. No other signs of nesting were noticed. A few of the large gulls seen during the summer were identified as Glaucous Gulls.

Black Guillemots were seen at the floe edge only in June and early July. They probably left the vicinity of Frustration Bay shortly after they were last seen there.

Butterfly Lake and vicinity

The arrival of most birds in this region coincided with the spring thaw. Between June 10 and 17 much snow melted and streams began to flow. Land vegetation appeared through the snow cover, and a few days later insects began to appear. Once the snow melted the nature of the land became apparent. There was fertile ground with abundant vegetation around the rivers, but these patches were separated by gravel ridges, which in many places were entirely barren although they generally had a sparse vegetation. Birds usually kept to the valleys but a few were encountered on the ridges. A pair of Semipalmated Sandpipers nested at the side of one ridge running along the west shore of Frustration Bay and terminating at Needle Point. Four eggs were laid between July 11 and 12; three of these hatched on August 2 but the other was deserted.

A valley extended from the head of Frustration Bay to Butterfly Lake and beyond. This valley was regularly walked by the crew of the *Calanus* in order to tend gill nets along the length of Butterfly River. Snow Buntings and Lapland Longspurs were seen regularly in the valley, and also shore birds, including Semipalmated Plovers, Black-bellied Plovers, Ruddy Turnstones, Semipalmated Sandpipers, White-rumped Sandpipers, Purple Sandpipers, and Red Phalaropes. Nests of Snow Buntings and Red Phalaropes were found. The Snow Bunting's nest was first seen on June 28 with 5 eggs, the young hatched on July 11 and left the nest on July 22, although they remained near the nest for some time afterwards. The Red Phalarope's nest was first seen on July 11 with four eggs, and the young were found about 50 yards from the nest on July 24. They were not seen again. Juvenile Purple Sandpipers, Baird's (?) Sandpipers, Lapland Longspurs, and Snow Buntings were seen during the summer, the last two species frequently.

Oldsquaws were seen regularly in the valley early in the summer but only one nest was found. Red-throated Loons and Arctic Terns were common. One young tern was seen flying along the river on August 26. Terns actually were ubiquitous in the vicinity of the *Calanus* and fed from a great variety of habitats: in the sea (three stomachs containing fish larvae), along the Butterfly River (one stomach containing Tipulid larvae), and from fresh-water ponds (no stomachs examined but the ponds were rich with a variety of Entomostraca).

Less regularly seen in the valley were three species of jaegers (Long-tailed, Parasitic and Pomarine), Pacific Loons, Sabine's Gulls (one juvenile seen), and Willow Ptarmigan. An unusual record was a small sparrow seen on July 6 and again the next day. It was identified as a White-crowned Sparrow, both by its striped crown and by its song.

A second valley to the west of Butterfly Lake had a similar but more abundant bird population. Ruddy Turnstones, Black-bellied Plovers and Red Phalaropes in particular were far more abundant than in the Butterfly River valley. A single Horned Lark was seen on July 7.

Black and Wilson walked to the east coast of Rowley Island in the same latitude as Frustration Bay on August 20. They saw a flock of about 30 Snow Geese (Lesser?) and two Blue Geese, a group of Sabine's Gulls, and Purple Sandpipers.

The west coast of Foxe Basin, latitude 68° 30′ N

Ellis and Wilson were detained four days in this region from August 31 to September 4 while returning to Montreal by aircraft. The coast consists of a series of raised gravel beaches containing many shallow pools and bounded at sea level by stony beaches with mud patches. On August 31 many shore birds were congregated along the coast and the following species were identified: Semipalmated Plovers, Golden or Black-bellied Plovers, Ruddy Turnstones, Baird's Sandpipers, White-rumped Sandpipers, and (Red?) Phalaropes in winter plumage. There were undoubtedly other species present. About 200 gulls, mostly of the Herring - Thayer's Gull complex but also Glaucous Gulls, were gathered around a garbage dump along the shore. A single Sabine's Gull was also seen. A few jaegers (only Pomarine identified), several loons, and small groups of Lapland Longspurs and Snow Buntings were also seen.

About 300 ducks were scattered in an unnamed bay along this coast, in the water, on pieces of ice, and on shore. Most of these were eiders in small groups of 1 or 2 females with juveniles, but there were also several flocks of Oldsquaws. A flock of about 200 Brant and several smaller flocks were disturbed on shore. The large flock, at least, contained both adults and juveniles.

From all appearances the birds observed during this period had left their summer haunts and were assembling along the coast prior to migrating south.

The departure of birds from Frustration Bay

The first sign of departing birds in 1957 was the appearance of flocks of up to a hundred male King Eiders flying up and down the Butterfly River during the period July 6-22. Rowley Island is in the same latitude as Clyde River, Baffin Island, where Wynne-Edwards (1952) saw hundreds of migrating King Eiders flying eastwards between July 14 and August 17, 1950. He postulated that the Clyde River valley was a major migration route for male King Eiders traveling from Arctic Canada to Disco Bay in West Greenland. The departure of males during late July, possibly crossing Rowley Island via the Butterfly River, fits neatly into the pattern of migration suggested by Wynne-Edwards.

The next indication of the fall migration was the appearance in early August of a larger number of shore birds along the Butterfly River than had been seen there during June and July. Small groups of the resident species, which previously had occurred only in scattered pairs, were seen almost daily along the river banks. In addition Golden Plovers were seen regularly, and of course many of the shore birds remained unidentified. On August 13 Ellis walked through the valley west of Butterfly Lake and found it almost deserted. In early August, also, Snow Buntings and Lapland Longspurs began to form small groups along the Butterfly River.

In late August and the first week of September Evans and Black were still able to observe a few birds near Frustration Bay. They included Red-throated and Pacific Loons, plovers (Black-bellied or Golden) and Ruddy Turnstones, unidentified jaegers and gulls (including 1 juvenile Sabine's Gull), Arctic Terns, Lapland Longspurs, and Snow Buntings. A single Gyrfalcon and a Snowy Owl were seen on September 7, the last day that any observations were made.

CONCLUDING COMMENT

Our observations on migration were few but they indicate the periods during which birds arrive and depart in northwest Foxe Basin.

In both 1956 and 1957 two species – King Eiders and Snow Buntings – arrived early in April or May, but most other species during the first two or three weeks of June. In 1957 the sea birds preceded most of the smaller ground birds by a few days.

We have given some information about the southward migrations in both 1955 and 1957. Male King Eiders were the first obvious departures in 1957, leaving during the last week of July. Manning reports seeing only 1 male in Foxe Basin in August and September, 1949, although he recorded hundreds of brown eiders. In August 1957, many species of shore birds and ducks congregated along the shores preparatory to flying south. Manning noticed the same phenomenon in 1949. A number of species were still present in early September in 1957, and Manning reports seeing flocks of many species during the same period in 1949, particularly Lapland Longspurs and Snow Buntings. He also reported seeing flocks of Red Phalaropes at sea between September 4 and 15.

In 1955 near Igloolik most birds had left by the middle of September, even eiders and Oldsquaws which are known to occur there abundantly during the summer and which can remain late in high-arctic regions. Only a few gulls and alcids were seen at sea; all but a few Black Guillemots left in late September or early October. Snow Buntings and Gyrfalcons stayed almost until the last day of October.

The Dovekies and Ivory Gulls that McLaren saw in the fall of 1955 were probably migrating birds and not residents, as there is no evidence that either species nests in Foxe Basin. Fulmars, Ivory Gulls, Dovekies and Brünnich's Murres have been reported occasionally by several different authors in northern Foxe Basin, presumably in migration from breeding colonies in northern Baffin

Island or even farther north. It is interesting that Kittiwakes, which nest in the same general areas as the preceding four species, have not yet been certainly reported in northwest Foxe Basin.

Black Guillemots were the only species of birds recorded near Igloolik during the winter of 1955-1956.

The most distinctive feature of the marine avifauna of northern Foxe Basin, a feature which was noticeable even during our limited time in the country, and which Manning's notes confirm, was the absence of fulmars, kittiwakes, and alcids other than Black Guillemots; in fact, all species which are completely dependent on the presence of cliffs for nesting sites. These species are amongst the commonest birds offshore on the east coast of Baffin Island, and presumably off any arctic coast where they nest. Their absence from northwest Foxe Basin during 1956 and 1957 is apparently typical. Previous authors either do not mention them or state that they occur rarely; nor do the *Labrador* reports mention them in Foxe Basin. There are few extensive cliffs in the basin which could provide these species with suitable colonial nesting sites. The marine species seen in 1956 and 1957 were all able to utilize flat or hilly land for nesting. Even the Black Guillemot can do this. The nature of the coast in Foxe Basin prevents the sea birds, which require extensive cliff nesting sites, from becoming residents.

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Received for publication 25 November 1958

PLANTS OF THE VICINITY OF NORMAN WELLS MACKENZIE DISTRICT, NORTHWEST TERRITORIES*

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Norman Wells is situated on the east bank of the Mackenzie River (65°17′N 126°51′W) approximately 50 miles downstream from Fort Norman which lies at the mouth of the Great Bear River. On the other side of the Mackenzie River, to the west, is the abandoned Camp Canol. This was the eastern end of the now abandoned Canol Road, which during the second great war was built across the Mackenzie Mountains to meet the Alaska Highway in the Yukon Territory.

My first visit to Norman Wells was on July 21, 1949, when I stopped there for a few hours during a plane trip out of Yellowknife through the courtesy of the Department of Northern Affairs and National Resources. At this time only a limited number of collections were taken. The greatest part of this report is based upon collections and observations made during the period from July 17 to August 21, 1953, when I was accompanied by Mr. R. L. Gutteridge. This work was done as a co-operative project between the Canada Department of Agriculture and the Canada Defence Research Board. Again in 1957 short stops were made here in early June and mid-August, when I was accompanied by Mr. D. H. Ferguson, while en route to and from Aklavik and the Arctic coast.

H. M. Raup (1947) has written extensively on the flora of southwestern Mackenzie District and A. E. Porsild (1943) has made a valuable contribution to our knowledge of the flora of the Mackenzie River delta and the vicinity of Great Bear Lake. Porsild (1945) has also published a paper on the alpine flora of the east slope of the Mackenzie Mountains, which lie just west of our area. Our collections from Norman Wells have thus helped to fill in a large gap in our knowledge of the flora of the Mackenzie River valley. Also, they have in many cases substantiated the early and rather vague data on plant distribution which Hooker (1829-40) published on the basis of the notes and collections of the great naturalist and explorer John Richardson.

The beach of the Mackenzie River at Norman Wells varied in width from a few yards, where the steep eroding banks rise to 35 feet, to some 35 yards, where the land sloped gently away from the water's edge to less precipitous banks. In many places bulldozers had churned up the beach so that there was little or no plant growth. High water and ice action have also limited the number of species. Many driftwood logs that had been carried downstream by the river were to be found along the steep bank, particularly at places where there was a bend in the river. These logs were presumably pushed there by the ice during the spring breakup.

*Contribution No. 1761 from the Botany and Plant Pathology Division, Science Service, Canada Department of Agriculture, Ottawa, Ontario.

Where the beach strip was narrow there was much bare clay and the vegetation was almost entirely restricted to a few patches of *Astragalus yukonis*, *Potentilla anserina* and *Equisetum arvense*. On the broader expanses *Eleocharis macrostachya* covered extensive areas, and in addition to the species listed, clumps of grasses, sedges and *Juncus* were frequent. These plants increased in frequency up the slope from the river to the steeper bank. There were several sewage outlets along the beach. Here the vegetation was more lush and *Rorippa islandica* var. *fernaldiana* and *Epilobium glandulosum* var. *adenocaulon* were quite common.

On July 27 we visited the shoreline of the Mackenzie river near the Royal Canadian Corps Signals Transmitters five miles upstream from Norman Wells. At this date the almost bare gravel sandy beach ranged in width from 10 to 30 yards. A 30° slope beginning at the water's edge gradually increased to nearly 45° near the top of the bank. Scattered *Astragalus yukonis*, *Artemisia caudata*, *Potentilla anserina* and *Equisteum arvense* were found on the beach. These species gradually increased in concentration up the slope. On the upper slope a number of species of *Gramineae* together with large stands of *Hedysarum alpinum* var. *americanum* and some *Solidago canadensis* var. *salebrosa* and low *Salix* spp. were also found. Some driftwood was noted near the top of the bank, and above this line *Salix* spp., *Alnus*, *Populus balsamifera*, *Betula papyrifera* var. *humilis* and *Picea glauca* grew thickly.

The settlement and airstrip at Norman Wells are situated on a low height of land consisting of glacial boulder clay which forms the east shore of the Mackenzie River. Here the original vegetation had almost completely been removed. Much of the cleared area had grown up to *Salix*, *Alnus crispa* and young *Betula*. A fringe of *Populus balsamifera* and *P. tremuloides* together with some *Picea glauca* occurred along some sections of the top of the river bank. Around the airstrip where the shrubs had been kept down the terrain was almost prairielike: *Agropyron trachycaulum*, *A. sericeum*, *Deschampsia caespitosa*, *Poa pratensis* and *Agrostis scabra* were the most common grasses. Also noted here were *Beckmannia syzigachne*, *Puccinellia nuttalliana*, *Carex raymondii*, *C. aenea*, *Arabis hirsuta* var. *pycnocarpa*, *Descurainea richardsonii*, *Dryas crenulata*, *Oxytropis deflexa* var. *sericea*, *Astragalus alpinus*, *A. eucosmus* and *Arctostaphylos uva-ursi*.

The original cover of this terrain was probably quite similar to that of the country on the same low height of land about five miles upstream from Norman Wells near the site of the Royal Canadian Corps of Signals Transmitters. Here there was an open stand of *Picea glauca*; trees were as high as 40 feet and associated with them was *Betula papyrifera* var. *humulis*, which measured up to 35 feet in height. The understory was made up of eight-foot *Alnus crispa*, *Salix* spp. up to 12 feet, the very common *Ledum groenlandicum* which measured up to three feet in height, together with some young *Picea* and *Betula* and an occasional shrub of *Rosa bourgeauiana*. The ground cover was a thick layer of moss and some lichen in which *Vaccinium vitis-idaea* var. *minus*, *Geocaulon lividum* and *Arctostaphylos rubra* were rooted. This area was evidently quite wet early in the year and there were deep holes throughout which made walking extremely treacherous.

A shallow valley cutting through this association maintained a much more varied flora. Here along a winding creek, which measured only three feet in width and a few inches in depth on July 27, scattered *Picea glauca* grew to 60 feet, a rare tree of *Betula papyrifera* var. *humilis* reached 30 feet and *Alnus tenuifolia* and *Salix* spp. rose to 20 feet. The understory consisted of *Cornus stolonifera, Shepherdia canadensis, Rosa bourgeauiana, Alnus crispa, Viburnum edule, Ribes triste* and *Ledum groenlandicum.* The ground cover which was rooted in a deep layer of moss, was also much more varied. The most frequent species found were *Geocaulon lividum, Moneses uniflora, Pyrola grandiflora, P. virens, Equisetum scirpoides, E. arvense, Habenaria obtusata, Viola renifolia* var. *brainerdii, Anemone richardsonii, Calamagrostis canadensis, Arctostaphylos rubra* and *Vaccinium vitis-idaea* var. *minus.*

Inland to the northeast of the airstrip the land sloped gently into a broad valley some two miles in width. This valley drained into Bosworth Creek, a stream that cut through the height of land to join the Mackenzie River just north of the townsite. *Picea mariana* was dominant on the slope and the area might well be termed a black spruce muskeg. Among the 12-foot spruce a few willow shrubs of almost equal height and some *Alnus crispa* were noted; *Ledum groenlandicum* was extremely common throughout, and at ground level *Vaccinium vitis-idaea* var. *minus* was very common in a thick moss bed.

The steep banks of Bosworth Creek where it cut through to the river were thickly covered with tall *Picea glauca.* The understory and ground cover were similar to that on the terrain near the Transmitter site with the interesting addition of *Potentilla fruticosa, Corallorhiza trifida, Listera borealis* and *Cypripedium passerinum.*

Inland, Bosworth Creek lay between low rolling hills. It was a rapid braided stream which flowed through a maze of boulders and gravel bars. The shrubby vegetation in the creek lowlands consisted of *Salix* spp. *Alnus tenuifolia, Cornus stolonifera* and *Potentilla fruticosa.* Extensive flats between the branches of the stream were covered with low shrubs, large patches of *Juncus, Eriophorum, Antennaria pulcherrima, Carex* spp. and *Equisetum variegatum.* Also noted here were *Tofieldia glutinosa, Achillea lanulosa, Hedysarum alpinum* var. *americanum, Allium schoenoprasum* var. *sibiricum, Triglochin palustre, T. maritimum* and several species of Gramineae including *Calamagrostis canadensis* and *Deschampsia caespitosa.*

The low rolling hills which formed the foothills of the Norman Range of the Franklin Mountains sloped towards the southwest. These hills were covered with a mixed growth of *Picea glauca, Betula papyrifera* var. *humilis, Populus tremuloides* and *P. balsamifera.* The understory consisted of *Salix* spp., *Alnus crispa* and young *Picea glauca, Betula* and *Populus* and the ground cover was made up of *Equisetum scirpoides, Arctostaphylos rubra, Pyrola grandiflora, P. secunda, Moneses uniflora, Linnaea borealis* var. *americana* and *Vaccinium vitis-idaea* var. *minus* together with an occasional plant of *Corallorhiza trifida, Boschniakia rossica* and *Carex eburnea.*

Unfortunately, it was not possible for us to carry out studies farther inland to the Norman Range.

ACKNOWLEDGMENTS

Grateful acknowledgment is offered to the Royal Canadian Air Force which furnished our living and working quarters and to the Imperial Oil Company which looked after our messing requirements and in addition gave us transportation across the Mackenzie River and some distance along the old Canol Road. We would also like to thank the members of the staff of the National Research Council Permafrost Station and the personnel of the Canadian Pacific Airlines who helped make our stay at Norman Wells more pleasant.

CATALOGUE OF PLANTS

Unless otherwise stated in the text the collection numbers cited in this catalogue are those of the author. The specimens are preserved in the herbarium of the Canada Department of Agriculture, Ottawa, Ont. (DAO).

EQUISETACEAE

EQUISETUM ARVENSE L. Very common in sandy gravel, Carcajou River, Mile 23E Canol Road, 7775; among *Populus* at top of bank overlooking Mackenzie River, growing with *E. pratense*, 7856*B*.

Noted as common along the lower reaches of Bosworth Creek near the waters' edge, along nearly all the road banks in the settlement, in woods, and along the upper beach of the Mackenzie River.

EQUISETUM PRATENSE Ehrh. Common among *Populus* at top of bank overlooking Mackenzie River, growing with *E. arvense*, 7856*A*.

This is an extension of the known range of this species of some 300 miles northward from Fort Simpson where it is extremely common in woodland.

EQUISETUM SYLVATICUM L. var. MULTIRAMOSUM (Fern.) Wherry Waste sandy ground by buildings, Camp Canol, Mile 5E Canol Road, 7977; growing with *E. arvense* in wet ground along roadside ditch between townsites, 9567*A*.

Rare, noted only twice in the area; the map given by Raup (1947) shows three stations for this species around Great Bear Lake and one east of the Mackenzie River delta, but in the text mention is made of only one great Bear Lake collection; Hooker recorded *E. sylvaticum* as "Canada . . . to Fort Franklin on the Mackenzie River."

EQUISETUM PALUSTRE L. Common in sedge-willow meadow at edge of muskeg, 7476.

Recorded by Hooker as "to the shores of the Arctic Sea"; the map given by Raup (1947) shows stations at Great Bear Lake, Brintnell Lake and Mackenzie River delta. This collection together with those I have made in the Fort Simpson area are apparently the first from the Mackenzie valley, but the species was certainly expected to be present in this area.

EQUISETUM FLUVIATILE L. Common in shallow water of ditch, 7982.

Recorded by Hooker " . . . to the shores of the Arctic Sea"; the map given by Raup (1947) shows collections from Great Slave Lake, Great Bear Lake, Brintnell Lake and Mackenzie River delta. This is apparently the first collection recorded from the Mackenzie River valley between Great Slave Lake and the Mackenzie River delta.

EQUISETUM HYEMALE L. var. AFFINE (Engelm.) A. A. Eaton, *E. prealtum* Raf. Common along Cabin Creek, Mile 22E Canol Road, 7956; moist sand by river, Carcajou River, Mile 23E Canol Road, 7773.

Not seen in the immediate vicinity of Norman Wells; these stations represent an extension of the known range of some 300 miles northward from Fort Simpson (Raup, 1947) where I have also collected it.

EQUISETUM SCIRPOIDES Michx. Moist bank of Bosworth Creek, 7393.

Common in spruce woods.

EQUISETUM VARIEGATUM Schleich. Moist sand, Cabin Creek, Mile 22E Canol Road, 7955; in partial shade of *Salix, Alnus* and *Picea*, Carcajou River, Mile 23E Canol Road, 7765; muddy gravel bank of Bosworth Creek, 7665.

Common in the sands along Cabin Creek and the Carcajou River, but collected only once in the immediate vicinity of Norman Wells.

SELAGINELLACEAE

SELAGINELLA SELAGINOIDES (L.) Link Mossy spots among *Salix* on flats of Bosworth Creek valley, *7576*, *7640*; moist bank at edge of *Populus-Salix* woods, Cabin Creek, Mile 22E Canol Road, *7973*.

An insignificant plant apparently rare in our area; observed only at the above localities. It is known from several stations along the Canol Road (Porsild, 1945) and Great Bear Lake (Porsild, 1943) but is approaching its northern limit in Mackenzie District here.

PINACEAE

PICEA GLAUCA (Moench) Voss Bank of Mackenzie River, *7979*.

Common along the banks of the Mackenzie and on higher ground and better-drained slopes inland.

PICEA MARIANA (Mill.) B.S.P. Trees to 15 ft., extensive black spruce muskeg northeast of airstrip, *7439*.

Forming dense stands in muskeg.

LARIX LARICINA (DuRoi) Koch Scattered throughout muskeg, *7863*.

Some trees in the Norman Wells area had attained a height of 25 feet with a DBH of 4 inches.

The bracts of the cone scales of our specimen bear projecting mucronate points at the apex and hence must be referred to the typical variety.

JUNIPERUS COMMUNIS L. var. DEPRESSA Pursh, *J. communis* L. var. *montana sensu* Raup *pro parte*. Depressed shrub to 2 ft. among *Populus, Salix* and *Picea*, Carcajou River, Mile 23E Canol Road, *7741*; depressed shrub to 15 inches in scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7964*.

Not observed in the immediate vicinity of Norman Wells, but certainly to be expected there.

JUNIPERUS HORIZONTALIS Moench Prostrate in scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7971*.

This is apparently a northward extension of range from the Wrigley site recorded by Raup (1947). The species was not noted in the immediate vicinity of Norman Wells although it might be expected there.

TYPHACEAE

TYPHA LATIFOLIA L. Patch covering approximately 5 sq. yds. in shallow water of broad roadside ditch, *7413*.

Hooker recorded this species "Throughout Canada to Fort Franklin" but no Richardson specimens from Mackenzie District are known to exist. Cody (1956) recorded this species from Great Slave Lake. The present collection is apparently the northernmost in Mackenzie District and substantiates the earlier note of its presence in that area. *Typha* was only noted once in the Norman Wells area in 1953, but in 1957 another small stand was observed in a wet depression near the airport.

SPARGANIACEAE

SPARGANIUM MINIMUM (Hartm.) Fries Rooted in muck in shallow water of overflow channel of Bosworth Creek, *7663*.

This is the first collection from the Mackenzie River with exact locality data (see Raup, 1947; Cody, 1956) and is the northernmost known locality in Mackenzie District. Rare; noted only once in the Norman Wells area.

SPARGANIUM HYPERBOREUM Laest. In shallow water of roadside ditch, *7682*.

Porsild (1943) recorded specimens from Great Bear Lake and Mackenzie River Delta but the species is apparently unknown elsewhere in Mackenzie District. Rare; noted at only one locality in the Norman Wells area.

POTAMOGETONACEAE

POTAMOGETON FILIFORMIS Pers. var. BOREALIS (Raf.) St. John Common in 2 to 6 inches water rooted in mucky bottom of Bosworth Creek, *7352*; rooted in ooze in shallow water of lakeshore, *7874*.

Apparently not previously recorded in Mackenzie District from north of Great Slave Lake (Raup, 1936, 1947; Cody, 1956). The species undoubtedly occurs far north of Norman Wells but has been overlooked because of its aquatic habitat. In the Canadian eastern arctic it is known from as far north as southern Southampton Island and southern Baffin Island in the barren grounds (Cody, 1951).

POTAMOGETON FRIESII Rupr. Rooted in ooze in shallow water along lakeshore, *7871*.

Previously recorded from as far north as Great Bear Lake in Mackenzie District (Raup, 1947); noted only once in the Norman Wells area.

POTAMOGETON PUSILLUS L. Very common in large dug pond on Mackenzie River beach, *7631*.

Not previously recorded from north of Lake Athabaska (Raup, 1936); new to the flora of Mackenzie District. Common at the

station cited but not noted elsewhere in the area.

POTAMOGETON ALPINUS Balbis var. TENUIFOLIUS (Raf.) Ogden Rooted in muck in 1 ft. water near mouth of Bosworth Creek, *7633*.

Previously recorded from as far north as the Eskimo Lakes basin (Raup, 1947); apparently rare in the Norman Wells area.

POTAMOGETON GRAMINEUS L. Rooted in ooze in shallow water of lakeshore, *7877*, *7880*; rare in large dug pond on Mackenzie River beach, *7632*.

Previously known in Mackenzie District from as far north as Great Bear Lake (Raup, 1947); No. *7880* has both floating and submerged leaves, while No. *7877* has only submerged leaves; the floating leaves of No. *7632* are much more delicate than those usually found in this species. Apparently not common in the Norman Wells area.

POTAMOGETON RICHARDSONII (Benn.) Rydb. Rooted in ooze in shallow water along lakeshore, *7872*.

Previously recorded from as far north in Mackenzie District as Great Bear Lake (Raup, 1936); noted only once in the Norman Wells area.

SCHEUCHZERIACEAE

TRIGLOCHIN MARITIMUM L. Rare on muddy bank of Bosworth Creek, *7351*.

This species is known from as far north as the Mackenzie River delta (Raup, 1947); it was only encountered once in the Norman Wells area.

TRIGLOCHIN PALUSTRE L. Rare on muddy bank of Bosworth Creek, *7350*; wet ground by buildings, *7833;* moist sand, Carcajou River, Mile 23E Canol Road, *7790;* moist sand, Cabin Creek, Mile 23E Canol Road, *7944*.

Apparently not previously known in Mackenzie District from north of Fort Simpson (Raup, 1947); occasional in the Norman Wells area.

GRAMINEAE

BROMUS PUMPELLIANUS Scribn. Moist bank of Bosworth Creek, *7392*; in sand and gravel, Cabin Creek, Mile 22E Canol Road, *7941*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7745*.

Rare in the vicinity of Norman Wells; along the Mackenzie River this species has apparently not previously been recorded north of Saline River above Norman (Porsild, 1945); undoubtedly it occurs to the north of Norman Wells since it is known to the northeast from Coppermine (Cody, 1954), about 15 miles west of Horton R., 67°42'N 123°00'W, *Mackay s.n.*, 1951 (DAO), and Bathurst Inlet, *Campbell 54* (DAO), *Pierce s.n.* 1951 (DAO).

FESTUCA RUBRA L. var. ARENARIA (Osb.) Fries, *F. richardsonii* Hook. Clumps in sandy gravel, Carcajou River, Mile 23E Canol Road, *7752*, *7784*.

Not noted in the immediate vicinity of Norman Wells.

FESTUCA ALTAICA Trin. Shallow soil over rock on tundra hilltop, Mile 44E, Canol Road, Mackenzie Mountains, *7717*.

Not noted in the immediate vicinity of Norman Wells.

GLYCERIA PULCHELLA (Nash) K. Schum. In moss in wet sedge meadow in muskeg, *7519*; clump on wet roadbank bordering sedge meadow, rare, *7537*.

Noted only in the above habitat, rare; this is a northward extension of range in Mackenzie District of some 300 miles from Fort Simpson (Raup, 1947).

PUCCINELLIA NUTTALLIANA (Schultes) Hitchc. Occasional clumps in heavy soil by airstrip, *7464*; scattered in disturbed ground by buildings, *7347*; a few clumps on moist gentle slope by Mackenzie River, *7430*; in heavy soil of bank overlooking Mackenzie River, *7493*.

Not previously recorded along the Mackenzie River below Great Slave Lake (Raup, 1936, 1947); a range extension of some 450 miles.

PUCCINELLIA ? VAHLIANA (Liebm.) Scrbn. & Merr. Very shallow soil over rock, Dodo Canyon, Mackenzie Mountains, Mile 41E Canol Road, *7725*.

Porsild (1945) recorded *P. vahliana* from Plains of Abraham, Mile 82E Canol Road; elsewhere the species is known from the Arctic coast some 450 miles to the northeast, and the islands of the Arctic Archipelago; it was not noted in the immediate vicinity of Norman Wells.

POA PRATENSIS L. In heavy soil of bank overlooking Mackenzie River, *7505*; scattered in disturbed ground by roadside, *7800;* rare in disturbed ground east of townsite, *7536*; clump in heavy soil by airstrip, *7456*, *7458*; cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7549*; in partial shade in cleared area, Royal Cana-

dian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7952*.

Occasional in disturbed situations throughout the area.

POA INTERIOR Rydb. Scattered in disturbed ground by roadside, *7799*; clump on moist bank of Bosworth Creek, *7365*; clumps in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7543*.

Not common in the vicinity of Norman Wells; not previously recorded from north of Great Slave Lake (Cody, 1956) although specimens cited by Raup (1947) under *Poa nemoralis* from Brintnell Lake may possibly belong here.

AGROPYRON TRACHYCAULUM (Link) Malte var. TRACHYCAULUM In heavy soil of bank overlooking Mackenzie River, *7501*, *7502*, *7503*, *7509*; clumps on open hillside by Mackenzie River, *7423*; clumps in heavy soil by airstrip, *7451*; clumps in open ground at southeast end of airstrip, *7818*, *7823*, *7824*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7748*, *7750*, *7754*.

Fairly frequent in cleared and disturbed areas; these collections are probably from near its northern limit in Mackenzie District.

AGROPYRON TRACHYCAULUM (Link) Malte var. GLAUCUM (Pease & Moore) Malte Sandy gravel, Carcajou River, Mile 23E Canol Road, *7749*.

Apparently not previously recorded north of Great Slave Lake (Cody, 1956); rare, not noted in the immediate vicinity of Norman Wells.

AGROPYRON LATIGLUME (Scribn. & Sm.) Rydb. Very shallow soil over rock, Dodo Canyon, Mile 41E Canol Road, Mackenzie Mountains, *7724*.

Not noted in the lowlands of the Mackenzie Valley near Norman Wells.

AGROPYRON SERICEUM Hitchc. Clumps in heavy soil by airstrip, *7452*, *7453*, *7454*; clumps on open hillside by Bosworth Creek, *7374*; clumps on open hillside by Mackenzie River, *7422*; in heavy soil of bank overlooking Mackenzie River, *7508*; Mile 24E Canol Road, near Carcajou River, 7727.

Occasional in cleared and disturbed areas; new to Mackenzie District. The type of this species was collected at Dawson, Yukon. It is known from a number of collections in Yukon and Alaska (Hultén, 1942; Porsild, 1951).

× AGROHORDEUM MACOUNI (Vasey) Lepage (*Elymus macounii* Vasey) Single clump on open hillside by Mackenzie River, *7421*.

This hybrid between *Agropyron trachycaulum* and *Hordeum jubatum* has not previously been recorded in Mackenzie District from north of the Salt Plain west of Fort Smith (Cody, 1956).

ELYMUS INNOVATUS Beal Rare on valley slopes of Bosworth Creek, *7583*; moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7704*, *7705*.

Rare, noted only once in the immediate vicinity of Norman Wells. The species is known as far north as the Mackenzie River delta (Porsild, 1943).

HORDEUM JUBATUM L. Clumps on open hillside by Mackenzie River, *7420*; in heavy soil of bank overlooking Mackenzie River, *7499*; common in clumps in open ground at southeast end of airstrip, *7822*.

Occasional in disturbed heavy ground. The northernmost locality previously recorded is Saline River, above Norman (Raup, 1947; Porsild, 1945), some 115 miles upstream from Norman Wells. Hooker recorded it as "Saskatchewan to the Mackenzie River" but gave no exact localities.

TRISETUM SPICATUM (L.) Richter Rare in sandy gravel, Carcajou River, Mile 23E Canol Road, *7783*; very shallow soil over rock, Dodo Canyon, Mile 41E Canol Road, Mackenzie Mountains, *7723*; Mile 74E Canol Road, Mackenzie Mountains, *Metro Tomasky 20* (DAO).

Not noted in the immediate vicinity of Norman Wells.

DESCHAMPSIA CAESPITOSA (L.) Beauv. Clump in disturbed ground by buildings, *7322*, *7326*; in heavy soil of bank overlooking Mackenzie River, *7494*, *7504*, *7507*; common, forming clumps on moist gentle slope by Mackenzie River, *7431*, *7432*; clump in heavy soil by airstrip, *7455*, *7457*; clumps in open ground at southeast end of airstrip, *7819*, *7820*; gravel bar of Bosworth Creek, *7657*; occasional in open *Salix-Alnus* flats of Bosworth Creek Valley, *7652*; moist sand, Cabin Creek, Mile 22E Canol Road, *7953*, *7976*; clump in sandy gravel, Carcajou River, Mile 23E Canol Road, *7751*, *7753*.

Fairly common in disturbed localities throughout the area. Our specimens are all relatively high-grown and seem on this basis best placed in the typical variety rather than var. *glauca*. Of interest is the wide variation

in the length and placement of the awn: in some specimens the awn was a mere extension of the midrib of the lemma, no longer than its erose tips, in other specimens the awn was attached below the middle of the lemma, and in still others it was attached above the middle. In one specimen (*7322*) the awn of the upper floret was attached above the middle, while that of the lower floret in the same spikelet was attached below the middle. In all cases the awn extended to or just below the tip of the lemma.

CALAMAGROSTIS PURPURASCENS R. Br. Scattered in disturbed ground by roadside, *7801*.

Occasional.

CALAMAGROSTIS LAPPONICA (Wahl.) Hartm. Open ground at southeast end of airstrip, *7827*; occasional clumps in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7545*, *7553*.

Occasional in disturbed heavy soil.

CALAMAGROSTIS CANADENSIS (Michx.) Nutt. Moist ground in broad ditch by roadside, *7981*; in heavy clay soil of bank overlooking Mackenzie River, *7506*; sedge-grass border of lake, *7876*; common in dried up roadside ditch bordering cleared muskeg, *7805*; in mud on gravel bar in Bosworth Creek, *7653*; in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7619*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7776*.

A common grass found in many different habitats throughout the area. These collections are from near the known northern limit in Mackenzie District.

CALAMAGROSTIS INEXPANSA Gray Moist sand, Cabin Creek, Mile 22E Canol Road, *7951*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7762B*.

Not noted in the immediate vicinity of Norman Wells.

CALAMAGROSTIS NEGLECTA (Ehrh.) G. M. & S. Occasional in open *Salix-Alnus* flats of Bosworth Creek valley, *7651*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7762A*.

Rare in the area.

AGROSTIS SCABRA Willd. In heavy soil of bank overlooking Mackenzie River, *7497*, *7498*; clumps on open hillside by Mackenzie River, *7419*; clumps in cleared heavy ground by roadside, 2 miles upstream from Norman Wells, *7546*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7746*.

In the Norman Wells area noted only on the heavy cleared and disturbed soils adjacent to the river. Hooker recorded *A. laxiflora* " . . . to Bear Lake" and Raup (1947) cited a Gray Herbarium specimen bearing the data "Cumberland House to Bear Lake." The collections listed here are therefore from the northern known limit in Mackenzie District and represent the first recorded collections with definite locality data from that region.

ARCTAGROSTIS ARUNDINACEA (Trin.) Beal Cleared muskeg, *7857A*, *7857B*; large stand in moist ground by buildings, *7808*; in heavy soil of bank overlooking Mackenzie River, *7495*; large clump in disturbed ground by Bosworth Creek, *7410*; in sedge meadow areas in muskeg near Bosworth Creek, *7569*; in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7619B*.

Occasional throughout the Norman Wells area in cleared muskeg, sedge meadows and disturbed heavy ground. A Richardson specimen in the Gray Herbarium cited by Raup (1947) bears the data "Cumberland House to Bear Lake"; Hooker gave the following information ". . . Cumberland House Fort, and Hudson's Bay. Drummond. Bear Lake to the shores of the Arctic Sea. Dr. Richardson."

BECKMANNIA SYZIGACHNE (Steud.) Fern. Small clumps on moist gentle slope by Mackenzie River, *7429*.

Known to occur as far north as Mackenzie River delta (Porsild, 1943) but rare in the vicinity of Norman Wells.

HIEROCHLOË ODORATA (L.) Wahl. Rare in open *Salix-Alnus* flats of Bosworth Creek valley, *7650*; in sand and gravel, Cabin Creek, Mile 22E Canol Road, *7942*; among *Equisetum arvense* in moist sand, Carcajou River, Mile 23E Canol Road, *7788*.

Rare, noted only once in the immediate vicinity of Norman Wells; apparently not previously recorded in the Mackenzie River valley north of Fort Simpson some 300 miles to the southeast. Raup (1947) cited a National Museum specimen collected by McConnell "in meadows, Bell R., Mackenzie R." I have been unable to find a Bell River flowing into the Mackenzie River on any map. There is, however, a Bell River which flows into the Porcupine River, a tributary of the Yukon River; this is in Yukon Territory, west of Fort McPherson.

CYPERACEAE

ERIOPHORUM RUSSEOLUM Fries var. ALBIDUM Nyl., *E. chamissonis* C. A. Mey forma *albidum* (Nyl.) Fern. Mud of wet ditch, *7342*; sedge meadow bordering muskeg, *7524*; rare in mud on gravel bar in Bosworth Creek, *7655*.

Found only occasionally in the same habitats as *E. angustifolium*; not previously recorded from north of Resolution (Raup, 1947) some 500 miles to the southeast.

ERIOPHORUM BRACHYANTHERUM Trautv. & Meyer. Clumps 6 inches in diameter in mud of wet ditch, *7341*.

Noted only once in the area.

ERIOPHORUM ANGUSTIFOLIUM Honckn. Mud of wet ditch, *7340*; in moss in wet sedge meadow in muskeg, *7520*; rare in mud on gravel bar in Bosworth Creek, *7654*.

Found only occasionally in the area.

SCARPUS VALIDUS Vahl Wet ground by buildings, *7835*.

This is a range extension of some 50 miles downstream from near Fort Norman (Raup, 1947); noted only once in the area. The specimens in this collection as well as some others from the southern parts of Mackenzie District have some dark-red resinous dots on the bractlets but, nevertheless, on the basis of other characters seem better placed here than in *S. acutus*; observed only once.

ELEOCHARIS PAUCIFLORA (Lightf.) Link var. FERNALDII Svenson. Wet flats of Bosworth Creek, *7673*.

Previously known from Great Slave Lake (Raup, 1936) and from Great Bear Lake (Porsild, 1943, Raup, 1947) but hitherto unknown along the Mackenzie River; fairly common at the Bosworth Creek site but not seen elsewhere in the area.

ELEOCHARIS MACROSTACHYA Britt. Wet ground by buildings, *7834*; common, forming large mats on moist gentle slope by Mackenzie River, *7427* (both det. Svenson).

Noted only at the above-mentioned localities; our specimens are considerably smaller in stature in comparison with others from farther south which are referred to this species, but Svenson wrote concerning them as follows: "At first sight they both had me puzzled, but they are both without any question *Eleocharis macrostachya*. No. *7427* has the general habit of *E. macrostachya* though the culms are unusually narrow. In both, the achenes, though small, are characteristic of the species." Our specimens are the northernmost yet recorded from the Mackenzie Valley, but Porsild's (1943) records of *E. palustris* from the north shore of Dease Arm, Great Bear Lake and Great Bear River, as well as the northern part of the range of *E. palustris* in Hooker "Throughout Canada to Bear Lake", undoubtedly belong here.

CAREX CAPITATA L. Occasional clumps in sedge-willow meadow at edge of muskeg, *7478*; moist peat of open muskeg, *7885*.

Infrequent in the area; this is apparently the northernmost recorded collection from Mackenzie District; the nearest known site is Mile 174E Canol Road (Porsild, 1945; Raup, 1947); other Mackenzie District sites are recorded by Cody (1956).

CAREX CHORDORRHIZA Ehrh. In moss in wet sedge meadow in muskeg, *7516*.

Rare, noted only once in the area; apparently never recorded from the area between Fort Smith (Cody, 1956) and Great Bear Lake (Porsild, 1943). Porsild stated that this species is not uncommon from the Mackenzie delta east to Hudson Bay, and north a short distance beyond the tree limit. This seeming absence in southern Mackenzie District is no doubt due to a lack of collections from the area rather than to a disjunct range. The species usually grows in and at the edges of floating bogs which are not accessible to or visited by the casual collector.

CAREX DIANDRA Schrank Clump in moss in wet sedge meadow in muskeg, *7518*; rare on clay beach of Mackenzie River, *7426*.

Apparently rare in the vicinity of Norman Wells; Porsild (1943) recorded a specimen from Great Bear Lake and stated that it was not previously known from north of Great Slave Lake. The map in Raup (1947) shows a collection from the vicinity of the delta of the Mackenzie River, but this is not mentioned in the text. Our collections are thus the first cited from the Mackenzie River.

CAREX DISPERMA Dewey In sod, *7471*.

Rare, noted only once in the area; apparently not previously collected along the Mackenzie River between Fort Simpson and Aklavik.

CAREX TENUIFLORA Wahl. Clumps in moss in sedge-willow meadow at edge of muskeg, *7486*.

Noted only once in the vicinity of Norman Wells; Raup (1947) reported that this species is occasional in the Athabaska—Great Slave Lake region, on the lower Mackenzie,

and at Great Bear L., but not yet collected along the upper Mackenzie. I have not seen it in the area between Norman Wells and Great Slave Lake.

CAREX BONANZENSIS Britton Rare, clump on moist gentle slope by Mackenzie River, *7428*.

Noted only once in the area; this fills the gap in distribution between Fort Simpson and the Mackenzie River delta (Raup, 1947).

CAREX CANESCENS L. Occasional clumps in sedge areas in muskeg near Bosworth Creek, *7568*; moist shallow ditch through cleared muskeg, *7843*; sedge-grass meadow along lakeshore, *7879*.

Occasional in sedge meadows and wet areas.

CAREX GYNOCRATES Wormskj. Sedge-willow meadow at edge of muskeg, *7474*.

Rare, noted only in this situation; according to the map in Raup (1947) this species has a wide distribution across Canada, but it has not previously been collected along the Mackenzie River south of the delta.

CAREX AENEA Fern. Rare in heavy soil by airstrip, *7463*; clumps in disturbed humus, *7531*.

Occasional in disturbed areas; apparently not previously recorded in Mackenzie District from north of Fort Simpson some 300 miles to the southeast (Raup, 1947).

CAREX LEPTALEA Wahl. Occasional clumps in sedge-willow meadow at edge of muskeg, *7477*.

Noted only once in the area; Raup (1947) cited a Richardson specimen labeled "Mackenzie River" together with a collection from near Fort Simpson; Porsild (1943) has collected it on the east side of Great Bear Lake; this is the northernmost recorded locality along the Mackenzie River.

CAREX SCIRPOIDEA Michx. Very moist bank of Bosworth Creek, *7355*, *7660*, *7391*; clumps in moist sand, Cabin Creek, Mile 22E Canol Road, *7960*; Hell's Gate in Dodo Canyon, Mackenzie Mountains, Mile 32E Canol Road, *7693*; shallow soil over rock on tundra hilltop, Mackenzie Mountains, Mile 44E Canol Road, *7711*.

In the immediate vicinity of Norman Wells, found only along Bosworth Creek.

CAREX CONCINNA R. Br. Occasional in heavy soil at edge of airstrip, *7436*; small clumps on moist bank of Bosworth Creek, *7364*; occasional clumps in cleared heavy ground two miles upstream from Norman Wells, *7560*; clump in cleared area, Royal Canadian Corps Signals Transmitters five miles upstream from Norman Wells, *7626*; Hell's Gate in Dodo Canyon, Mackenzie Mountains, Mile 32E Canol Road, *7689*.

Occasional in the area; Porsild (1943) recorded several collections from the lowlands of the Mackenzie River delta; the only other collection which might have come from the lowland areas bordering the Mackenzie River is a Richardson specimen labeled "Mackenzie River" cited by Raup (1947).

CAREX EBURNEA *Boott* Clump in disturbed ground east of townsite, *7535*; rare, clump on open hillside by Bosworth Creek, *7377*; spruce, poplar, birch, alder hillside, upper Bosworth Creek valley near Norman Wells, *7666*; scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7972*; by buildings at pumping station Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7696*.

Rare in the vicinity of Norman Wells; the type is reported to have been collected by Richardson at Fort Norman some 50 miles upstream. This species is known from a number of stations in the Mackenzie Mountains, but in the lowlands of the Mackenzie basin it is known only from Fort Norman, the station cited here and Cornwall Bay on Lake Athabaska.

CAREX GARBERI Fern. Sedge-willow meadow at edge of muskeg, *7475*.

Noted only once in the area; Porsild (1943) has recorded this species from as far north as Great Bear Lake and the Mackenzie River Delta.

CAREX AUREA Nutt. Patch two ft. in diameter on moist bank of Bosworth Creek, *7363*; sandy soil by Carcajou River, Mile 23E Canol Road, *7730*.

Rare in the area; apparently not recorded along the Mackenzie River from north of Fort Simpson some 300 miles to the southeast, although Raup (1947) cited a Richardson specimen labeled "Mackenzie River." It is not recorded for our area by Hooker.

CAREX VAGINATA Tausch In moss in sedge-willow meadow at edge of muskeg, *7485*, *7571*.

Occasional in open meadows in muskeg; this species is known along the Canol Road (Porsild, 1945; Raup, 1947) and according to Hooker at Fort Norman on the Mackenzie River. The map in Raup (1947) shows numerous collections in the area of the Mac-

kenzie River delta but I have found no literature citations for the specimens so represented.

CAREX CAPILLARIS L. Clump on moist bank of Bosworth Creek, *7394*, *7354*, *7661*; rare in sandy soil by Carcajou River, Mile 23E Canol Road, *7736*, *7747*; moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7703*.

Noted only along the banks of Bosworth Creek in the immediate vicinity of Norman Wells.

CAREX PAUPERCULA Michx. (inc. var. *irrigua* (Wahl.) Fern.) Clump in moss in wet sedge meadow in muskeg, *7517*; in moss in small sedge meadow clearing in muskeg near Bosworth Creek, *7574*.

Rare in the area, this appears to be the northernmost collection of the species along the Mackenzie River; previously known from McTavish Arm, Great Bear Lake (Porsild, 1943) and Great Slave Lake (Raup, 1936).

CAREX MEDIA R. Br. Clump in sod, *7472*; rare, clump in disturbed ground by buildings, *7346*; small clumps in cleared heavy ground by roadside, 2 miles upstream from Norman Wells, *7559*.

Rare in disturbed situations.

CAREX RAYMONDII Calder Clump among willows, *7470*; rare in heavy soil bordering airstrip, *7446*; single large clump in open ground at southeast end of airstrip, *7825*; rare, clump on open hillside by Bosworth Creek, *7378*.

Occasional in the area; not previously recorded from north of Alexandra Falls on Hay River some 450 miles to the southeast (Cody, 1956).

CAREX AQUATILIS Wahl. Large stand in moist ground by buildings, *7809*; in moss in wet sedge meadow in muskeg, *7515*; large patch on moist gentle slope by Mackenzie River, *7433*; bank of Bosworth Creek, *7362*, *7672*; common in deep wet moss around small lake, *7864*; clump on stream bank on upper beach, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7606*; moist gravel bank of river, Carcajou River, Mile 23E, Canol Road, *7786*.

Common in open muskeg, bordering lakes and streams and in other wet places.

CAREX PHYSOCARPA Presl Clumps in moist soil of ditch, *7635*; muddy bank of Bosworth Creek, *7369*.

Occasional in moist situations.

CAREX MEMBRANACEA Hook. Moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 42E Canol Road, *7708*.

An arctic-alpine species; not noted in the lowland area in the vicinity of Norman Wells.

CAREX ROSTRATA Stokes, *C. ampulacea sensu* Hooker Stream bank on upper beach near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7605*.

Noted only once in the area; Hooker gave the range of *C. ampulacea* as "Cumberland House, Bear Lake . . .," which is undoubtedly based in part on the Richardson specimen cited by Raup (1947) "Mackenzie River." Raup stated that the species is abundant in the Athabaska — Great Slave Lake region and that its northernmost limit is unknown. The northernmost recorded station appears to be 36 miles south of Aklavik (Cody, 1956).

JUNCACEAE

JUNCUS BUFONIUS L. Mud of deep ditch, *7837*; moist ditch, *7937*.

Noted only twice in the area; Hooker recorded this species "Throughout Canada to Bear Lake," however the northernmost collection seen by Raup (1947) was from Fort Simpson. Our collections are certainly from near the northern limit of range.

JUNCUS TRIGLUMIS L. Very moist bank of Bosworth Creek, *7659*.

Not noted elsewhere in the area; this is an arctic-alpine species, the nearest known stand is Plains of Abraham, Mile 82E Canol Road in the Mackenzie Mountains (Porsild, 1945; Raup, 1947).

JUNCUS BALTICUS Willd. Mud of wet ditch, *7343*; wet ground by buildings, *7832*; moist sand, Cabin Creek, Mile 22E Canol Road, *7954*; moist sand, Carcajou River, Mile 23E Canol Road, *7789*, *7793*.

Occasional in moist situations.

JUNCUS ALPINUS Vill. var. RARIFLORUS Hartm. Wet ground by buildings, *7831*; very common in moist clay of ditch along road to airstrip, *7852*; in moss in sedge-willow meadow at edge of muskeg, *7484*; scattered clumps on moist shoreline of Mackenzie River, *7434*; moist sand, Carcajou River, Mile 23E Canol Road, *7791*, *7792*.

In wet situations throughout the area; apparently not previously recorded from north of the Fort Simpson along the Mackenzie River, but it undoubtedly will be found further north along the river.

JUNCUS CASTANEUS J. E. Smith Rare in moist clay of ditch along road to airstrip, *7853*; rare on muddy bank of Bosworth Creek, *7361*.

Occasional in wet places.

LILIACEAE

TOFIELDIA PUSILLA (Michx.) Pers. Among *Salix* on flats and slopes of Bosworth Creek valley, *7582*, *7356*; in partial shade of *Alnus*, *Salix* and *Picea*, Carcajou River, Mile 23E Canol Road.

Not common in the area.

TOFIELDIA GLUTINOSA (Michx.) Pers. Open *Salix-Alnus* flats of Bosworth Creek valley, *7643*, *7578*.

Raup (1947) cited a Richardson specimen preserved in Gray Herbarium, with the vague data "Cumberland House to Bear Lake." Otherwise, this species is unrecorded in the Mackenzie Valley north of Nahanni Mt., some 250 miles to the south; noted only at the above-mentioned locality.

ZYGADENUS ELEGANS Pursh Among *Salix* on flats of Bosworth Creek Valley, *7579*.

Not seen elsewhere in the area.

ALLIUM SCHOENOPRASUM L. var SIBIRICUM (L.) Hartm. Occasional on gravel bars and muddy banks of Bosworth Creek, *7349*, *7638*.

Hooker recorded *A. schoenoprasum* as occurring "Throughout the woody country to Bear Lake." Our specimens are apparently the northernmost collected along the Mackenzie River, although it will undoubtedly be found in similar habitats further north along the river; noted only on the banks of Bosworth Creek.

SMILACINA TRIFOLIA (L.) Desf. Rare in deep moss of partly cleared muskeg, *7487*.

Hooker recorded this species as occurring in "swamps throughout Canada to Bear Lake." Our collection is apparently the northernmost collected along the Mackenzie Valley; noted only once in the area.

IRIDACEAE

SISYRINCHIUM MONTANUM Greene, *S. angustifolium sensu* Raup (1947) and Porsild (1945) Rare on muddy bank of Bosworth Creek, *7359*; clumps on open hillside by Bosworth Creek, *7372*.

Not previously recorded in the Mackenzie River Valley north of Norman, some 50 miles to the southeast; noted only in the vicinity of Bosworth Creek.

ORCHIDACEAE

CYPRIPEDIUM PASSERINUM Richardson Moist bank of Bosworth Creek, *7389*; scrub poplar woods, Cabin Creek, Mile 22E Canol Rd., *7969*; in shade of *Alnus*, *Salix* and *Picea*, Carcajou River, Mile 23E Canol Rd., *7768*.

The previously known northern limit of this species was Fort Norman (Raup, 1947), some 50 miles to the southeast; rare.

CYPRIPEDIUM CALCEOLUS L. var. PARVIFLORUM (Salisb.) Fern. *C. parviflorum* Salisb. Creek near Norman Wells, *F. V. Hutton 3A*, July 12, 1945 (DAO).

Previously known only as far north along the Mackenzie River as Fort Norman, some 50 miles to the southeast; it was not observed at Norman Wells by the author.

ORCHIS ROTUNDIFOLIA Pursh Rare in *Picea glauca* woods, upper Bosworth Creek valley near Norman Wells, *7670*.

Rare, noted only in this situation.

HABENARIA VIRIDIS (L.) R. Br. var. BRACTEATA (Willd.) Gray In moist sand and in humus under *Populus* and *Salix*, with *H. hyperborea*, Cabin Creek, Mile 22E Canol Rd., *7946B*.

Not previously recorded north of Nahanni Mt. (Raup, 1947) some 250 miles to the south; not observed in the immediate vicinity of Norman Wells.

HABENARIA HYPERBOREA (L.) R. Br. Rare in mucky ground by ditch, *7348*; rare on muddy bank of Bosworth Creek, *7353*; in moist sand and in humus under *Populus* and *Salix* with *H. viridis* var. *bracteata*, Cabin Creek, Mile 22E Canol Rd., *7946A*; sandy soil by Carcajou River, Mile 23E Canol Rd., *7729*.

Hooker gave the distribution "from the Saskatchewan to Fort Franklin," but the northernmost record cited by Raup (1947) is from Nahanni Mt. some 250 miles to the south; noted only at Bosworth Creek in the immediate vicinity of Norman Wells.

HABENARIA OBTUSATA (Pursh) Richardson Common in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7620*; in humus in *Salix-Betula-Picea-Populus* woods, 2 miles upstream from Norman Wells, *5538B*; rare in shade of *Salix*, *Alnus* and *Picea*, Carcajou River, Mile 23E Canol Rd., *7759*.

Occasional in suitable habitats.

SPIRANTHES ROMANZOFFIANA Cham. Occasional in moss in sedge-willow meadow at edge of muskeg, *7480*.

As suggested by Raup (1947), the range given by Hooker under *S. gracilis* ". . . from Lake Huron . . . to Fort Franklin, on the Mackenzie River" probably belongs here. The northernmost collections cited by Raup (1947) are those of Crickmay from Mackenzie R. between Wrigley and Blackwater R. and near large lake between southern extremities of Franklin Mountains some 175 miles to the southeast; noted only once in the area.

LISTERA BOREALIS Morong Rare in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7616*; rare in humus among *Picea, Betula, Salix* and *Alnus* on slope by Bosworth Creek, *7407*.

Apparently rare, but easily overlooked.

CALYPSO BULBOSA (L.) Oakes Limestone ridge east of settlement, *Bird, s.n.* May 30, 1953 (DAO).

Hooker recorded this species as "Canada to Bear Lake River," but the only Richardson specimen cited by Raup is labeled "Between Forts Simpson and Chipewyan." The closest record with exact locality data is that of Wynne-Edwards from Nahanni Mountain, some 250 miles to the south (Raup, 1947); not observed by the author at Norman Wells.

CORALLORHIZA TRIFIDA Chat. Rare in humus among *Picea, Betula, Salix* and *Alnus* on slope of Bosworth Creek, *7408*; humus in *Alnus, Betula, Picea, Salix* woods 2 miles upstream from Norman Wells, *7563*; rare in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7612*; spruce, poplar, birch, alder hillside, upper Bosworth Creek valley, *7668*.

Occasional in suitable habitats.

SALICACEAE

POPULUS TREMULOIDES Michx. A common tree along the Mackenzie River, along creeks and on the better drained slopes inland, *7678*.

POPULUS BALSAMIFERA L. A common tree along the Mackenzie River, along creeks and on the better drained slopes inland, *7677*.

SALIX SERISSIMA Fern. Shrub to 8 ft. in wet muskeg, rare, *7865*.

Rare; previously recorded as new to Mackenzie District, based on a collection from Fort Smith (Cody, 1956) the present collection extends the known range down the Mackenzie system some 700 miles.

SALIX LASIANDRA Benth. var. RECOMPONENS Raup Shrub to 6 ft., Carcajou River, Mile 23E Canol Rd., *7785*.

Raup (1947) has the following statement under this entity: "Hooker, in Fl. Bor.-Am., gives the range of *S. lucida* ' . . . as far north as Fort Franklin on the Mackenzie River.' This record is probably based upon all the *S. lucida*-like willows in the Mackenzie basin (*S. serissima, S. lasiandra* vars.)." This record of *S. lasiandra* var. *recomponens* and also the record of *S. serissima* above are thus both northward extensions to the range given by Hooker; not noted in the immediate vicinity of Norman Wells.

SALIX INTERIOR Rowlee var. PEDICELLATA (Anders.) Ball A 3 to 5 ft. shrub scattered throughout the disturbed ground in the townsite area and along the sides of roads through the muskeg near Bosworth Creek, *7492* and *7566*.

Preble (1908) sub nom *Salix fluviatilis* gave the following account: "A willow taken at the mouth of North Nahanni River is identified as this species. Sandbar willows, evidently of the same species, cover the low islands and banks of the Athabaska, Slave, and Mackenzie rivers throughout their courses." The specimens cited here are, however, apparently the first to be taken along the Mackenzie River from north of the North Nahanni River.

SALIX ATHABASCENSIS Raup Low shrub to 1 ft. in sedge-willow meadow at edge of muskeg, rare, *7483* (det. Ball).

This is an extension of range of some 600 miles northwest from the type locality at the Moose Lake ranger station in Wood Buffalo Park, [Alberta]. It is also known from Fort Simpson (Cody, in press). New to Mackenzie District.

SALIX BRACHYCARPA Nutt. var. MEXIAE Ball Decumbent shrub, Hell's Gate in Dodo Canyon, Mackenzie Mountains, Mile 32E Canol Rd., *7691* (det. Ball) and *7692*.

Previously known from British Columbia, Alaska and Yukon (Ball, 1934) and from the Mackenzie Mountains in Yukon (Porsild, 1951), this variety is apparently new to the flora of the east slope of the Mackenzie Mountains and Mackenzie District; not

noted in the lowland area around Norman Wells.

SALIX NIPHOCLADA Rydb. 1 ft. shrub, rare, in heavy soil bordering airstrip, ♂ *7442*; 2 ft. shrub, *Salix-Alnus* flats of Bosworth Creek valley, ♀ *7656*.

The type of this species was collected by Miss E. Taylor along the Mackenzie River about 30 miles north of the Arctic Circle.

SALIX GLAUCA L. Common in heavy soil bordering airstrip, *7441*.

Fairly common, scattered throughout the area.

SALIX LUTEA Nutt. A 6 ft. shrub in cleared area by Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7625*.

Noted only once in the area; this is a northwestward extension of range of some 475 miles from the south shore of Great Slave Lake (Cody, 1956).

SALIX MYRTILLIFOLIA Anders. A low shrub in heavy soil bordering the airstrip, *7444*; scattered throughout the cleared muskeg, *S. D. Hicks, s.n.* June 10, 1949 and June 23, 1949 (DAO).

Occasional.

SALIX ALAXENSIS (Anders.) Cov. Common, growing to a height of 16 ft. among *Populus*, *Picea* and *Salix* spp., along the Carcajou River, Mile 23E Canol Rd., *7739*; occasional in wet ground in the vicinity of Norman Wells, *7327* and *7437*.

Occasional.

SALIX BEBBIANA Sarg. A common shrub throughout the area, in both wet and dryer localities, sometimes attaining a height of at least 10 ft.; *7325*, *7443* and *7802*.

Raup (1947) cited Richardson specimens labeled "between Cumberland House and Fort Franklin" and "Fort Franklin, Mackenzie River." Preble (1908) provided the following interesting information: "This is one of the commonest willows, forming dense thickets on the banks of the streams and in the alluvial swamps north to the lower Mackenzie. Specimens were collected at various points between Grand Rapid and Fort Good Hope [near the arctic circle]. On the upper Mackenzie it grows to be a fair-sized tree—nearly a foot in diameter and 25 feet high.—". It is quite possible that this willow may be found in the Mackenzie River delta.

SALIX PLANIFOLIA Pursh Shrub 15 ft. in wet ground in townsite, *7328*.

Raup (1947) cited a Richardson specimen labeled "Fort Franklin, Mackenzie River," in addition to the following text: "Noted in Fl. Bor.-Am. on 'Mackenzie River and Bear Lake.' Schneider cited a Preble specimen (322-A) from Norman, but I have not seen it." The present collection from Norman Wells is therefore a very slight extension of the range of the species northward and may possibly be from near its northern limit on the Mackenzie; Raup's map, however, does show a locality in the Mackenzie River delta, but no specimens have been seen from that area.

SALIX ARBUSCULOIDES Anders. Shrub to at least 10 ft., *7440*, *7565*, *S. D. Hicks, s.n.*, June 15, 1945 (DAO).

This is a very common willow throughout the district.

MYRICACEAE

MYRICA GALE L. 10-inch shrub in sedge-willow meadow at edge of muskeg, *7481*; shrub to 15 inches in moist shallow ditch through cleared muskeg, *7845*.

Scattered through the muskeg in the area; Porsild (1943) recorded this species as common around Great Bear Lake but rare in the Mackenzie River delta.

BETULACEAE

BETULA PAPYRIFERA Marsh. var. HUMILIS (Regel) Fern. & Raup. Tree 20 ft., DBH 2 inches, occasional in muskeg near Bosworth Creek, *7572*; tree 35 ft., DBH 7 inches, cleared muskeg, *7840*; tree to 40 ft., DBH 6 inches, heavy soil on top of bank overlooking Mackenzie River 2 miles upstream from Norman Wells, *7562*; tree 35 ft., DBH 5 inches, scattered along top of slope by Bosworth Creek, *7402*.

Scattered trees throughout the area; our specimens all have more or less resinous twigs and white bark and are therefore referred to var. *humilis*.

BETULA GLANDULOSA Michx. Shrub to 4 ft. in cleared muskeg, *7521*; shrub to 6 ft., common in open muskeg, *7883*.

Fairly common, particularly in open muskeg.

ALNUS CRISPA Ait. Shrub to 11 ft., among *Salix*, *Viburnum*, etc. on hillside by Bosworth Creek, *7384*.

In the immediate vicinity of Norman Wells, noted only at Bosworth Creek, but five miles up the Mackenzie River near the Royal Canadian Corps Signals Transmitters

it was one of the dominant species of the understory in an open *Picea glauca, Betula papyrifera* var. *humilis* association. It was a common shrub on wooded slopes to the east of the settlement.

ALNUS TENUIFOLIA Nutt. Small tree to 12 ft. in *Salix, Alnus, Populus* bush near Bosworth Creek, *7385*; shrubs to 9 ft. among *Populus, Salix* and *Picea,* Carcajou River, Mile 23E Canol Road, *7740*.

In the immediate vicinity of Norman Wells, noted only near Bosworth Creek; the map in Raup (1947) shows collections of this species from along the Mackenzie River near Fort Simpson, Great Bear River and Southern Mackenzie River delta.

SANTALACAEE

GEOCAULON LIVIDUM (Richards.) Fern., *Comandra livida* Richards. Dry hummock on bank of Bosworth Creek, *7395*; scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7965*; in shade of *Salix, Alnus* and *Picea,* Carcajou River, Mile 23E Canol Road, *7763*.

Hooker recorded *Comandra livida* ". . . to lat. 69° on the Mackenzie River." The species was not common in the Norman Wells area.

POLYGONACEAE

RUMEX TRIANGULIVALVIS (Danser) Rech. f., *R. mexicanus sensu* Raup, *R. salicifolius sensu* Hooker in part. Disturbed ground by buildings at airstrip, *7850*; occasional in disturbed ground on upper beach of Mackenzie River, *7939*.

These are probably the northernmost records for this species along the Mackenzie River. Hooker recorded *R. salicifolius* "Lake Winnipeg, to Great Bear Lake and the Mackenzie River." The northernmost specimen cited by Raup (1947) was from Simpson. This species seems to prefer disturbed localities and in our area sometimes appears to be introduced.

RUMEX OCCIDENTALIS Watson Rare in cleared muskeg, *7861*; sedge-grass border of lake, *7866*.

Only observed in open situations just east of the settlement of Norman Wells. This is a northwestern extension of range of some 450 miles from the Great Slave Lake localities cited by Raup (1936). I also collected this species in 1955 at Fort Simpson (Cody, in press) and it is certainly to be expected in suitable habitats in the intervening area.

POLYGONUM AVICULARE L. Prostrate along little used road in townsite, *7934*; plants standing upright, common along roadside and around buildings, *7796*; prostrate garden weed, *7424*; prostrate on sandy gravel, Carcajou River, Mile 23E Canol Road, *7755*.

It is quite possible that there are two entities here, one native and one introduced. The strains of *P. aviculare* occurring in North America have not been completely worked out and are treated here in the broad sense. *P. aviculare s.l.* is recorded by Hooker "throughout Canada, to lat. 65° . . ." These Norman Wells collections from 65°18'N thus substantiate Hooker's northern limit of range. It is fairly common in disturbed situations in the Norman Wells area.

POLYGONUM VIVIPARUM L. Rare along muddy bank of Bosworth Creek, *7360*; open *Salix-Alnus* flats of Bosworth Creek valley, *7649*; in partial shade of *Salix, Alnus* and *Picea,* Carcajou River, Mile 23E Canol Road, *7780*.

In the immediate vicinity of Norman Wells observed only along Bosworth Creek, but widespread throughout the north.

CHENOPODIACEAE

CHENOPODIUM CAPITATUM (L.) Asch. Rare, weed in garden, *7417*; Mile 74E Canol Road, *Metro Tomasky 21*.

Rare, possibly introduced at these locations (see Porsild, 1951). Hooker recorded this species only as far north as Great Slave Lake. The Norman Wells locality is a northward extension of range of some 150 miles from site on the Mackenzie River between Wrigley and Blackwater River listed by Raup (1947).

CHENOPODIUM BERLANDIERI Moq. var. ZSCHACKEI (Murr.) Murr. Among *Epilobium angustifolium* and *Populus* spp. at top of bank overlooking Mackenzie River, *7674*.

Fairly frequent in this habitat, but not noted elsewhere in the vicinity. The record "to Bear Lake" under *C. album* in Hooker should probably be referred here as also should the Fort Simpson and Providence collections of Raup (1947).

CHENOPODIUM GLAUCUM L. var. SALINUM (Standley) Boivin Rare on gravel beach of Mackenzie River, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7604*.

New to Mackenzie District; this is a range extension of some 700 miles from the Peace

River District from where there are several collections. Raup (1936) recorded a specimen from Fort McMurray in northern Alberta under *C. glaucum* and also mentioned a Back's Narrative record of "Athabasca" under this entity. *C. glaucum* var. *salinum* is apparently very rare in the Norman Wells area.

CORISPERMUM HYSSOPIFOLIUM L. Forming thick mats on eroding heavy soil on slope by airstrip, *7466*; rare on gravel beach of Mackenzie River, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7603*.

This is a range extension of some 325 miles downstream from Fort Simpson (Raup, 1947); noted only at the localities cited above.

CARYOPHYLLACEAE

STELLARIA CALYCANTHA (Ledeb.) Bong. Disturbed ground by Bosworth Creek, *7399*; among grass and *Equisetum* in grown-over area *7414*.

Occasional.

STELLARIA CRASSIFOLIA Ehrh. Mud of deep ditch, *7838*; disturbed ground by buildings, *7628*.

Occasional; not previously recorded from the area between Great Slave Lake (Cody, 1956) and the Arctic Coast (Porsild, 1943); forms flat mats except when found next to the warmth of buildings.

STELLARIA LONGIPES Goldie Open hillside by Bosworth Creek, *7375*; rare in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7547*.

Apparently rare in the area.

STELLARIA CILIATOSEPALA Trautv. Rare in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7550*; thick patch 3 ft. diameter in disturbed humus, *7530*; rare among grasses in open area at northeast end of airstrip, *7828*; shallow soil over rock on tundra hilltop, mile 44E Canol Road, *7712*.

Of rare occurrence in the area.

STELLARIA ATRATA (J. W. Moore) Boivin var. ATRATA, *S. longifolia sensu* Raup *pro parte* Disturbed ground by Bosworth Creek, *7397*.

Hooker recorded *S. longifolia* as "Woody country from lat. 54° to 64°." The most northern specimen cited by Raup (1947) was from Norman by an unknown collector; rare in the area.

STELLARIA ATRATA (J. W. Moore) Boivin var. ECILIATA Boivin, *S. longifolia sensu* Raup *pro parte*. Among grasses and sedges in disturbed humus, *7532*; among tall grasses at southeast end of airstrip, *7826*; large thick clump 4 ft. in diameter in disturbed humus by roadside 2 miles upstream from Norman Wells, *7552*; cleared heavy ground by roadside, same locality, *7544*.

See note under var. *atrata*; occasional in the area.

STELLIARIA MEDIA (L.) Cyrill. Rare weed in garden, *7468*.

Only noted once at Norman Wells; introduced, previously known in Mackenzie District from Yellowknife (Cody, 1956) and Fort Simpson (Raup, 1947), where the author has also collected it.

SAGINA NODOSA (L.) Fenzl Moist banks of broad roadside ditch, *7469*.

Hooker recorded *Spergula nodosa* as "Upper Canada, to the shores of the Arctic Sea, eastward of the Mackenzie River." Raup (1947) did not record any collections from below Fort Simpson on the Mackenzie River and apparently did not see the Richardson specimens on which Hooker based his record. Porsild (1943) has collected the species at McTavish Arm, Great Bear Lake. At Norman Wells it was only noted once along the road past the ball park, where it was quite common.

ARENARIA DAWSONENSIS Britton Rare in sod on open hillside by Bosworth Creek, *7376*; cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7541*; rare among grasses in open area at southeast end of airstrip, *7830*; cleared ground among grass, rare, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7607*.

Occasional; the nearest known localities to ours appear to be the east side of Great Bear Lake, some 250 miles to the east (Porsild, 1943) and Pelly River valley on the Canol Road, Yukon Territory, some 250 miles to the southwest (Porsild, 1951).

ARENARIA ROSSII R. Br. ssp. ELEGANS (C. & S.) Maguire Shallow soil over rock on tundra hilltop, Mackenzie Mountains, Mile 44E Canol Road, *7719* (det. Maguire).

Not noted in the immediate vicinity of Norman Wells but previously recorded from the east slope of the Mackenzie Mountains (Maguire, 1958; Porsild, 1945, *sub A. rossii*). Our specimens were loose-growing, with

long capillary pedicels and less fleshy leaves than specimens of typical *A. rossii* collected in the eastern Arctic. The distribution given by Maguire (1958) should be amended to read: Coastal and montane Alaska and Yukon of the Yukon River drainage *and the east slope of the Mackenzie Mountains.*

ARENARIA HUMIFUSA Wahl. Rare, small cushion on disturbed humus, *7533.*

Apparently not common in Mackenzie District and certainly rare in the Norman Wells area. Previously known in Mackenzie District from only eight localities: east end of Great Slave Lake, Brintnell Lake, Canol Road (2), Great Bear Lake (3) and Mackenzie River delta. Our specimens had mature seed when collected on July 24.

ARENARIA ARCTICA Stev. Shallow soil over rock on tundra hilltop, Mile 44E Canol Road, *7718.*

Porsild (1943) recorded this species from the mountains west of the Mackenzie delta and a single collection at Great Bear Lake; Raup (1947) added a site on the Mackenzie River between Blackwater and Norman; the former later (1951) reported it as common on limestone along the Canol Road east of the Mackenzie-Yukon divide. The species was not observed at Norman Wells.

NYMPHAEACEAE

NUPHAR VARIEGATUM Engelm. Rooted in ooze in shallow water along lakeshore inland from Norman Wells, *7870.*

Not common in this area but occurs far to the north.

RANUNCULACEAE

ACTAEA RUBRA (Ait.) Willd. Rare in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7614.*

Observed only at this one locality; this is an extension of range northward some 275 miles from previously known sites at Fort Simpson (Raup, 1947); Hooker recorded this species only as far north as 60°. The berries were still immature and green when collected on July 27.

ANEMONE PARVIFLORA Michx. Rare, protected spot by stack of pipes, *7473, 9566*; rare in open *Salix-Alnus* flats of Bosworth Creek valley, *7646*; rare in partial shade of *Salix, Alnus* and *Picea,* Carcajou River, Mile 23E Canol Road, *7779.*

Rare, found only at these three localities.

ANEMONE RICHARDSONII Hook. In moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7617.*

Rare; seen only at this locality.

RANUNCULUS GMELINII D.C. var. GMELINII In shallow water and on mud of roadside ditch, *7681*; wet sedge meadow areas in muskeg near Bosworth Creek, *7567.*

R. gmelinii is known as far north as the Arctic Coast. At Norman Wells it was not common, only being observed in the two localities cited.

RANUNCULUS LAPPONICUS L. Cleared moist muskeg, *7859.*

Rare; observed only once at Norman Wells.

RANUNCULUS SCELERATUS L. var. MULTIFIDUS Nutt. *R. scelertus* L. *sensu* Hooker. Rare in muck in ditch in townsite, *7637*; only one plant found in cleared ground among grass, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7608.*

This is an extension of range of some 425 miles northwestward from the only locality cited by Raup (1947), northwest shore of Great Slave Lake. Hooker recorded this species as ". . . from Canada to lat. 67°" so it is quite possible that it may yet be found still further north of our locality. The author has also collected it at Fort Simpson.

RANUNCULUS CYMBALARIA Pursh Rare in moist gravel by buildings, *7345.*

This is an extension of range of some 450 miles northwestward from the Great Slave Lake localities cited by Cody (1956). Norman Wells at a latitude of 65°17′N is, however, still far south of the 68° northern range recorded by Hooker. The species was only noted once in the Norman Wells area, where it was in both flower and fruit on July 18.

THALICTRUM ALPINUM L. var. ALPINUM Open *Salix-Alnus* flats of Bosworth Creek valley, *7641* (det. B. Boivin).

Previously known in Mackenzie District from only three localities: Nahanni Mountain, and Bolstead Creek and Macmillan Pass along the Canol Road. This is the first collection from east of the Mackenzie River and differs from the other Mackenzie District collections in that it was found in a lowland rather than an alpine habitat. It was observed only at the one locality.

THALICTRUM VENULOSUM Trel., *T. dioicum sensu* Hooker in part. Disturbed ground by buildings, rare, *7538A* (det. B. Boivin).

Hooker gave the range of *T. dioicum* as extending to lat. 67° on the banks of the Mackenzie River, but the nearest locality from which I have seen any *Thalictrum*, other than *T. alpinum* and the present collection, is Fort Simpson at 61°52′N, where both *T. venulosum* and *T. turneri* occur. It was only observed at the one locality.

FUMARIACEAE

CORYDALIS AUREA Willd. ssp. AUREA Cleared heavy ground and humus by roadside 2 miles upstream from Norman Wells, *7548*.

Noted only once in the area; this is the northernmost locality yet recorded along the Mackenzie River; to the east, however, it is known somewhat farther north at Sawmill Bay on Great Bear Lake (Cody, 1956).

CRUCIFERAE

DRABA NEMOROSA L. var. LEJOCARPA Lindbl. Disturbed ground by Bosworth Creek, *7398*.

Occasional at this locality but not noted elsewhere in the area; Hooker recorded *D. lutea* as occurring ". . . from lat. 56° to 66°. . ." but there have apparently been no recent collections from north of Fort Simpson (Raup, 1947) where I have also collected it.

THLASPI ARVENSE L. Disturbed ground by buildings, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7609*.

An introduced weed not noted elsewhere in the area; previously known in Mackenzie District from Great Slave Lake and Fort Smith (Cody, 1956).

LEPIDIUM SATIVUM L. Waste ground by buildings (by covered steam pipes near greenhouse), *7629*; rare weed in greenhouse, *7330*.

An escape from cultivation; not previously recorded from Mackenzie District; the nearest known localities are from the Peace River District and Lac la Biche in northern Alberta (Cody, 1956).

LEPIDIUM BOURGEAUIANUM Thell. Rare in moist disturbed ground by buildings, *7814*; occasional in heavy soil bordering airstrip, *7448* (both det. Mulligan).

Occasional in disturbed areas; Hooker recorded *L. ruderale* ". . . from lat. 50° to 68°. . . ," but the only Hooker specimen seen by Raup (1947) which might have substantiated this literature record, lacked locality data. Raup (1947) (*sub L. apetalum*) recorded only one other specimen and it was labeled simply "Mackenzie River." There are two species now known from the District, *L. bourgeauianum* and *L. densiflorum*; the Hooker reference based on Richardson's notes probably included both species; the Kennicott specimen cited by Raup has not been seen.

CAPSELLA BURSA-PASTORIS (L.) Medic. Common weed in garden, *7418*; around buildings, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7586*.

A common weed about buildings and waste ground along roadsides; Hooker recorded this species ". . . as far north as Great Bear Lake" but it seems doubtful if this species could have been introduced that far north at such an early date. It is known from Fort Simpson and elsewhere to the south in Mackenzie District (Raup, 1947; Cody, 1956).

DESCURAINEA RICHARDSONII (Sweet) O. E. Schulz Rare in heavy soil by airstrip, *7462*; eroding heavy soil on slope by airstrip, *7467*.

Observed only in this situation; the northernmost location previously recorded along the Mackenzie River is Norman (Raup, 1947) some 50 miles to the southeast.

DESCURAINEA SOPHIA (L.) Webb Common in disturbed ground by Bosworth Creek, *7400*.

Common in the above-mentioned locality but not noted elsewhere; an introduced weed previously known from Mackenzie District (Cody, 1956) but until now unrecorded from the valley of the Mackenzie River.

BRAYA HUMILIS (C. A. Mey.) Robins. On steep eroded river bank, local, *2815*; a single large plant in gravelly disturbed soil, *7339*; rare in sandy soil at southeast end of airstrip, *7329*.

Occasional in the area; found the length of the Mackenzie River.

ERYSIMUM CHEIRANTHOIDES L. Common in disturbed ground by Bosworth Creek, *7401*.

Not noted elsewhere in the area; recorded by Hooker "Throughout Canada . . . to lat. 67° on the Mackenzie."

RORIPPA ISLANDICA (Oeder) Borbas var. FERNALDIANA Butt. & Abbe, *R. islandica* var. *microcarpa* (Regel) Fern. Moist ground of roadside ditch, *7679*; common on beach particularly around sewage outlets, *7335*.

Occasional, especially in disturbed peaty situations; known to occur at least as far north as the Mackenzie River delta.

ARABIS HIRSUTA (L.) Scop. var. PYCNOCARPA (Hopkins) Rollins Rare in heavy soil by airstrip, *7450*; among grasses in disturbed ground at southeast end of airstrip, *7829*; occasional in sedge-willow meadow at edge of muskeg, *7479*; cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7542*.

Occasional in the area; usually found in disturbed situations where it is often more luxuriant; known as far north along the Mackenzie River as Good Hope (Raup, 1947).

SAXIFRAGACEAE

SAXIFRAGA AIZOIDES L. Rare among *Salix* on flats of Bosworth Creek valley, *7577*; moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7699*; Mackenzie Mountains, Mile 74E Canol Road, *Metro Tomasky 1* (DAO).

Observed only at Bosworth Creek in the immediate vicinity of Norman Wells. This is an arctic-alpine, amphi-atlantic element which strangely is not found north of Norman Wells either in the Mackenzie Mountains or along the Mackenzie River, but is known from numerous localities around Great Bear Lake. A map of its known distribution is given by Hultén (1958).

PARNASSIA PALUSTRIS L. var. NEOGAEA Fern., *P. montanensis* Fern. & Rydb. Moist sand, Cabin Creek, Mile 22E Canol Road, *7958*; sand, soil by Carcajou River, Mile 23E Canol Road, *7737*; fairly common on moist bank of Bosworth Creek, *7366*.

Fairly common at the Bosworth Creek site but rare elsewhere in the immediate vicinity of Norman Wells; Hooker recorded *P. palustris* ". . . as far north as the Arctic Circle . . ." and the map in Raup (1947) indicates that this species is known from the Mackenzie River delta. Rydberg (1932) separated *P. palustris* from *P. montanense* as follows: *P. palustris*, petals nearly twice as long as the sepals; hypanthium inconspicuous; staminodia 9-15 in each fascicle; *P. montanense*, petals only slightly exceeding the sepals; hypanthium conspicuous, obconic, fully half as long as the sepals and nearly as broad as high; staminodia 7-9 in each fascicle. The characters of sepal length, number of staminodia and hypanthium have, however, been found to vary independently from one collection to another. For example, *Turner 1985* collected near Fort Saskatchewan, Alta., has sepals 11 mm in length (as long as the sepals) and 10-12 staminodia in each fascicle. *P. montanense* was no doubt described from an extreme form with long sepals and fewer staminodia.

RIBES TRISTE Pallas Among scrub *Salix* and *Alnus* at northeast end of airstrip, *7817*; *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7613*.

Occasional in the area.

RIBES HUDSONIANUM Richardson Among willows and grasses in disturbed ground by roadside, *7804*; shrubs to 2 ft. among *Salix* on slope of Bosworth Creek, *7379*; rare on beach by small stream, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7601*.

Occasional in the area.

ROSACEAE

FRAGARIA VIRGINIANA Duch., *F. glauca* (Watson) Rydb. Sandy soil by Carcajou River, Mile 23E Canol Road, *7734*.

Not noted in the immediate vicinity of Norman Wells; Hooker recorded *F. virginiana* "Woody country between lat. 52° and 64°"; Raup (1947) did not record any specimens from north of Fort Simpson; our collection from slightly north of 65° is thus a range extension even beyond that cited by Hooker.

POTENTILLA FRUTICOSA L. Wet willow area in rich humus, *7511*; moist bank of Bosworth Creek, *7390*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7756*; Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7697*.

Occasional in the area.

POTENTILLA PALUSTRIS (L.) Scop. Rare in sedge meadow at edge of road, *7523*; moist shallow ditch through cleared muskeg, *7839*; rare on very moist bank of Bosworth Creek, *7662*.

Occasional in sedge meadows and borders of muskeg; Hooker recorded this species ". . . as far north as Bear Lake," from where Raup (1947) recorded a specimen collected

by *J. M. Bell.* Norman Wells is apparently the northernmost locality along the Mackenzie River from which this species has been recorded, but it should be looked for farther north, since it has been collected at Bathurst Inlet (*Campbell, 49* (DAO)), to the northeast.

POTENTILLA NORVEGICA L. Disturbed ground by Bosworth Creek, *7409.*

Hooker recorded this species "Throughout Canada; as far north as the Bear Lake." The map in Raup (1947) shows a collection from Fort Good Hope and several collections from the Mackenzie River delta to the north, but no mention is made of these in the text. Occasional in disturbed situations in the Norman Wells area.

POTENTILLA ANSERINA L. Scattered in disturbed ground along shore of Mackenzie River, *2805*; common on moist sandy beach of Mackenzie River, *7630*; disturbed ground around buildings, *7935.*

Fairly common along the shores of the Mackenzie River and occasional in disturbed situations in the townsite; our specimens appear to belong to that extreme of this polymorphic species which has been called *P. yukonensis* Hultén. Hooker recorded *P. anserina* ". . . from Lake Huron to the extreme Arctic regions . . .," in this species, however, he included specimens of the arctic species now separated as *P. egedii* Wormskj. var. *groenlandica* (Tratt.) Polunin. The northernmost record for *P. anserina* in Raup (1947) was Wrigley, some 175 miles to the southeast of Norman Wells.

DRYAS CRENULATA Juz. Prostrate, covering area 3 ft. in diameter, only one plant found in heavy soil by airstrip, *7461*; rare on valley slopes of Bosworth Creek, *7584.*

Occasional in the area; this plant, which is closely related to *D. integrifolia,* was recorded by Porsild (1947) from the Mackenzie River delta to the north.

DRYAS DRUMMONDII Rich. Forming large patches in sand at Cabin Creek and along roadsides, Mile 22E Canol Road, *7940*; patch 3 ft. diameter in sandy gravel, Carcajou River, Mile 23E Canol Road, *7743.*

Not noted in the immediate vicinity of Norman Wells.

GEUM PERINCISUM Rydb., *G. macrophyllum* Willd. var. *perincisum* (Rydb.) Raup Clearing around buildings, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7588.*

Not noted elsewhere in the area; Porsild has collected this species at Macmillan Pass, Mile 225E Canol Road some 160 miles to the southwest (Porsild, 1945; Raup, 1947); along the Mackenzie River the nearest collection with exact locality data is from Fort Simpson some 300 miles to the southeast (Raup, 1947).

RUBUS CHAMAEMORUS L. Cleared muskeg, *7862.*

Rare in the area.

RUBUS ARCTICUS L. ssp. STELLATUS (Sm.) B. Boivin var. ACAULIS (Michx.) B. Boivin, *R. acaulis* Michx. Among grass and *Equisetum* in grown-over area, *7415*; edge of scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7975.*

Occasional in open or semiopen situations.

RUBUS IDAEUS L. var. ACULEATISSIMUS Regel & Tiling, *R. idaeus* L. var. *canadensis* Richards., *R. strigosus* Michx. Shrub to 2 ft. in disturbed ground pushed up by bulldozers around airstrip, *7438.*

Rare, not noted elsewhere in the vicinity of Norman Wells; the northern limit of this species is apparently Peel River in the southern parts of the Mackenzie River delta (Raup, 1947).

ROSA BOURGEAUIANA Crépin, *R. acicularis* AA Shrub to 3 ft. along top of bank overlooking Mackenzie River, *7803*; occasional in cleared area, Royal Canadian Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7624*; Cabin Creek, Mile 22E Canol Road, *7957.*

Occasional in open wooded and cleared areas.

LEGUMINOSAE

ASTRAGALUS AMERICANUS (Hook.) M. E. Jones, *A. frigidus* (L.) Gray var. *americanus* (Hook.) Wats. Clearing on top of bank overlooking Mackenzie River, *7331*; among *Populus* at top of bank overlooking Mackenzie River, *7855.*

Fairly common in this situation but not noted elsewhere in the area; not previously recorded north of Fort Simpson (Raup, 1947), some 300 miles to the southeast.

ASTRAGALUS AGRESTIS Douglas, *A. goniatus* Nutt. Disturbed ground by roadside, *7806*; rare on clay beach of Mackenzie River, *7425.*

Rare in the area; this is a northwestward extension of range down the Mackenzie River from Hay River on Great Slave Lake some 475 miles (Cody, 1956).

ASTRAGALUS ALPINUS L. Heavy soil at edge of airstrip, *7435*; occasional in heavy soil bordering airstrip, *7449*; disturbed ground by buildings, *7321*; common everywhere on dry soil, *S. D. Hicks s.n.*, June 10, 1949.

Scattered in heavy, usually disturbed soil throughout the area; our specimens are quite robust and are similar to specimens from Fort Simpson. Raup (1947) thought that his Simpson specimens approached var. *brunetianus* Fern., but our collections cannot be placed there. Also, the Mackenzie Valley specimens which I have seen cannot be differentiated on the basis of comparative length of keel and standard following the treatment of Hultén (1941-52); the keel varies from slightly shorter to much longer than the standard on specimens from the same area and sometimes on the same plant.

Hultén *l.c.* has included Alaskan and Yukon specimens named *Atelophragma collieri* in *Astragalus occidentalis* (Wats.) Jones (sub *A. macounii* Rydb.) The specimen from Great Bear Lake (*Porsild 3751*) on which Porsild (1943) based the record of *Astragalus collieri* (Rydb.) Pors. has, among other characters, leaves pubescent on both sides and hence belongs to the *A. alpinus* complex rather than to *A. occidentalis*.

ASTRAGALUS EUCOSMUS Robinson A few scattered clumps in heavy soil by airstrip, *7460*.

Noted only in this situation; according to the map in Porsild (1957) this species is absent along the Mackenzie River between Great Slave Lake and Fort Good Hope but it was certainly to be expected there.

ASTRAGALUS YUKONIS M. E. Jones Scattered in disturbed ground along Mackenzie River, *2806*; prostrate on disturbed ground by buildings, *7320*; common on sand beach, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7598*.

Scattered along the Mackenzie River shore; rare in disturbed areas around buildings; not previously recorded from the area between Fort Simpson (Raup, 1947) and the Mackenzie River Delta (Porsild, 1943).

OXYTROPIS DEFLEXA (Pall.) DC. var. SERICEA T. & G., *O. retrorsa* Fern. Rare in moist disturbed ground by buildings, *7811*; scattered in moist disturbed ground, *7527*; rare in heavy soil by airstrip, *7447*.

Occasional in the area, apparently preferring disturbed situations; not previously known from along the Mackenzie River although it has been recorded from Great Slave Lake (Cody, 1956), Great Bear Lake and Eskimo Lake Basin (Porsild, 1943).

OXYTROPIS CAMPESTRIS (L.) DC. var. VARIANS (Rydb.) Barneby Clump in moist sand, Cabin Creek Mile 22E Canol Road, *7959*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7744*.

Not noted in the immediate vicinity of Norman Wells.

OXYTROPIS VISCIDA Nutt. var. HUDSONICA (Greene) Barneby Mackenzie Mountains: Hell's Gate in Dodo Canyon, Mile 32E Canol Road, *7685*.

Not noted in the immediate vicinity of Norman Wells.

HEDYSARUM ALPINUM L. var. AMERICANUM Michx. Common in disturbed ground along roadsides, *7797*; common in disturbed ground by buildings, *7323*.

Common in disturbed situations.

VICIA AMERICANA Muhl. var. AMERICANA Common in sod by buildings, *2814*; twining among low shrubbery, etc., on open hillside by Bosworth Creek, *7396*.

Hooker recorded *V. americana* ". . . to Bear Lake." The northernmost collection previously recorded with accurate locality data was from Saline River above Norman some 90 miles to the southeast.

LINACEAE

LINUM LEWISII Pursh Common in open places along bank overlooking Mackenzie River, *7333*; rare in disturbed ground east of townsite, *7534*; rare in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7556*.

Hooker recorded this species ". . . as far north as the shores of the Arctic Sea" but Raup (1947) stated that he had seen no material from north of Great Bear Lake. It will undoubtedly be found on the steep eroding banks of the Mackenzie River north of Norman Wells.

EMPETRACEAE

EMPETRUM NIGRUM L. Prostrate in drier parts of cleared muskeg, *7490*.

Observed only in this habitat.

VIOLACEAE

VIOLA RENIFOLIA Gray var. BRAINERDII (Greene) Fern., *V. blanda sensu* Hooker *pro parte*. Common in moss by creek in *Salix-Alnus-Picea* bush near Royal Canadian

Corps Signals Transmitters, 5 miles upstream from Norman Wells, *7615*.

Hooker recorded *V. blanda* "as high north as Fort Franklin, in lat. 66°" and Porsild (1943) recorded *V. renifolia* var. *brainerdii* from McTavish Arm, Great Bear Lake. Our specimens are apparently from near the northern limit of range in Mackenzie District; not noted elsewhere in the area.

ELAEAGNACEAE

ELAEAGNUS COMMUTATA Bernh., *E. argentea* Pursh Shrub to 10 inches in heavy soil by airstrip, rare, *7459*; shrubs to 4 ft. among *Populus balsamifera* along bank of Mackenzie River just above high water mark as shown by line of driftwood logs, *7978*; among open *Salix, Alnus* and *Picea,* rare, Carcajou River, Mile 23E Canol Road, *7771*; shrubs to 3 ft. in sand and gravel along Cabin Creek, Mile 22E Canol Road, *7943*.

Although Hooker recorded *E. argentea* ". . . to lat. 69° near the coast" the northernmost locality previously recorded is Norman, some 50 miles upstream from Norman Wells (Raup, 1947).

SHEPHERDIA CANADENSIS (L.) Nutt. Shrub to 15 inches, rare in cleared muskeg, *7522*; shrubs to 2 ft. among *Populus, Salix* and *Picea*, Carcajou River, Mile 23E Canol Road, *7742*; shrubs to 3 ft. in scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7966*.

Shepherdia canadensis forms part of the understory in the white spruce and poplar woods as well as borders of muskeg. It is reported to occur northward to the treeline on the Paleozoic formations.

ONAGRACEAE

EPILOBIUM ANGUSTIFOLIUM L. Under *Salix* spp. at top of bank overlooking Mackenzie River, *7676*.

Fairly common in this situation.

EPILOBIUM LATIFOLIUM L. Several small patches of disturbed ground by oil tanks *7529*; gravel bar of Bosworth Creek, *7658*.

Rare, noted only in the above situations.

EPILOBIUM PALUSTRE L. *s.l.* Moist ground of roadside ditch, *7680*; sedge-grass meadow by lake, *7882*; in moss in wet sedge meadow areas in muskeg near Bosworth Creek *7570*; in moss on *Salix-Alnus* flats of Bosworth Creek valley, *7664*.

Throughout the area in moist situations; Hooker recorded *E. palustre* β *albiflora* ". . . as far north as lat. 64° . . ." and Porsild (1943) stated that *E. palustre* was "Common northward beyond the limit of trees . . ."

EPILOBIUM GLANDULOSUM Lehm. var. ADENOCAULON (Haussk.) Fern. On beach around sewage outlets, *7336*.

Not noted elsewhere in the area; our record for this plant from north of 65° substantiates Raup's (1947) supposition that the record for *E. tetragonum* in Hooker ". . . . throughout the plains to lat. 64° . . ." should be referred to this species at least in part; otherwise unknown north of Fort Simpson (Raup, 1947), some 300 miles to the southeast.

HALORRHAGIDACEAE

MYRIOPHYLLUM VERTICELLATUM L. var. PECTINATUM Wallr. Rooted in ooze in shallow water along lakeshore, *7868*.

Rare; not noted elsewhere in the area; not previously recorded from north of Hay River on Great Slave Lake (Cody, 1956) some 450 miles to the southeast.

HIPPURIDACEAE

HIPPURIS VULGARIS L. In shallow water of roadside ditch, *7683*; in muck along border of lake, *7873*.

Rare; noted only in the above situations; Hooker recorded this species ". . . from Canada as far north as lat. 60°"; Raup (1947) cited a specimen from Norman and stated that its extent below Norman was unknown. Our collections from Norman Wells are thus the northernmost yet recorded from Mackenzie District.

UMBELLIFERAE

CICUTA BULBIFERA L. Sedge-grass border of lake, *7867*.

Not noted elsewhere in the area; previously unknown north of Wood Buffalo Park [Alberta] (Raup, 1935), and Lake Athabaska (Raup, 1936) some 600 miles to the southeast; new to the flora of Mackenzie District.

CORNACEAE

CORNUS CANADENSIS L. In moss by creek in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7618*; in shade of *Salix, Alnus* and *Picea*, Carcajou River, Mile 23E Canol Road, *7766*.

Noted only in the above situations; our collections are the northernmost with exact locality data yet recorded for Mackenzie District; see Porsild (1943) for discussion of the range of this species in Mackenzie District.

CORNUS STOLONIFERA Michx. Banks of upper Bosworth Creek near Norman Wells, *7669*; by creek in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7623*; Cabin Creek, Mile 23E Canol Road, *7950*; sandy soil among *Populus, Salix* and *Picea*, Carcajou River, Mile 23E Canol Road, *7738*.

Apparently confined to stream banks in our area; our collections are the northernmost yet cited from the Mackenzie River Valley, but Preble (1908) stated that it was found along streams throughout the woody country and the range in Hooker (*sub C. alba*) is given as ". . . from Lake Huron to North lat. 69°"; the nearest collection is from Bear River some 50 miles upstream from Norman Wells (Raup, 1947).

PYROLACEAE

MONESES UNIFLORA (L.) Gray Spruce, poplar, birch, alder hillside, upper Bosworth Creek valley, *7667*; in moss by creek in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7622*.

Occasional colonies in humus in wooded areas.

PYROLA SECUNDA L. Common in moss among *Picea, Betula, Salix* and *Alnus* on slope by Bosworth Creek, *7405*; in humus in *Salix, Betula, Picea, Populus* wood 2 miles upstream from Norman Wells, *7540*; scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7967*; in shade of *Salix, Alnus* and *Picea*, Carcajou River, Mile 23E Canol Road, *7760*.

Occasional colonies in humus in wooded areas.

PYROLA VIRENS Schweigg., *P. chlorantha* Sw. Rare in moss among *Picea, Betula, Salix* and *Alnus* on slope by Bosworth Creek, *7404*; occasional in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7611*.

Rare in humus in wooded areas.

PYROLA GRANDIFLORA Radius In moss among *Picea, Betula, Salix* and *Alnus* on slope by Bosworth Creek, *7403*; in humus in *Salix, Betula, Picea, Populus* wood 2 miles upstream from Norman Wells, *7539*; in moss by creek in *Salix, Alnus, Picea* bush near Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7621*.

Occasional colonies in humus in wooded areas.

PYROLA ASARIFOLIA Michx., *P. asarifolia* var. *incarnata* (DC.) Fern. Open *Salix, Alnus* flats of Bosworth Creek valley, *7648*; scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7968*; in shade of *Salix, Alnus* and *Picea*, Carcajou River, Mile 23E Canol Mackenzie Mountains, Mile 36E Canol Road, Road, *7761*; moist rocky slope, Dodo Canyon, *7701*.

Noted only at the Bosworth Creek site in the immediate vicinity of Norman Wells; these collections represent a slight northern extension of the known range from Mile 111E Canol Road (Porsild, 1945; Raup, 1947).

ERICACEAE

LEDUM GROENLANDICUM Oeder Shrub to 18 inches in cleared muskeg, *7842*.

Fairly common in this type of habitat and in the black spruce muskeg east of the airstrip.

RHODODENDRON LAPPONICUM (L.) Wahl. Hell's Gate in Dodo Canyon, Mackenzie Mountains, Mile 32E Canol Road, *7690*; Mile 74E Canol Road, Mackenzie Mountains, *M. Tomasky* 7 (DAO).

Not noted in the immediate vicinity of Norman Wells.

CASSIOPE TETRAGONA (L.) Don Shallow soil over rock on tundra hilltop, Mackenzie Mountains, Mile 44E Canol Road, *7715*.

Not noted in the immediate vicinity of Norman Wells.

ANDROMEDA POLIFOLIA L. Common in cleared muskeg, *7514*; in shade of *Salix, Alnus,* and *Picea*, Carcajou River, Mile 23E Canol Road, *7764*.

Found only in the above situations.

CHAMAEDAPHNE CALYCULATA (L.) Moench. Shrub to 1 ft. in sedge-willow meadow at edge of muskeg, *7482*; shrub to 15 inches along moist, shallow ditch through cleared muskeg, *7844*.

Fairly common in wet situations bordering muskeg.

ARCTOSTAPHYLOS UVA-URSI (L.) Spreng. Heavy soil around airstrip, *7445*; prostrate among *Salix* and *Alnus* at southeast end of airstrip, *7815*; prostrate in scrub poplar woods, Cabin Creek, Mile 22E Canol Road, *7963*.

Noted only in the above situations; our collections are apparently the northernmost

yet recorded with accurate locality data, the nearest collection being one of Porsild from Mile 51E Canol Road; see Raup (1947) for a discussion of the distribution of this species in Mackenzie District.

ARCTOSTAPHYLOS RUBRA (Rehd. & Wils.) Fern. Moist bank of Bosworth Creek, *7386*; scrub poplar woods, *7970*; Hell's Gate in Dodo Canyon, Mackenzie Mountains, Mile 32E Canol Road, *7686*; Mile 74E Canol Road, Mackenzie Mountains, *M. Tomasky 6* (DAO).

In the immediate vicinity of Norman Wells noted only at Bosworth Creek.

VACCINIUM ULIGINOSUM L. *s.l.* In sedge, willow meadow at edge of muskeg and in deep moss of muskeg, *7489*.

Fairly common in this situation.

VACCINIUM VITIS-IDAEA L. var. MINUS Lodd. Among scrub *Salix* and *Alnus* at southeast end of airstrip, *7816*.

Common in the black spruce muskeg and frequent in other wooded areas.

VACCINIUM OXYCOCCUS L. Among grasses, sedges and shrubs in cleared muskeg, *7846*.

Fairly common in this situation, but not noted elsewhere in the area; apparently new to Mackenzie District; Porsild (1938) referred all the Mackenzie District collections of the subgenus *Oxycoccus* which he saw to *Oxycoccus microcarpum*; the remainder of my own recent collections of this group also belong there.

VACCINIUM MICROCARPUM (Turcz.) Hook. Moss hummock in muskeg near Bosworth Creek, *7575*.

Rare in the area.

PRIMULACEAE

PRIMULA INCANA M. E. Jones Rare in moist gravel by buildings, *7344*; moist disturbed ground by buildings, *7810*; rare on muddy bank of Bosworth Creek, *7358*.

Occasional in the area; Porsild (1943) extended the known northern limit of range of this species from Great Slave Lake north to Bear Rock near Fort Norman, some 50 miles to the southeast; it is probable, however, that the part of the range included under *P. farinosa* by Hooker ". . . to lat. 66° on the Mackenzie River" belongs here, but the extent of this range remains to be verified.

PRIMULA STRICTA Hornem. Open *Salix*, *Alnus* flats of Bosworth Creek valley, *7645*.

Noted only in this situation at Norman Wells.

ANDROSACE CHAMAEJASME Host var. ARCTICA Knuth, *A. chamaejasme* Host var. *lehmanniana* (Spreng.) Boivin Open *Salix*, *Alnus* flats of Bosworth Creek valley, *7642*; rooted in broken rock, Dodo Canyon, Mackenzie Mountains, Mile 35E Canol Road, *7695*.

At Norman Wells noted only at the Bosworth Creek site.

GENTIANACEAE

GENTIANELLA AMARELLA (L.) Börner spp. ACUTA (Michx.) J. M. Gillett Moist disturbed ground around buildings, *7936*; small patch in disturbed ground by roadside, *7807*; among grasses in heavy soil on hillside overlooking Mackenzie River, *7513*; cleared moist muskeg, *7858*; among tall grass in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7593*.

Occasional in moist situations throughout the area; this is apparently a northwestward extension of the known range of some 50 miles from Norman; No. *7807* had white flowers which dried a light yellow with the lobes tinged slightly bluish; the typical phase has mauve flowers which turn blue upon drying.

GENTIANELLA PROPINQUA (Richards.) J. M. Gillett ssp. PROPINQUA. Open hillside by Bosworth Creek, *7368*; rare on moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 42E Canol Road, *7707*.

At Norman Wells noted only at the Bosworth Creek locality.

GENTIANELLA DETONSA (Rottb.) G. Don ssp. RAUPII (A. E. Porsild) J. M. Gillett, *Gentiana raupii* A. E. Porsild Moist disturbed ground by buildings, *7512*, *7838*; among grasses on upper beach of Mackenzie River, *7636*; open hillside by Bosworth Creek, *7367*; moist sand, Cabin Creek, Mile 22E Canol Road, *7947*; only 1 plant found in sandy gravel in partial shade, Carcajou River, Mile 23E Canol Road, *7947*.

Occasional stands in moist open situations; No. *7947* is remarkable for the variation in size of the individual plants: 2 to 25 cm in height with flowers 0.8 to 4.0 cm in length. The type (*A. E. Porsild, 6571* (CAN)) was collected on the Mackenzie River near Blackwater River, 62°30′N, some 125 miles upstream from Norman Wells, and the species has been recorded from the Mackenzie River delta (Gillett, 1957). The Mackenzie part of the range of *Gentiana*

detonsa in Hooker, "Cumberland House to Bear Lake," undoubtedly belongs here. The Bear Lake citation has been confirmed by a collection from McVicar Arm (*Wynne-Edwards, 8617* (CAN)).

LOMATOGONIUM ROTATUM (L.) Fries In shade in *Picea glauca* woods, upper Bosworth Creek valley near Norman Wells, *7671*.

Rare; apparently very spotty in its occurrence in Mackenzie District; this is apparently the first record with accurate locality data from along the Mackenzie River.

MENYANTHES TRIFOLIATA L. Rare among grasses, etc., in moist broad ditch through cleared muskeg, *7848*.

Rare, noted only once in the area; our specimens are without flowers or fruit; this is apparently the first collection with accurate locality data recorded from the Mackenzie River.

LABIATAE

SCUTELLARIA GALERICULATA L. var. PUBESCENS Bentham, *S. epilobiifolia* Hamilton, *S. galericulata* L. var. *epilobiifolia* (Hamilton) Jordal Rare in disturbed ground by buildings, *7627*; among grasses, *Epilobium angustifolium*, etc., by roadside, *7836*; rare in moist broad ditch through cleared muskeg, *7849*.

Rare, noted only in disturbed habitats in this area; these collections, which are the northernmost yet recorded along the Mackenzie River, substantiate the northern limit of range given by Hooker ". . . as far north as Fort Franklin on the Mackenzie River."

DRACOCEPHALUM PARVIFLORUM Nutt. Rare in disturbed ground, *7528*; rare in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7558*.

Rare in disturbed situations; the only record which might come from the Mackenzie valley is that of Raup (1947) based on a Richardson collection "Between Bear Lake and Cumberland House." Hooker recorded it as "Saskatchewan River to Fort Franklin." The northern limit of this range is now substantiated by our collection.

STACHYS PALUSTRIS L. var. PILOSA (Nutt.) Fern. Rare on creek bank on upper beach of Mackenzie River, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7600*.

Rare, not noted in the immediate vicinity of Norman Wells; recorded by Hooker "Throughout Canada to Fort Franklin on the Mackenzie River," but otherwise unknown downstream from between Wrigley and Blackwater R. (Raup, 1947); our collection thus substantiates the early observation of Richardson.

MENTHA ARVENSIS L. var. VILLOSA (Benth.) Stewart, *M. canadensis* L. var. *glabrata* Benth. Rare on creek bank on upper beach of Mackenzie River, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7599*.

Rare, noted only in this situation, apparently from near the northern limit of its range in Mackenzie District; the nearest records are from Fort Simpson, some 300 miles to the southeast (Raup, 1947).

SCROPHULARIACEAE

CASTILLEJA PALLIDA (L.) Spreng. ssp. PALLIDA var. CAUDATA (Pennell) B. Boivin Among *Equisetum arvense* in moist sand, Carcajou River, Mile 23E Canol Road, *7787*.

Not noted in the immediate vicinity of Norman Wells.

CASTILLEJA RAUPII Pennell ssp. URSINA Pennell Common in disturbed ground along roadsides, *7798*.

This is an extension of range northward from the Nahanni Mountains, where it was collected by Preble and Cary (Raup, 1947).

CASTILLEJA RAUPH Pennell ssp. URSINA Pennell Common in open places along bank overlooking Mackenzie River, *7332*; among *Bromus, Solidago*, etc., in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7595*.

Occasional in the area; the type of this subspecies was collected along the Bear River.

RHINANTHUS KYROLLAE Chab. Open hillside by Bosworth Creek, *7373*; clearing around buildings, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7587*.

Noted only in the above-mentioned situation; see Cody (1956) for discussion; this is apparently near the northern limit of range along the Mackenzie River and substantiates the record in Hooker ". . . to Fort Franklin."

PEDICULARIS LABRADORICA Wirsing Deep moss of partly cleared muskeg, *7488*; in moss in *Salix, Alnus* bush, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7610*.

Occasional in the area.

PEDICULARIS SUDETICA Willd. Open *Salix, Alnus* flats of Bosworth Creek valley, *7639*.

Noted only in this situation.

PEDICULARIS LANATA Cham. & Schl. Limestone ridge east of settlement, *Charles D. Bird s.n.*, May 30, 1953 (DAO).

Not noted by the author in the vicinity of Norman Wells.

OROBANCHASEAE

BOSCHNIAKIA ROSSICA (Cham. & Schl.) Fedtsch. Scattered in humus among *Picea, Betula, Salix* and *Alnus* on slope by Bosworth Creek, *7406*; humus in *Alnus, Betula, Picea, Salix* woods two miles upstream from Norman Wells, *7564*.

Parasitic on the roots of *Alnus crispa*; occurs sporadically throughout the area in habitats where *Alnus crispa* is found.

LENTIBULARIACEAE

PINGUICULA VULGARIS L. Rare, muddy bank of Bosworth Creek, *7357*; open *Salix, Alnus* flats of Bosworth Creek valley, *7644*; moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7700*.

Rare; noted only in the vicinity of Bosworth Creek at Norman Wells; Hooker recorded *P. vulgaris* as found on "Woody and barren territories to Mackenzie's River," but Raup (1947) recorded a specimen collected by Miss Taylor from as far north as Good Hope.

UTRICULARIA VULGARIS L. Rooted in ooze in shallow water along lakeshore, *7869*.

Fairly common in this situation; apparently not previously recorded along the Mackenzie River Valley between Mackenzie River delta (Porsild, 1943) and near Wrigley (Raup, 1947).

UTRICULARIA INTERMEDIA Hayne Shallow water among *Carex* in sedge meadow, *7860*.

Occasional in wet meadows; recorded by Hooker "Lake Huron . . . to Bear Lake" but apparently not otherwise recorded from along the Mackenzie River between Great Slave Lake (Raup, 1936) and Mackenzie River delta (Porsild, 1943), although it is certainly to be expected there. Porsild (1943) confirmed the occurrence of *U. intermedia* at Great Bear Lake, and Cody (1956) has found it in the Pre-Cambrian region between Great Slave Lake and Great Bear Lake.

PLANTAGINACEAE

PLANTAGO MAJOR L. Waste ground around buildings and in partial shade of *Populus* and long grass, *7684*.

This collection should probably be referred to var. *pilgeri* Domin (var. *asiatica sensu* Raup, 1936) for the leaves are thin and are held stiffly upright. The native Mackenzie valley material is, however, extremely variable and its relationships are not well known. It is therefore included with the typical species, which is an introduced weed throughout much of Canada. Hooker recorded *P. major* "from Lake Huron . . . to lat. 68°."

PLANTAGO CANESCENS Adams, *P. septata* Morris Disturbed ground along shores of Mackenzie River, *2811*; disturbed ground on open hillside by Bosworth Creek, *7382*; fairly common in moist disturbed ground by buildings, *7812*; rare in sandy gravel, Carcajou River, Mile 23E Canol Road, *7770*.

This species, which flowers in the latter half of July, seems to be confined to disturbed situations in our area.

RUBIACEAE

GALIUM BOREALE L. Occasional on upper beach of Mackenzie River, *7337*.

Recorded by Hooker ". . . to lat. 68° North . . ."; Raup (1947) reported that Porsild had collected it at Great Bear Lake and Mackenzie River Delta. Along the Mackenzie River, however, there are apparently no records from between Saline River above Norman (Raup, 1947) and Mackenzie River Delta.

GALIUM TRIFIDUM L. Rare among grasses, etc., in moist broad ditch through cleared muskeg, *7847*; sedge, grass meadow along lakeshore, *7878*; rare on beach by small stream, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7602*.

Occasional in low moist situations in open muskeg.

CAPRIFOLIACEAE

VIBURNUM EDULE (Michx.) Raf. Shrub to 4 ft. among *Alnus, Salix,* etc., on hillside by Bosworth Creek, *7383*; shrub to 18 inches among *Salix, Alnus* and *Picea,* Carcajou River, Mile 23E Canol Road, *7757*.

Occasional among other shrubs on better drained slopes; although Porsild (1943) stated that *V. edule* is occasional along the lower Mackenzie River, there are apparently no exact locality records from between Wrigley (Raup, 1947) and Mackenzie River delta (Porsild, 1943).

LINNAEA BOREALIS L. var. AMERICANA (Forbes) Rehd. Moist bank of Bosworth Creek, *7388*.

Occasional in wooded areas.

COMPOSITAE

SOLIDAGO MULTIRADIATA Ait. Moist rocky slope, Dodo Canyon, Mackenzie Mountains, Mile 36E Canol Road, *7706*.

Not noted in the immediate vicinity of Norman Wells.

SOLIDAGO CANADENSIS L. var. SALEBROSA (Piper) Jones, *S. lepida* DC. var. *elongata* (Nutt.) Fern., *S. lepida* DC. var. *fallax* Fern. Scattered in overgrown areas around buildings, *7416*; common in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7594*; sandy soil by Carcajou River, Mile 23E Canol Road, *7732*.

Occasional in cleared areas adjacent to the Mackenzie River; our specimens more than substantiate the northern limit of range given by Hooker under *S. canadensis* ". . . from Lake Huron to Fort Franklin, on the Mackenzie River"; the northernmost collection previously recorded was from Saline R. above Norman (Raup, 1947; Porsild, 1945), some 90 miles to the southeast.

ASTER SIBIRICUS L. Moist bank of Bosworth Creek, *7387*; rare in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7596*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7767*.

Occasional in the area.

ASTER ERICOIDES L. s.l. Moist disturbed ground by buildings, *7813*; occasional along bank overlooking Mackenzie River, *7334*; occasional in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7551*, *7555*.

Our specimens are a good match for other collections from Fort Simpson and elsewhere along the Mackenzie River, the root is hard and cormlike, the pubescence of the stem is appressed, the inflorescence is branched, the peduncle is naked or at most with one or two bracteoles and the involucre measures 4-6.5 mm in height. Raup (1947) referred his Fort Simpson specimens as well as other Mackenzie River collections to *A. falcatus* Lindl. apparently with some hesitation. He stated that his material resembled a part of the type of *A. falcatus* at Gray Herbarium but that the latter was a strict plant with relatively few heads. *A. falcatus* is decribed elsewhere (Cronquist, 1955) as a plant with well-developed creeping rhizomes and if this is true our plant could not possibly be called *A. falcatus*.

At least two other entities of the *A. ericoides* group are represented in Mackenzie District: the first is a tall (6 dm) plant with cinereous leaves and spreading pubescence on the stem with a branching inflorescence and imbricated tegules, which is found on the Salt Plains west of Fort Smith (*C.C. Loan, 314* (DAO)); the other is a smaller (1.0-2.3 dm) plant from a cormlike root, with a strict inflorescence, appressed pubescence on the stem, bracteolate pedicels and imbricated tegules (*C.C. Loan, 192* (DAO)).

Our collections from Norman Wells are the northernmost yet recorded for the *A. ericoides* complex in Mackenzie District. This is a small extension of range from Saline R. above Norman (Raup, 1947). The range given in Hooker for *A. falcatus* is "Arctic America" which is certainly erroneous, and for *A. ramulosus*, which was described on the next page and is now considered a synonym, "Saskatchewan to Fort Franklin on the Mackenzie River . . . ."

ERIGERON ANGULOSUS Gaudin var. KAMTSCHATICUS (DC.) Hara, *E. acris* L. var. *asteroides* (Andrz.) DC. Wet peaty area east of town, rather rare, *2819*, *2820*; common on open hillside by Bosworth Creek, *7371*; among grasses and *Epilobium angustifolium* in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7591*.

Occasional in more or less disturbed situations; recorded by Hooker ". . . from the Saskatchewan to Fort Franklin on the Mackenzie River"; Porsild (1943) has recorded this plant from several localities around Great Bear Lake, but ours are the northernmost yet cited from the Mackenzie River.

ERIGERON LONCHOPHYLLUS Hook. Open hillside by Bosworth Creek, *7370*; moist sand, Cabin Creek, Mile 22E Canol Road, *7952*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7781*.

In the immediate vicinity of Norman Wells, noted only at the Bosworth Creek site; a range extension of some 500 miles from Fort Smith and Yellowknife (Cody, 1956).

ERIGERON HYSSOPIFOLIUS Michx. Among *Salix* on flats and slopes of Bosworth Creek valley, *7581*; rare on sandy gravel in shade, Carcajou River, Mile 23E Canol Road, *7758*.

Occasional at the Bosworth Creek site but not noted elsewhere in the area; our collection is the northernmost yet recorded from along the Mackenzie River, the nearest collection is from Mile 51E Canol Road (Porsild, 1945); Raup (1947) mentioned a J. M. Bell specimen from Great Bear Lake, but gave no definite locality.

ANTENNARIA PULCHERRIMA (Hook.) Greene Rare among *Salix* on flats of Bosworth Creek valley at Norman Wells, *7580*; in sandy soil by Carcajou River, Mile 23E Canol Road, *7735*; in moist sand of scrub area, Cabin Creek, Mile 22E Canol Road, *7949*.

Rare; in the immediate vicinity of Norman Wells noted only at Bosworth Creek.

ACHILLEA SIBIRICA Ledeb. Occasional around buildings, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7589*.

Not noted elsewhere in the area.

ACHILLEA LANULOSA Nutt. Occasional on upper beach, *7738*; ligules purplish, rare with typical form, *7795*; clump 2 ft. in diameter at top of bank overlooking Mackenzie River 2 miles upstream from Norman Wells, *7554*; sandy soil by Carcajou River, Mile 23E Canol Road, *7733*.

Occasional, usually in light soil or disturbed areas. The average outside diameter of pollen grains for these collections was as follows, *7338*: 3.09μ (29.3 to 32.5μ); *7554*: 29.9μ (27.7 to 30.9μ); *7733*: 29.1μ (27.7 to 30.9μ); *7795*: 29.3μ (27.7 to 32.5μ). Hence, they belong to *A. lanulosa* rather than the european *A. millefolium* L. or the arctic *A. borealis* Bong. (see Mulligan, G. A., and I. J. Bassett, 1959).

MATRICARIA MATRICARIOIDES (Less.) Porter Only one plant found by buildings, *7794*; around buildings Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7585*.

Introduced; rare at the Norman Wells site, but forming a large patch covering about 20 square feet at the Transmitter site; previously recorded from several localities in Mackenzie District, but until now unrecorded from the Mackenzie River valley.

ARTEMISIA CAUDATA Michx. var. DOUGLASIANA (Besser) Boivin, *A. canadensis sensu* Raup (1947). Rare, clump in disturbed ground by buildings, *7324*; clumps in cleared heavy ground by roadside 2 miles upstream from Norman Wells, *7557*.

Occasional in disturbed situations; No. *7557* has flower heads somewhat larger than is usually found in var. *douglasiana* thus approaching var. *rydbergiana* Boivin; this plant is known from as far north along the Mackenzie River as 30 miles north of the Arctic Circle (Raup, 1947).

ARTEMISIA BIENNIS Willd. Disturbed ground by buildings at airstrip, *7851*; rare in disturbed ground in cleared area, Royal Canadian Corps Signals Transmitters 5 miles upstream from Norman Wells, *7597*.

Occasional in disturbed areas; Raup (1947) reported that Porsild had collected this species as far north along the Mackenzie as the Ramparts above Good Hope, but otherwise it is unknown north of Fort Simpson.

ARTEMISIA TILESII Ledeb. Among *Epilobium angustifolium* and *Populus* spp. at top of bank overlooking Mackenzie River, *7675*; near Carcajou River, mile 24E Canol Road, *7726*.

Occasional along the bank of the Mackenzie River.

PETASITES SAGITTATUS (Banks) A. Gray Rare in sedge meadow at edge of muskeg, *7491*.

Rare; no flowers were found on July 23; not previously recorded for the area between Fort Simpson (Raup, 1947) and Mackenzie River delta (Porsild, 1943); see Porsild (1943) for a discussion of the records for *Petasites* (*Nardosmia*) in Hooker.

ARNICA FRIGIDA Meyer Rooted in broken rock, Dodo Canyon, Mackenzie Mountains, Mile 35E Canol Road, *7694*.

Not noted in the immediate vicinity of Norman Wells.

SENECIO INDECORUS Greene Moist disturbed ground, *7525*, *7526*; rare on open hillside by Bosworth Creek, *7380*.

Occasional; the northernmost collection previously recorded was a Richardson specimen labeled "Mackenzie R., Fort Franklin" (Raup, 1947). Whether this specimen was collected along the Mackenzie River or at Fort Franklin on Great Bear Lake at the source of the Bear River cannot be determined now. Our specimens are probably from near the northern limit of the species in the Mackenzie valley.

SENECIO PAUPERCULUS Michx. var. FLAVOVIRENS (Rydb.) Boivin, *S. pauperculus sensu*

Raup (1947) Open *Salix, Alnus* flats of Bosworth Creek valley, *7647*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7782*.

Rare, noted only at the Bosworth Creek site in the vicinity of Norman Wells; our specimens are apparently the northernmost yet collected along the Mackenzie River valley, and form an extension of the known range of some 115 miles downstream from Saline R. above Norman (Raup, 1947).

SENECIO CONGESTUS (R.Br.) DC., *S. congestus* (R.Br.) DC. var. *palustris* (L.) Fern. Rare in disturbed ground by Bosworth Creek, *7411*.

Rare in wet situations; Hooker recorded *S. palustris* "From the Saskatchewan . . . to the extreme Arctic islands . . ." but with the exception of a Mackenzie River specimen without any exact locality cited by Raup (1947) this early record has not been substantiated in print.

SAUSSUREA ANGUSTIFOLIA DC. Moist peat of open muskeg, *7884*.

Noted only in this situation; Raup (1947) recorded a Mackenzie River collection by Hardisty but this specimen lacked exact locality data; our specimens are thus the first accurately located for the Mackenzie River between Great Slave Lake and the Mackenzie River delta; our specimens had good seed when collected on Aug. 10. The type of *S. angustifolia* var. *yukonensis* A. E. Porsild was collected at Mile 111E Canol Road in the Mackenzie Mountains, some 70 miles to the southwest.

CREPIS ELEGANS Hook. Mile 24E Canol Road near Carcajou River, *7728*; sand and gravel by Cabin Creek, Mile 22E Canol Road, *7945*.

Apparently not common in Mackenzie District; previously known from Fort Simpson, mouth of N. Nahanni R., Norman (Raup, 1947) and Bear River (Porsild, 1943); our collections are thus the northernmost record from Mackenzie District; not noted in the immediate vicinity of Norman Wells.

HIERACIUM CANADENSE Michx. var. SCABRUM Schwein., *H. scabriusculum* Schwein. Disturbed ground by roadside, Cabin Creek, Mile 22E Canol Road, *7962*; sandy soil by Carcajou River, Mile 23E Canol Road, *7731*.

Not noted in the immediate vicinity of Norman Wells; our collections are the northernmost yet recorded from the Mackenzie River valley; Porsild (1943, *sub H. canadense*) recorded it from Mt. Charles on the Bear R. and McTavish Arm, Great Bear Lake.

TARAXACUM LACERUM Greene Rare in disturbed ground on open hillside by Bosworth Creek, *7381*; sandy gravel, Carcajou River, Mile 23E Canol Road, *7769*.

Rare; in the immediate vicinity of Norman Wells noted only at Bosworth Creek.

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Received for publication 17 February 1959

OBSERVATIONS ON THE HABITAT, FOOD, REPRODUCTIVE STATE AND INTESTINAL PARASITES OF THE SMOOTH GREEN SNAKE AT LONDON, ONTARIO

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TOWARDS the end of May, 1957, it was discovered that specimens of the smooth green snake *Opheodrys vernalis vernalis* (Harlan) were common in a patch of ground about 1.7 acres in area at the southern limits of London, Ontario (Figure 1). The site is close to the southerly limits of three city streets and is bounded on the west, north and east by streets and pathways and on the south by the edge of a large gravel pit. A search for more snakes was made in the area surrounding the patch of ground but no more were found. During the summer of 1957 observations were made on the habitat of the snakes and nineteen specimens were collected, measured and dissected. The data were assembled while the writer held a summer research associateship of the National Research Council.

HABITAT

The soil in the patch of ground is sandy loam with rough gravel a few inches below the surface. When the place was first visited at the end of May the dominant vegetation was grass, which covered the whole area. During subsequent weeks several coarse weeds grew and came into bloom, including butterfly-weed (*Asclepias tuberosa*), viper's bugloss (*Echium vulgare*), white sweet clover (*Melilotus officinalis*), red clover (*Trifolium pratense*), alfalfa (*Medicago sativa*), yarrow (*Achillea millefolium*), toadflax (*Linaria vulgaris*), and Queen Anne's lace (*Daucus carota*). Most of these species were represented by scattered plants but the sweet clover and Queen Anne's lace grew thickly over the whole area and by August they were dominant, forming a heavy growth of vegetation up to five feet tall.

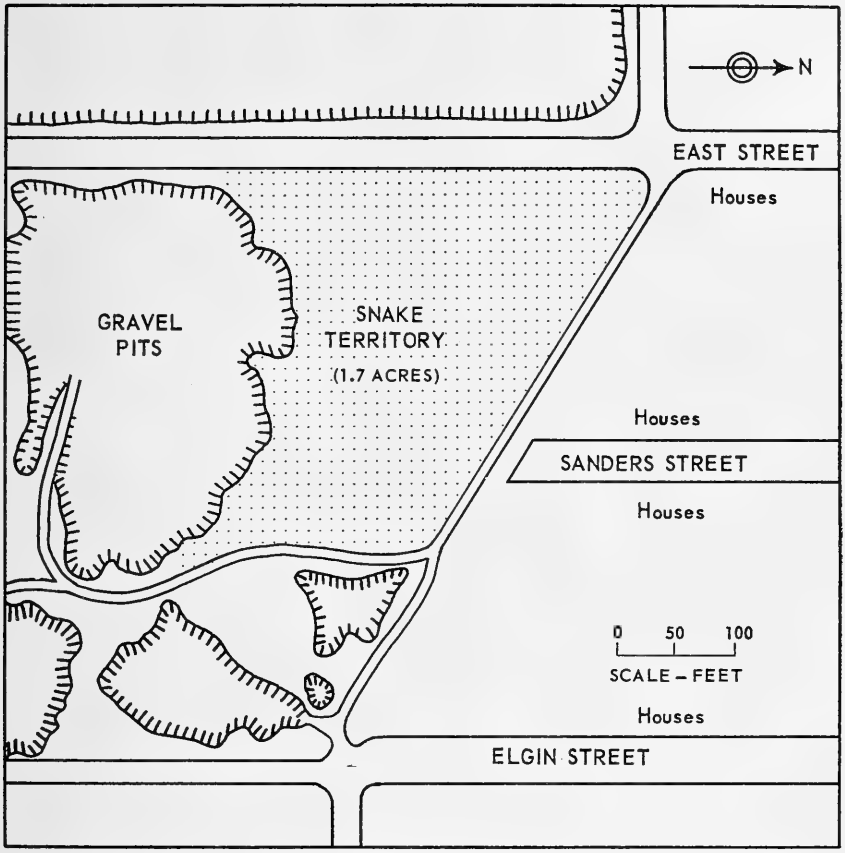

FIGURE 1. Map showing territory inhabited by smooth green snake at London.
The map was derived from a tracing of an aerial photograph taken in April 1957 for the use of the London and Suburban Planning Board.

The snakes were collected during the day on eight days (Table 1) during the season. Four were found in the open, one of them coiled up in the sun on a grassy patch on June 29 and the three others moving about in the grass. The other fifteen snakes were found under shelters lying loosely on the ground, including bits of tar paper, flattened cardboard boxes, pieces of plywood, flat rocks, loose boards, flattened tins, bits of mattress stuffing, asphalt shingles and broken blocks of cement. No snakes were found under objects which were firmly settled into the ground.

LENGTH OF SNAKES

After the nineteen snakes were collected and killed with a cyanide jar each snake was measured by being placed flat against the edge of a ruler. The total length and the length of the tail were recorded (Table 1). The longest snake,

No. 16, was 53.2 cm long. This length is greater than the length of snakes recorded by Cope (1900) and Pope (1944) but less than maximum lengths reported by Ditmars (1932): 24 in., Bishop (1927): 21., and Wright and Wright (1957): 26 in. The average lengths of the seven males measured was 35.1 cm and of the eight females measured was 46.0 cm. Pope (1944) also records that the average length of females exceeds that of males.

FOOD

After the snakes had been measured they were dissected so that ingested food might be removed from the digestive tract. This was accomplished by placing each snake ventral side up in a wax tray and slitting the ventral integument along the midventral line from the anus to the head, by using fine scissors. The integument was pinned back on each side to the wax and three parts of the digestive tract, namely the esophagus and stomach together, the midgut, and the rectum, were snipped out separately. Each of these parts was placed in water in a watch glass and was slit along its length and the ingested food was removed and recognizable items of food were identified. These items consisted of complete small invertebrates or dissociated parts of invertebrates such as heads, wings, bits of integument, carapaces, legs, terga and sterna of body segments. The minimum numbers of invertebrates, which could be deduced from examination of the items present as forming the food of the snakes, are shown in Table 1.

The food of the snakes, in order of decreasing abundance, consisted of caterpillars (46), spiders (36), moths (10), crickets (5), praying mantids (5)

TABLE 1. DATA PERTAINING TO NINETEEN SNAKES COLLECTED AT LONDON

Snake	Date	Length (cm)		Food Items						Reproductive State	Parasites		
		Total Length	Length of Tail	Caterpillars	Spiders	Moths	Crickets	Mantids	Harvestmen		*Oochoristica*	*Aplectana*	*Physaloptera*
1	May 26	42.0	12.7	4	1	1				♀ – 6 eggs	+		
2	May 27	42.0	12.1	6	3		1			♀ – 5 eggs	+		
3	May 27	39.2	11.9	5	5				1	♀ – 5 eggs	+		
4	May 29	14.7	3.8	2						?			
5	May 29	13.4	3.5	2						?		+	
6	May 29	41.5	12.1	4	10	2				♀ – 7 eggs	+		
7	May 30	15.5	4.8	3	2					?			
8	May 30	35.1	11.8	1	4	1				♂	+		
9	May 30	46.0	13.3	5	2		1			♀ – 7 eggs			
10	May 31	39.0	13.2	2	3	2				♂	+		+
11	May 31	51.5	14.8	1	1	3	1			♀ – 11 eggs	+		
12	May 31	34.4	11.2	2	2					♂	+		+
13	June 29	37.4	12.8							♂			
14	June 29	34.7	11.0					4		♂	+		
15	June 29	45.4	16.0	2						♂	+		+
16	June 29	53.2	15.9	3						♀ – 9 eggs	+		+
17	June 29	19.5	6.1					1		♂			
18	Aug. 7	52.4	15.1	2	2	1	2			♀	+		
19	Sept. 30	?	?	2	1					♂	+		

and one harvestman. The caterpillars were mostly smooth cutworms (Phalaenidae) though other kinds, including small green caterpillars, were present. In the esophagus and stomach of five snakes there were seven intact caterpillars, the largest of these being smooth cutworms up to 3 cm in length. Also in this region of the digestive tract and in the midgut and rectum were abundant remains of caterpillars, such as head capsules, portions of integument, etc. The greatest number of caterpillars, six, was found in snake No. 2. The spiders were mainly small gray or brown ones. Six complete spiders were present in the esophagus and stomach of four snakes, and the remains of other spiders were legs and carapaces of the cephalothorax. The greatest number of spiders, ten, was found in snake No. 6. The moths were brown ones of the family Phalaenidae and were represented by heads, legs, wings, etc. Only one complete cricket, a nymph, was found (snake No. 18); other remains consisted of head capsules, wings, legs and the lining of a proventriculus. This last was recognizable as being from the field cricket *Gryllus assimilis* as identified by keys and descriptions in Judd (1948). Five specimens of *Mantis religiosa* were found in the snakes, including a complete nymph and parts of three other nymphs in snake No. 14 and sclerites of another nymph in snake No. 17. *Mantis religiosa* was recorded first from London by Judd (1953) in 1950. One harvestman (Phalangida) was found in the stomach of snake No. 3. The greatest number of invertebrates in the food of one snake — four caterpillars, ten spiders, and two moths — was in snake No. 6 Only in the esophagus and stomach were any invertebrates intact; in the rest of the digestive tract the parts of the body had fallen apart.

In order to assess the extent to which the snakes selected their items of food from among the available invertebrates, samples were taken of the invertebrates in the habitat of the snakes. As the snakes were collected, invertebrates were also collected from beneath the shelters occupied by the snakes. These were earthworms, slugs, snails, sowbugs, centipeds, millipeds, ants, ground beetles (Carabidae), crickets (Gryllidae), spiders, caterpillars (Phalaenidae) and moths (Phalaenidae). Only the last four of these were represented in the food of the snakes. A sampling of the invertebrates in the vegetation was also made on five days during the summer (Table 2). This was accomplished by making, on each day, five circular sweeps at separate places in the area. Each sweep was made low in the vegetation with an insect net. The net had a mouth one foot wide and was swept over the circumference of a circle six feet in radius. The invertebrates so collected were counted. The counts for each day are presented in Table 2. The only items in this list which were represented in the food of the snakes were spiders, crickets and caterpillars. No praying mantids were collected in the sweep but a nymph was seen in the grass on August 7 and adults were seen on September 30. It is concluded from these data that the snakes selected as food spiders, crickets, caterpillars and moths, deriving them mainly from beneath the shelters inhabited by the snakes and that also they occasionally took larger items such as caterpillars, mantids and harvestmen from the ground or vegetation.

Accounts of the food of the smooth green snake are given by several authors, including Bishop (1927), Blanchard (1932), Ditmars (1915, 1930,

TABLE 2. COUNTS OF INVERTEBRATES FROM SWEEPS MADE IN VEGETATION

	June 2	June 29	Aug. 7	Sept. 30
Spiders (Araneida)	5	0	8	2
Grasshopper nymphs (Acrididae)	0	1	0	0
Crickets (Gryllidae)	0	0	1	0
Aphis-lions (Chrysopidae)	0	0	1	0
Lady beetle larvae (Coccinellidae)	0	0	6	0
Lady beetle adults (Coccinellidae)	0	0	5	0
Weevils (Curculionidae)	1	12	0	1
Other beetles (Coleoptera)	0	1	1	0
Bugs (Nabidae)	0	3	0	0
Assassin bugs (Reduviidae)	0	0	1	0
Plant bug nymphs (Miridae)	102	0	6	3
Plant bug adults (Miridae)	0	6	14	12
Leafhopper nymphs (Cicadellidae)	0	5	0	0
Leafhopper adults (Cicadellidae)	3	1	8	1
Spittle bug nymphs (Cercopidae)	2	0	0	0
Spittle bug adults (Cercopidae)	0	144	27	25
Plant lice (Aphididae)	14	15	0	1
Damsel flies (Coenagriidae)	5	0	0	0
Caterpillars (Lepidoptera)	7	1	3	0
Skippers (Hesperiidae)	0	1	0	0
Sawfly larvae (Tenthredinidae)	5	0	0	1
Wasps (Ichneumonidae)	5	0	0	0
Small wasps (Hymenoptera)	7	0	1	0
Ants (Formicidae)	1	2	0	0
Crane flies (Tipulidae)	1	0	0	0
Small flies (Diptera)	36	9	1	1

1932), Logier (1939), Pope (1944), Schmidt and Davis (1941), Williams (1913) and Wright and Wright (1957). The list of items included by these authors as food of this snake comprises salamanders, slugs, snails, centipeds, millipeds, spiders, crickets, grasshoppers, caterpillars, and "other invertebrates". Most of these authors conclude that a preference is shown particularly for caterpillars, but also for spiders, crickets and grasshoppers. Blanchard (1932) reports refusal of bugs, ants, slugs, centipeds and sowbugs and Blanchard (1932) and Ditmars (1930) both report refusal of earthworms. The present study indicates that the snakes in the population at London selected caterpillars and spiders particularly, but also took moths, crickets and mantids and excluded from their diet earthworms, slugs, snails, centipeds, millipeds and sowbugs as well as some insects.

REPRODUCTIVE STATE

Eight of the snakes were recognized as males by the presence in them of two testes each. Eight were females and of these seven contained in their reproductive systems developing eggs from 5 to 11 in number, as shown in Table 1. The average number of eggs per female was 7.1. Wright and Wright (1957), recording data from several egg counts, report that the number of eggs per female ranges from 3 to 12 with an average of 7.4. Snake No. 18, collected on August 7, had evidently laid its eggs, for the reproductive ducts were large and membranous but flaccid and empty. Blanchard (1932), Logier (1939), Pope (1944), Surface (1906) and Wright and Wright (1957) report

egg-laying dates from June 24 to September 15, dates in late July and early August occurring most commonly.

PARASITES IN THE DIGESTIVE TRACT

When the digestive tracts of the snakes were being examined for their food content they were also examined for parasites. These were removed and preserved and were identified by Miss G. A. Webster, Institute of Parasitology, McGill University, who retained for the collections of the institute specimens of the three species of worms present and returned the remaining specimens for the collection of the Department of Zoology, University of Western Ontario. The distribution of the worms in the snakes is shown in Table 1.

Cestoda

Anoplocephalidae

Oochoristica (*natricis* Harwood?)

This tapeworm was the commonest parasite and was found in thirteen snakes. In most cases there were several worms in each snake, the majority of them in a crowded mass at the anterior end of the midgut though with scattered individuals farther back in the midgut. Worms of the genus *Oochoristica* are chiefly parasites of snakes and lizards, but also occur in mammals (Loewen, 1940; Wardle and McLeod, 1952).

Nematoda

Oxyuridae

Aplectana sp.

One male worm was found in the midgut of snake No. 5. Worms of this genus are parasites of amphibia and reptiles (Olsen, 1938; Yorke and Maplestone, 1926).

Physalopteridae

Physaloptera sp.

One larva was found in the stomach of each of four snakes. Worms of this genus are parasites of mammals, birds and reptiles (Chandler, 1949; Yorke and Maplestone, 1926). Chandler (1949) reports that in all cases in which the life cycles have been worked out the eggs are swallowed by coprophagous insects and that infection of the final host results from swallowing of the intermediate host. For the population of snakes at London, likely intermediate hosts are crickets which are omnivorous and which are eaten by the snakes.

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Received for publication 22 September 1958

OBSERVATIONS ON SNOWY OWLS AT DELTA, MANITOBA

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INTRODUCTION

DESPITE the fact that the Snowy Owl, *Nyctea scandiaca*, is one of the most frequently studied of our arctic birds, surprisingly little has been published on weights and other measurements, age and sex ratios, and the day-to-day movements of winter residents. During a recent five-month stay at the Delta Waterfowl Research Station, Delta, Manitoba, I had the opportunity to observe migrating and wintering Snowy Owls and to secure certain post-mortem measurement data.

I should like to thank H. Albert Hochbaum of the Delta Waterfowl Research Station for his spring observations of Snowy Owls and for his comments and criticisms on the manuscript. Dr. Robert A. McCabe of the University of Wisconsin also read the manuscript and made many helpful suggestions.

MEASUREMENT DATA

The data which follow were obtained from nine owls taken in traps situated at or near a waterhole used by the research station's captive duck flock, and from four others shot by local hunters.

Bursa Depth

The bursa of Fabricius as an age criterion has been utilized extensively by wildlife managers ever since Gower (1939) first drew attention to it. Studies on the regression of the bursa have been conducted for a number of game birds (Hochbaum, 1942; Hanson, 1949; Stokes, 1954, p. 75), but nongame species have been almost wholly neglected. Generally the bursa is completely resorbed within the first year of life. However, in the Canada Goose, *Branta canadensis*, a bird that does not usually breed until its third year, the bursa persists longer, although continuing a steady decrease in size. As far as I am able to determine, nothing has been reported to date concerning bursal regression in Snowy Owls.

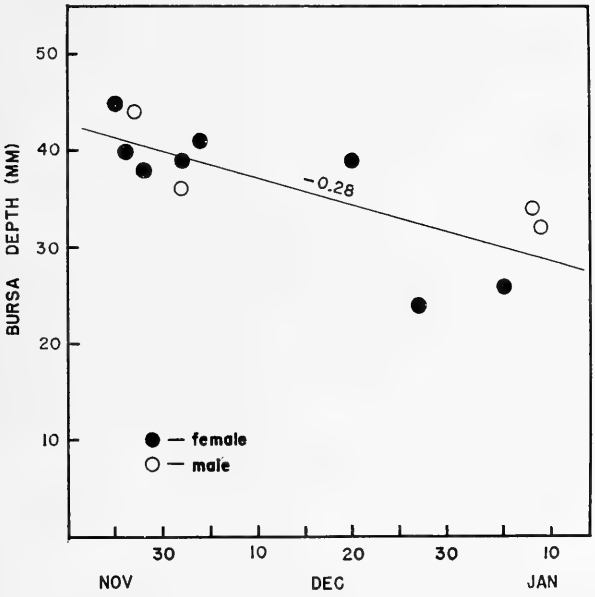

FIGURE 1. Regression of the bursa of Fabricius in Snowy Owls.

Bursa measurements were secured by inserting a probe into the bursa through the vent. These data have been graphed and the regression of the bursa against time computed (Figure 1). Judging from the depth of the bursa in owls I examined, it appeared that all were juveniles (birds hatched the previous summer). This was corroborated in every case by an inspection of the plumage at the base of the neck. As Bent (1938, p. 364) has pointed out, juvenile birds retain a conspicuous patch of drab down beneath their contour feathers in this area.

Assuming that the rate of bursal regression is fairly constant and that a reduction of 0.28 mm per day (Figure 1) is reasonably close to that which normally occurs, we can, through extrapolation of the regression line in

Figure 1, obtain a rough estimate as to the date of complete resorption of the bursa. From these data it seems likely that there would be little evidence of the bursa in Snowy Owls beyond the last week of April.

Weights

Gross (1931), quoting B. W. Cartwright, reported weights of six owls taken in southern Canada. These averaged as follows: two females, 4.56 lb (2070 grams); four males, 3.66 lb (1660 grams). The means of weights given by Sutton (1932) for Southampton Island were: three females, 5.73 lb (2600 grams); five males, 4.35 lb (1973 grams). Both adults and juveniles were presumably included among the above birds.

Weights of Snowy Owls from Delta are presented in Table 1, column 3. Mean weight of eight juvenile females was 2314 grams, while four juvenile males averaged 1808 grams, a difference of 506 grams. In this sample of twelve, the largest male was 98 grams lighter than the smallest female.

Comparing date of capture and weight, one finds little evidence for the frequently expressed view that migrant owls have been driven south by scarcity of food on the northern breeding grounds. Quite to the contrary,

TABLE 1. SUMMARY OF MEASUREMENT DATA FROM SNOWY OWLS EXAMINED AT DELTA, MANITOBA*

Sex	Date	Weight (grams)	Relative lightness**	Length of center rectrices (mm)	Wing span (inches)	Length (inches)
Female	Nov. 25/57	2624	0.50	254	62.0	22.8
Female	Dec. 3/57	2511	0.49	251	60.0	23.8
Female	Nov. 26/57	2394	0.52	258	61.5	23.5
Female	Dec. 27/57	2342	0.60	261	62.8	23.3
Female	Dec. 2/57	2255	0.41	252	62.5	24.0
Female	Jan. 5/58	2197	0.81	252	60.5	25.5
Female	Dec. 20/57	2154	0.50	251	60.8	23.3
Female	Nov. 28/57	2034	0.50	256	57.5	23.5
Average		2314	0.54	254	61.0	23.7
Male	Dec. 2/57	1936	0.87	234	57.5	21.8
Male	Nov. 27/57	1850	0.93	231	54.8	22.5
Male	Nov. 25/57	1830	0.98	237	54.5	22.8
Male	Jan. 5/58	1617	1.00	240	59.3	24.5
Male	Jan. 9/58	—	—	235	55.8	23.1
Average		1808	0.95	235	56.4	22.9
Difference (Females-Males)		506		19	4.6	0.8

*Plumage characteristics and bursal depths indicated that all specimens were juveniles.

**Foot-candles of light reflected from breast and back were measured with a photometer and calculated as a percentage of the reflection from a standard surface measured at the same time. Percentage light reflected from back and breast were averaged to give a mean percentage reflectivity. Mean percentage reflectivity for each specimen was then divided by that for the specimen having the greatest mean percentage reflectivity (male; Jan. 5, 1958) to give the relative reflectivity or lightness of the plumage.

post-mortem examination of these birds revealed that all were extremely fat and in excellent condition. Heaviest fat depositions occurred over the abdomen and around the stomach.

Lightness of Plumage

It has long been recognized that female snowy owls tend to be darker than males. To help determine if plumage color could provide a satisfactory field technique for sexing owls, I measured the relative lightness of each owl obtained, using a photometer (Table 1, column 4). In the present series of juveniles, the lightest female was darker than the darkest male. Although there was no difficulty in distinguishing the sex of these two birds when in hand, it is doubtful whether they could have been accurately sexed in the field with binoculars. I feel, however, that with good binoculars and a little practice, error in sexing juveniles by plumage can be easily reduced to less than 10 percent. Further, if specimens of uncertain sex are excluded, I believe that a reasonable estimation of sex ratios can be secured.

There seems to be considerable disagreement among various writers as to the relative lightness or darkness of adult as compared with juvenile plumage. Taverner (1947, p. 259) referred to "heavily marked juveniles" and to "very white and almost unspotted adults," while Sutton (1932, p. 209) states that "... the first winter plumage (of juveniles) is usually very white. As the birds become older, the females often, if not always, become more heavily barred and consequently darker in appearance." According to Bent (1938, p. 364), "in their first winter plumage . . . the young birds are much more heavily barred everywhere than adults of the same sex . . ." Forbush (1927, p. 231) indicated that young males are much like adult females but have a patch of heavily barred feathers in the middle of the nape. Preble (1908, p. 374) reported that in a series of 18 specimens he collected in the Mackenzie District, N.W.T., the dark barring of only one male equalled in extent that of the lightest female.

In view of the above conflict of opinion it would seem unwise at this time to attempt to utilize plumage characters as a means of field-sexing populations known to contain both juvenile and adult age groups.

Length of Rectrices

A characteristic which may prove useful as a quick check on sex is the over-all length of the center rectrices (Table 1, column 5). These feathers in eight juvenile females averaged 254 mm (range; 251-261 mm). Center rectrices in five juvenile males averaged 235 mm (range; 231-240 mm). Whether a similar difference in rectrix length holds for adult birds, and whether averages for juveniles approximate those for adults of the same sex I cannot say.

MIGRATION

In the fall of 1957, the first Snowy Owls arrived at Delta, Manitoba, on November 24. From that time until January 18 a record was kept of the location and sex of all owls seen. In order to increase the sample size, road-counts were made through the surrounding countryside. Chances of re-

peatedly tabulating the same owls during migration are thought to have been minimized by allowing at least one week to elapse between counts.

The sexing of observed owls was based on differences in plumage coloration previously discussed. For this purpose I assumed that most, if not all of the birds, were juveniles, as indeed the complete absence of adults in trapped and shot samples suggests. Where sex was doubtful, individuals were omitted from sex ratio tallies. A pair of 24-power Busch Turlux binoculars was used and afforded an excellent view of the birds.

Data secured in this manner pointed to a distinct change in the sex ratio after mid-December. Accordingly, these data as well as those for owls trapped and shot are presented in two groups: November 25 to December 16, and December 18 to January 18 (Table 2). Sample sizes here are small, but the implied shift in sex ratio is sufficiently great to warrant consideration.

During the initial period the sex ratio was 26:74 favoring females; during the second the sex ratio reversed to 66:34 favoring males. I believe that such ratios indicate that the earliest migrants were females, many of which continued south and were later replaced by males. Another explanation, though to me less plausible, might be that the increased percentage of males in the period December 18 to January 18 resulted solely from an exodus of females.

The total male to female sex ratio of 45:55 (60 owls) compares favorably with that of 46:54 (136 owls) among winter migrants as summarized from a number of sources by Watson (1957).

While I have no personal knowledge of the spring migration, H. Albert Hochbaum has informed me that Snowy Owls are commonly seen passing northward through the Delta region in April and early May.

HUNTING RANGE

Soon after Snowy Owl observations began at Delta, it became apparent that some birds had settled in the district and were restricting their daily movements to rather limited areas which I have interpreted as hunting ranges.

Tracing these ranges was greatly facilitated by the presence of unusually light or dark specimens that could be identified as individuals. What proved

TABLE 2. SEX RATIOS OF SNOWY OWLS

Sex	Period	Source of data			Total
		Sight record	Trap	Shot	
Male	Nov. 25–Dec. 16	5	3	–	8 (26%)
Female	Nov. 25–Dec. 16	18	5	–	23 (74%)
Male	Dec. 18–Jan. 18	17	–	2	19 (66%)
Female	Dec. 18–Jan. 18	7	1	2	10 (34%)
Male	Total period	22	3	2	27 (45%)
Female	Total period	25	6	2	33 (55%)

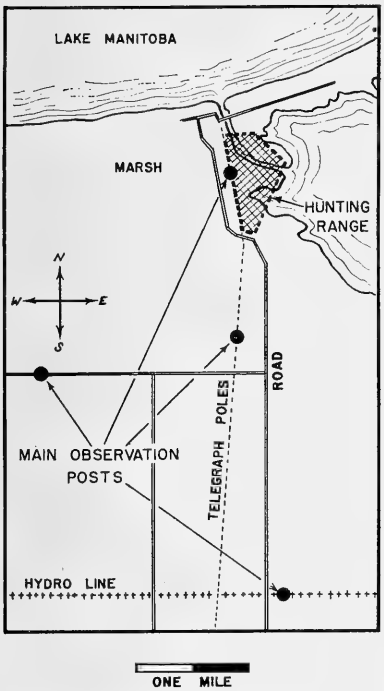

FIGURE 2. Distribution of winter-resident Snowy Owls at Delta, Manitoba.

to be the hunting range of at least three different owls is shown in Figure 2 (hatched area); the main observation posts of three others are also given here. The hunting range outlined in Figure 2 was immediately adjacent to the research station, hence I was able to make frequent checks each day on the exact location of the owl occupying it. As far as I could determine, only one bird frequented this area at any one time.

Another factor which helped to delineate the boundaries of the above hunting range was the fact that each Snowy Owl taking up residence there was sooner or later trapped. For a period of from two days to a week thereafter the area would be vacant, then a new owl would appear. Invariably it utilized the same points of observation employed by its predecessor and hunted over the same ground.

Briefly, this hunting range could be described as a mosiac of Phragmites beds (*Phragmites communis*), high ground, and marsh openings, totaling in all about 300 acres. It was bordered on the west and south by a string of telegraph and electric power poles, and on the north and east by several scattered trees. Both the poles and the trees were used extensivly as sites from which to survey nearby terrain. To the north there was a wooded ridge and in all other directions stretched large tracts of marshland.

Distances between the main observation posts of neighboring hunting ranges (Figure 2) averaged approximately two miles.

I have lately been informed by H. Albert Hochbaum of an interesting deviation from the fairly sedentary behavior of Snowy Owls just described. During February and March he noted owls moving out on to Lake Manitoba at dawn, and returning at sunset to the farmlands. He also reported that as the spring thaw progressed, they shifted their roosts to the vicinity of remaining snow patches.

FOOD HABITS

Stomach contents of owls examined at Delta consisted chiefly of rodents (Table 3). In late November and early December Snowy Owls were often observed feeding on the frozen carcasses of wild ducks in the Delta marsh.

TABLE 3. STOMACH CONTENTS OF 13 SNOWY OWLS

Contents	Occurrence
Microtus sp.	3
Rattus sp.	1
Ondatra zibethicus	1
Wild duck	1
Domestic poultry	2
Empty	6

Crippled ducks still surviving in open waterholes were continually harassed. On the Trans-Canada highway between Winnipeg and Portage La Prairie, during the first week of January I saw two Snowy Owls that had apparently been hit by automobiles while feeding on road-killed jack rabbits (*Lepus townsendi*).

SUMMARY

1. Measurement data including bursa depth, weight, plumage lightness, and center-rectrix length are given for 13 juvenile Snowy Owls examined at Delta, Manitoba.
2. Rate of bursal regression was calculated at 0.28 mm per day, placing the date of complete resorption at about the end of April.
3. It is believed that most, if not all, Snowy Owls observed at Delta in the winter of 1957-58 were juveniles, and that the earliest arrivals were largely females.
4. Snowy Owls which became winter residents at Delta appeared to restrict their daily movements to a rather specified area, designated hunting range in the present paper.

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Received for publication 20 October 1958

SPRING PHENOLOGICAL RECORDS AT EDMONTON, ALBERTA

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Flowering dates of several species at Edmonton, Alberta, are presented for the period 1926-1958. These dates are correlated with temperature records, the heat accumulated for flowering being expressed in thermal units (degree-days).

Most of the species of this paper are woody plants and all bloom during April-May-June. Data for a few herbs are included. Nearly all of the records are for plants growing in or near the river valley and close to the University of Alberta, Edmonton. Reports for the herbs *Pulsatilla ludoviciana*, *Caltha palustris*, and *Lilium philadelphicum* are from areas close to the city. Data for a particular species usually pertain to the same stand or to the same locale and habitat.

For phenological purposes, date of flowering is commonly taken as that when the first flower opens on a designated plant or group of plants; this is probably the most accurate procedure. However, in this paper, all flowering records pertain to the time of height of bloom; that is, they give the date when the plants under observation were in full flower. This method of recording was embarked upon during my early study of poplar species, for which the best criterion of anthesis seemed to be the fully elongated staminate catkin. Though satisfactory for most amentiferous species, full bloom as a criterion is not so readily used for many other plants. This aspect of the records is elaborated below.

Flowering Data

Flowering time for each of 25 species in Table 1 is given in terms of earliest and latest recorded dates and the average (normal) date. The latter is estimated partly from the average (mode) of earliest and latest dates for the species and partly by comparison with other species growing nearby and blooming at about the same time. Though the observations extend over a period of 33 years, only 5 of the species are recorded for 24 years or more and 12 for 11 years or longer. Only for these 12 species are the records summarized in full. Normal flowering dates of the other species are estimated mainly by comparison with blooming of contiguous ones.

With the exception of the prairie anemone, *Pulsatilla ludoviciana*, all of the earlier flowering species, that is, those normally blooming before the middle of May, are woody plants. Indeed, rather few native herbaceous species flower so early. The following are probably in this category: *Ranunculus rhomboideus* Goldie, *Petasites* spp., *Androsace septentrionalis* L. and *Corydalis aurea* Willd. Plants normally flowering after the middle of May include numerous herbs, a few of which are recorded in Table 1.

The records show a spread of four to five weeks between the earliest and the latest flowering date of each species for which there are adequate data. It seems

TABLE 1. DATES OF FULL FLOWERING OF TWENTY-FIVE SPECIES OF PLANTS, AND MONTHLY MEAN TEMPERATURES FOR APRIL AND MAY, EDMONTON, ALBERTA, 1926-1958.

	Number of Years Observed	Dates of Full Flowering				Mean Temperatures			
		Earliest record	Latest record	Determined Average (Mode)	Estimated Average (Normal)	Earliest Record		Latest Record	
						April	May	April	May
Alnus tenuifolia Nutt.	4				Apr. 22				
Corylus cornuta*	16	Apr. 12	May 14	Apr. 28	Apr. 24	47.5	52.8	26.8	48.6
Populus tremuloides	32	" 11	" 15	" 28	" 25	43.3	48.8	26.8	48.6
Ulmus americana	13	" 18	" 11	" 29	" 29	47.5	52.8	35.6	50.4
Salix discolor	5				" 30				
Pulsatilla ludoviciana	7				May 1				
Populus balsamifera	24	" 21	" 19	May 5	" 4	42.8	51.9	26.8	48.6
Acer negundo var. interius	25	" 26	" 20	" 8	" 6	46.7	53.8	26.8	48.6
Shepherdia canadensis	9				" 6				
Betula papyrifera	5				" 8				
Ribes triste	11	May 1	" 21	" 10	" 10	47.5	52.8	26.9	53.8
Ribes setosum	11	" 3	" 22	" 13	" 14	47.5	52.8	26.9	53.8
Adoxa moschatellina	6				" 16				
Prunus pensylvanica	25	" 3	June 10	" 19	" 18	42.8	51.9	26.8	48.6
Amelanchier alnifolia	25	" 3	" 7	" 20	" 19	42.8	51.9	26.8	48.6
Viola adunca	4				" 23				
Caltha palustris	8				" 23				
Prunus virginiana var. melanocarpa (A. Nels.) Sarg.	17	" 16	" 22	June 3	" 31	46.7	53.8	26.8	48.6
Syringa vulgaris	12	" 18	" 22	" 4	" 31	46.7	53.8	26.8	48.6
Viola rugulosa	5				June 4				
Actaea rubra	7				" 6				
Aralia nudicaulis	6				" 9				
Viburnum trilobum	12	June 2	" 30	" 13	" 15	45.4	54.8	30.7	50.0
Rosa acicularis	7				" 20				
Lilium philadelphicum var. andinum	4				" 22				

*Names of authors given in Gray's Manual of Botany (8th ed.) are omitted.

likely that other early-blooming plants of the region exhibit similar variations over the years. On the other hand, species that normally produce bloom later in the season probably have a narrower spread from year to year. This may be true even of species such as *Rosa acicularis* and *Lilium philadelphicum*, which flower in the latter part of June (Table 1); but my data bearing upon this question are inadequate. Of interest here is an extensive phenological report by Criddle (1927) for Manitoba. In that report species that flower during the summer show considerably less variation from year to year than do spring-flowering species, though a spread of two to three weeks is common. The following quotation from Criddle's paper is pertinent: "Finally it should be borne in mind that seasons vary enormously and that the influences of an early or late spring are frequently felt throughout the entire flowering period of the year."

Apart from a summary of my earlier phenological data for *Populus* spp. (Moss, 1938), the only published dates for native species at Edmonton are in the annual reports of the Canadian Plant Disease Survey, 1936-57. These records include a few of the species in Table 1 but are not strictly comparable because they are mostly for the opening of the first flower. However, with a few exceptions, the species appear in the same relative positions in respect to flowering. An important difference is that the Survey reports generally show *Pulsatilla ludoviciana* as flowering a few days earlier than *Populus tremuloides* rather than a few days later. This apparent inconsistency is attributable to the use of different flowering criteria: time of first flower rather than date of the height of flowering. It should also be borne in mind that the former species, in a given area, produces flowers over a period of several days from a few early ones to a height of flowering, whereas the aspen bursts into full flowering much more quickly. A second difference is that the Survey reports usually place the saskatoon (*Amelanchier alnifolia*) a few days ahead of the pin cherry (*Prunus pensylvanica*). Again the explanation is found in the criteria for flowering and in the fact that the saskatoon raceme may expand its first flower in advance of any pin cherry anthesis, yet the umbel-like cluster of the cherry is fully opened before complete blooming of the saskatoon raceme.

Questions pertaining to criteria of flowering and interpretation of records are well illustrated by reference to a paper by Stupart and Payne (1914). Though this paper reports no observations at Edmonton, it does include dates of flowering for other Alberta localities. Of interest here are the flowering dates of *Anemone patens* (*Pulsatilla ludoviciana*), which are Feb. 25 at Calgary, Mar. 17 at Halkirk (about 100 miles southeast of Edmonton), Mar. 19 at Banff. What significance is to be attached to these dates, which seem quite early even for the flowering of plants in a chinook belt? One needs to know about the extent of flowering and subsequent events. It seems rather unlikely that these flowering dates are to be taken as marking the beginning of spring. A well-known behavior of *Salix discolor* and *Populus tremuloides* may be mentioned. During prolonged mild periods of winter, not infrequently in February at Edmonton, these species extend their catkins, but rarely, if ever, is anthesis complete or pollen produced. These abortive efforts are generally followed by very cold weather and cessation of growth for long periods.

Temperature Analyses

It seems obvious even to the casual observer that variations in time of blooming of spring-flowering plants at Edmonton are governed principally by temperature. That early blooming is correlated with relatively high mean temperatures and late blooming with lower mean temperatures is shown in Table 1. However, monthly mean temperatures are not entirely satisfactory for close analyses of the heat factor. It seems desirable to know the mean temperatures for periods shorter than the month, as well as for certain periods involving portions of two months. Minimum and maximum temperatures for these periods may be significant too. Therefore, temperature statistics were abstracted from the monthly meteorological reports (1926-1958) for particular periods that seemed to culminate in flowering of the species shown in Table 2.

Though the official temperature records are for locations at Edmonton some 3 miles from the area of the phenological observations, it is believed that they can be applied with confidence to these observations. For each of aspen, pin cherry and choke cherry, records for six years are set forth. Of these years, two are very early, two nearly average and two very late, in respect to time of flowering.

A general inspection of temperature data for several days preceding flowering reveals certain facts concerning growth in spring. First, as has been concluded by Currie (1948) and by Kendrew and Currie (1955) for the

TABLE 2. RELATION OF FLOWERING TO TEMPERATURE IN THREE PLANT SPECIES EDMONTON, ALBERTA, 1926-1958.

Flowering Date	Year	Effective Period (Most days above 54°)				Heat required	Effective Days of Period (all days above 54°)				Heat required (degree-days)		
		Days	Mean Min.	Mean Max.	Daily Mean	$(m-42)$ × days	Days	Mean Min.	Mean Max.	Daily Mean	$(m-42)$ × days	$\left(\frac{h-42}{2}\right)$ × days	$\left(\frac{h-54}{2}\right)$ × days
Populus tremuloides (Aspen)													
April 13	1926	5	29.4	63.2	46.3	21.5	5	29.4	63.2	46.3	21.5	53.0	23.0
" 15	1932	5	37.0	63.0	50.0	40.0	5	37.0	63.0	50.0	40.0	52.5	22.5
" 20	1958	10	34.8	57.0	45.9	39.0	6	35.3	60.5	47.9	35.4	55.5	19.5
" 28	1951	4	35.0	66.0	50.5	34.0	4	35.0	66.0	50.5	34.0	48.0	24.0
May 12	1948	10	38.9	57.6	48.2	62.0	9	38.4	58.8	48.6	59.4	75.6	21.6
" 15	1954	12	38.5	54.9	46.7	56.4	7	38.0	60.0	49.5	52.5	63.0	21.0
							6	35.5	61.9	48.8	40.5	57.9	21.9
Prunus pensylvanica (Pin Cherry)													
May 3	1926	25	37.3	65.5	51.3	232.5	24	37.6	66.0	51.8	235.2	288.0	144.0
" 8	1944	41	34.7	59.7	47.2	213.2	35	34.7	61.7	48.2	217.0	344.7	134.7
" 16	1932	37	37.6	56.7	47.1	188.7	26	39.1	64.9	52.0	260.0	297.7	141.7
" 16	1958	36	36.4	58.1	47.2	187.2	22	40.6	64.8	52.7	235.4	250.8	118.8
" 28	1948	26	43.3	64.2	53.7	304.2	23	43.3	66.1	54.7	287.5	277.1	139.1
June 10	1954	38	42.4	57.2	49.8	296.4	23	41.8	62.0	51.9	227.7	230.0	92.0
							25.5	39.5	64.2	51.9	243.8	281.4	128.4
Prunus virginiana (Choke Cherry)													
May 16	1952	45	37.5	63.1	50.3	373.5	37	39.1	66.7	52.9	403.3	456.9	236.0
" 19	1926	41	37.2	65.8	51.5	389.5	40	37.4	66.2	51.8	392.0	484.0	243.0
" 29	1958	49	39.7	62.2	50.9	436.1	35	43.8	68.0	55.9	486.5	455.0	240.3
" 30	1932	51	38.9	59.1	49.0	357.0	40	39.8	62.7	50.3	332.0	414.0	223.5
June 6	1948	35	46.1	67.5	56.8	518.0	32	46.3	69.2	57.7	502.4	435.2	244.5
" 22	1954	50	43.4	59.0	51.2	460.0	33	43.7	63.5	53.6	382.8	354.7	156.0
							36.2	41.7	66.0	53.7	416.5	433.3	223.9

m—daily mean temperature h—daily mean maximum

Prairie Provinces, a daily mean temperature exceeding 42°F breaks the vegetative dormancy of winter. This temperature level may be taken as the first requisite for flowering of all of the species. Secondly, a daily mean maximum temperature exceeding 54°F, over a period of about six days, appears to be a second requisite for flowering of aspen. For pin cherry and choke cherry the daily mean maximum temperature is not so evident. It may actually be somewhat higher than 54° but for comparison with aspen this threshold temperature is assumed; however, the time involved is much longer.

A critical aspect of the following attempt to express flower production in terms of required heat is the determination of the precise period of time involved. This effective period, with most days or all days above 54°F, is rather well indicated for aspen. In 1926, and again in 1932, a period of five days sufficed, the daily mean maximum being about 63°. In 1951, with an unusually high temperature of 66°, flowering occurred in just four days. The years 1948, 1954 and 1958 had longer effective periods because each of these included days when the daily mean maximum temperature was below 54°; hence the item "effective days of period" shown in Table 2. In 1958, for example, four days of the effective period had maximum temperatures below 54° and six days above that threshold level. Only these six days are considered as effective in flower production. Therefore, heat calculations for the "effective days" of such a period are likely to be more significant than those derived for the entire period. The following methods of expressing heat requirements for flowering are based on the assumption that rate of plant development is directly proportional to increase in temperature. The validity of this assumption is discussed by several investigators including Katz (1952).

A commonly used method of expressing heat requirements of plants is by direct summation of heat units (degree-days). This procedure has been considered recently by Katz (1952) and by Nuttonson (1955). A degree-day designates one degree per day of mean temperature above a certain base (threshold) temperature. A summation index, in terms of degree-days, is obtained by multiplying the daily value by the number of days involved, that is, (m-42) $\times$ days (Table 2). This method was applied to data under the headings "effective period" and "effective days of period." Index figures for the latter category are, on the whole, the more consistent; but, even for these the divergence is such as to cast doubt upon their significance.

Two other methods of expressing heat requirements gave index figures, also in terms of degree-days, as shown in the last two columns of Table 2. These methods grew out of my attempt to apply a procedure of temperature analysis published by Lindsey and Newman (1956). Actually, my data did not seem to lend itself to the treatment used by these authors. Both methods employ daily mean maximum temperatures and a threshold temperature. The first method, with 42° as the threshold temperature, is certainly open to criticism on theoretical grounds but is presented for purposes of comparison. The second method, with a threshold temperature of 54°, seems more realistic. Subtracting this figure from the daily mean maximum and dividing by 2 gives a degree-day figure which is then multiplied by the number of days involved. The effective heat indices thus derived, (last column, Table 2), are quite

consistent, barring two striking deviations, the last entry for each of pin cherry and choke cherry, which are for June flowering. However, if weighted for day-length, these indices would probably fall into line. The long days of June might be expected to compensate for the rather low maximum temperatures (see Table 2) of the periods involved and so increase the total heat production.

Consistency of heat index figures for a species, as derived by the last method, might be anticipated in view of the assumption that flowering is promoted only on days with temperatures above 54°. Somewhat the same degree of consistency might be expected in figures for daily mean maximum and for daily mean temperatures. As shown in Table 2 these figures are fairly consistent and could actually be used to indicate at least one aspect of heat requirements for flowering.

Of still greater interest is a comparison of heat requirements of different species. The differences as between aspen, pin cherry and choke cherry are indicated by the number of days involved (about 6, 25, 36, respectively), and by the daily mean maximum temperatures (about 62°, 64°, 66°, respectively), but are expressed most accurately by the heat indices (about 22, 128, 224, respectively), which combine time and temperature. If the last figure (Table 2) for each of the cherry species be left out of consideration, the heat indices for aspen, pin cherry and choke cherry become approximately 22, 136 and 237, a ratio of 1:6:11.

Though temperature seems to be the principal factor affecting flowering of these species, other factors doubtless operate to some extent. For instance, there is the possibility of a photoperiodic effect such as Daubenmire (1949) reports in connection with resumption of cambial activity in certain trees.

The foregoing discussion is presented in the hope that it may have some useful bearing on future phenological studies.

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Received for publication 12 January 1959

THE BIRDS OF CHILKAT PASS, BRITISH COLUMBIA

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IN THE past 15 years, several important papers have been published on the birds of southern Yukon and extreme northern British Columbia (Rand, 1944; Munro and Cowan, 1947; Godfrey, 1951; and Drury, 1953). The present paper is intended as a companion to those publications. It is hoped that it contributes fresh, and perhaps more complete information on the birds of one major biotic community within the region, the alpine zone.

Data for the present paper were obtained during the periods of 7 May to 10 September 1957, 15 June to 4 July 1958 and 17 July to 22 July 1959. Observations were made while I was studying ptarmigan in Chilkat Pass; the nature of the work made it possible for me to be in the field daily. Without the financial assistance of the Arctic Institute of North America, which supported the ptarmigan research, these data could not have been collected, and I am grateful to the Institute for the opportunity to conduct the study. I am indebed to Harold Gibbard, biologist, Ontario Department of Lands and Forests, for his valuable help in observing the birds in 1957, and to M. Timothy Myres, a fellow student at the University of British Columbia, for his suggestions during the writing of this report.

DESCRIPTION OF THE AREA

There are three passes which link the Yukon to the Pacific coast; from east to west they are White Pass, Chilkoot Pass and Chilkat Pass. They lead the traveler, whether man or bird, from the Lynn Canal, the northernmost fiord of the Alaska panhandle, across a narrow strip of land which joins the tiny triangle of mountainous country in the northwestern corner of British Columbia to the main body of that province (Figure 1). Chilkat Pass (59°50'N 136°20'W), the broadest of the three passes, lies in a north-south direction at elevations of 3000 to 3600 feet. The 'flats' of the pass are about 24 miles long and from one to five miles wide; they are bisected along much of their length by the Haines Road, a highway kept open for public use from May to November. The flats are flanked to the east and west by mountain ranges rising to 7500 feet or more above sea level. Small glaciers are found on all of the mountain groups, and there is one large glacier-fed lake, Kelsall Lake, four miles to the east of mile 75 Haines Road. To the north the pass drops into the boreal forests of the upper Tatshenshini and Alsek river valleys, while to the south it descends abruptly to the coastal forests of the Chilkat and Kelsall river valleys. All four rivers flow into the Pacific Ocean.

The climate of the area shows the effect of coastal and continental influences, and the pass lies in a region of rapid east-west climatic changes. Large amounts of snow fall in winter, and light rains are common throughout the rest of the year, especially spring and fall. Summer thermal maxima (up to 8°F in 1957) are often higher than on the immediate coast, and the daily range is greater at the pass. Freezing temperatures may occur any month.

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FIGURE 1. Outline map of northwestern Canada and Alaska with location of the Chilkat Pass study area. Picket-fence line shows the northern and western limit of trees.

Two important physiographic features contribute to the character of the avifauna through the influence of these features on the vegetation. First, the altitude of the floor of the pass coincides with timberline. If the pass were 300 feet lower, the valley probably would be covered with forests; a similar increase in altitude would place it well within the alpine zone. Under existing conditions, trees survive only on favorable, lower mountain slopes; even there, many dead trees scattered among the living ones attest to past hardships. Second, the floor of the pass is quite level, creating a tortuous, much-impeded drainage system. It is probable that the high water table, the downward movement of cold air from the surrounding slopes and glaciers, and patches of permafrost, are major factors allowing the continued existence of dwarfed shrubs and marshy tundra on the flats (Figure 2).

The vegetation of the flats is a network of cover types composed of a small number of dominant species. Dwarf willows (*Salix* spp.), dwarf birch (*Betula glandulosa*), shrubby cinquefoil (*Potentilla fruticosa*), graminoids, bryoids and perennial forbs, all in a wide range of heights, densities and species combinations, form an almost endless series of habitats for birds. Rarely does any one association extend unbroken over more than a few acres; the great amount of edge created in this way probably explains why some species of passerine birds are so numerous on the flats.

FIGURE 2. Wet-sedge-willow-moss marsh, mile 75 Haines Road. Most of the willows in the marsh are between one and two feet high; the birch, willow, and *Shepherdia canadensis* shrubs near the spruce woodland (on drier sites than the marsh) are as much as six feet high. Note that most of the spruce trees are dead. 14 August 1957.

FIGURE 3. Herbmat vegetation in seepage area, lower slopes of the Dataiaska Mountains, mile 75 Haines Road. Willows in background are four to five feet tall. 14 August 1957.

Whereas the luxuriance of the vegetation on the floor of the pass is limited somewhat by the factors mentioned above, the lower mountain slopes support a dense vegetation and a varied flora. Relatively dry slopes usually are covered with closely spaced willow and birch from two to seven feet tall. Openings in such areas are dominated by perennials, of which tall grasses are most conspicuous. Wherever seepage is prevalent the willows are taller, but are restricted to slender bands and small patches, usually near gullies or solifluction ridges. Alder (*Alnus* sp.) occurs on that habitat also. The shrubless spaces in these areas differ greatly from openings on dry slopes. Throughout May and early June the snow lies in the openings in deep, litter-strewn patches, even when bare areas have appeared at higher altitudes and on the flats. The snow usually melts in June, and a few plants particularly well adapted to this late habitat, such as *Veratrum eschscholtzii*, *Petasites frigidus* and *Heracleum lanatum*, send up their green spears. In July, however, a thick mass of vegetation begins to unfold, reaching its peak in August; this is the well-known 'herbmat' typical of alpine meadows in the central and southern Cordillera (Figure 3).

Shrubs do not grow well above 3700 to 3900 feet, except for isolated patches in sheltered hollows. In alpine areas above the shrubs, heaths (*Cassiope* sp., *Phyllodoce* spp.), tiny willows which may not rise more than one or two inches above the ground, lichens, mosses, *Empetrum nigrum*, *Luetkea pectinata*, *Saxifraga* spp., *Vaccinium* spp., and many other plants, mingle in a great array of combinations. Many rocky areas at high altitudes give the overall impression of total lack of plant life, although such places often support a variety of small plants on favorable sites.

The environment offered by the alplands is so different from forested areas of the same region, or even the same mountain, and the change is so rapid, that the response of the bird fauna is almost startling. I do not wish to give the impression that the alpine environment is much more severe than that of lower elevations; this idea has, perhaps, been given too great an emphasis in the past. The majority of birds that breed in arctic-alpine areas are present only from May to August or September, when the climate is relatively mild. But the alpine environment is different, and the birds living in it must be adjusted, if only temporarily, to these differences.

It may be of interest to consider briefly the main elements that seem to affect bird life in alpine areas more than in others. The primary cause of many of the unique characteristics of alplands is the instability of the physical habitat. The spectacular snow and rock avalanches in spring, the huge cracked boulders and the crumbling canyon walls are apparent to any visitor to mountainous regions. But besides these there are other more subtle agents of physical change. The slow downhill creep of soil, the moving of large quantities of silt and gravel by the rushing creeks, the advance and retreat of glaciers and snowfields, the shifting and sliding of screes, the heave and push of frost in the soil, the slumping of land during the summer thaw — all of these create a constantly changing substrate on which alpine plants must survive. The limitations of size, form, structure, method of reproduction, regularity of fruit and seed

production, and period of active growth imposed on plants by those factors necessarily influence the animals of alpine communities as well.

Most alpine and arctic birds nest on the ground, and each species must wait for the snow to disappear from its habitual nesting habitats before egg laying can begin. Thus, the distribution of snow in the spring, and the amount that falls during the winter, seem to be very important in determining when and where birds breed in alpine regions. Two other features of the alpine environment which affect the lives of birds are exposure to wind and to predators.

In the following paragraphs I have attempted to summarize the broad habitat types of Chilkat Pass and to classify the avifauna by ecologic preferences. In some species that hold definite territories during the breeding season, and that use the territories for courting, nesting and feeding, all activities may be carried out within one type of habitat. Other species, however, may nest and feed in different areas; those birds are placed in the habitat type in which the nest is found.

The following species frequented isolated trees found at lower elevations in the pass: Sharp-shinned Hawk, Bonaparte's Gull, (in trees around ponds), Yellow-shafted Flicker, Gray Jay, Black-billed Magpie and Robin. In the dense, tall, willow and birch shrubs within and between the stands of spruce were found the Hermit, Gray-cheeked and Swainson's Thrush, Slate-colored Junco and Fox Sparrow.

Around pool margins in the flats were the following: Red-throated Loon, Pintail, Green-winged Teal, Lesser Yellowlegs, Least Sandpiper, Short-billed Dowitcher, Northern Phalarope, Mew Gull and Arctic Tern.

On flat or gently sloping moist sites, where dwarfed shrubs and graminoids were abundant, the Willow Ptarmigan, Wilson's Warbler, Common Redpoll, Savannah Sparrow, Tree Sparrow, White-crowned Sparrow, Golden-crowned Sparrow and Lincoln's Sparrow nested. Savannah Sparrows were found also in a dry, savannah-like community of shrubs and lichens near timberline; Horned Larks and Smith's Longspurs lived in such areas as well.

Midway up the mountain slopes, where heaths and very low shrubs and sedge-meadows predominate, Rock Ptarmigan, Horned Larks, Townsend's Solitaires and Water Pipits nested.

The following birds were recorded from cliffs, screes and the rocky shores of high-altitude pools: Gyrfalcon, Golden Eagle, White-tailed Ptarmigan, Say's Phoebe (which also nested in buildings), Rosy Finch and Snow Bunting.

Gravelly banks of braided streams supported Semipalmated Plovers and Wandering Tattlers. Lakesides and rivers were used for nesting by Herring Gulls; Barrow's Goldeneye, Lesser Scaup, Common Loon, Oldsquaw, Harlequin Duck, Surf Scoter and Common Merganser were seen there as well.

Say's Phoebes, Tree Swallows and Barn Swallows nested in buildings at low elevations in the pass.

Five species seen by other workers on the Haines Road or elsewhere in southwestern Yukon, but not recorded in the present study, are Greater Scaup, *Aythya marila* (Clarke, MS); Common Snipe, *Capella gallinago* (Banfield, 1953; Drury, 1953); Upland Plover, *Bartramia longicauda* (Drury, 1953); Whimbrel,

Numenius phaeopus (Banfield, 1953); Brewer's Sparrow, *Spizella breweri* (Munro and Cowan, 1947; Banfield, 1953).

ANNOTATED LIST OF SPECIES

Every species of bird seen in Chilkat Pass in 1957, 1958 and 1959 is included in the annotated list. The name of each species follows the A. O. U. Check-List of North American Birds, fifth edition (1957). If doubt exists as to the status or identification of any bird, it is noted in the description. New or unusual records have been compared with the previously known distribution as given in Munro and Cowan (1947), whose statements are indicated by (M.-C.), and as supplemented by later papers. The subspecific status of the birds is open to question, as few specimens were collected. Therefore, names of subspecies are omitted.

The symbol * indicates species whose nests or young were seen at Chilkat Pass. The symbol (*) indicates species which, by their continued presence in midsummer or by their behavior, are believed to have bred there. Migration and nesting dates are from 1957 unless the years 1958 or 1959 are given specifically. All mileages refer to the Haines Road; miles 0-45 are in Alaska, miles 45-93 in British Columbia, and miles 93-159 in Yukon. Full details of all nests were recorded on cards and deposited at the Department of Zoology, University of British Columbia.

COMMON LOON *Gavia immer*. Rare. Male seen 8 August 1957 on Kelsall Lake, east of mile 75. Single males seen also on the lake on 24 June 1958 and 16 July 1959.

*RED-THROATED LOON *Gavia stellata*. Uncommon nester on lakes and bays near the B.C. and Alaska coast (nesting records Queen Charlotte Islands, 1910; Swanson Bay, B.C., 1936; M.-C.). Pair nested on small pool less than one acre in extent at mile 75. Two downy chicks of this pair seen 8 July 1957, and an adult observed 3 July 1958 and 17 July 1959 near Kelsall Lake. The main breeding range is to the north of British Columbia, and it is unlikely that many nesting records will be obtained on the mainland east and south of Chilkat Pass.

MALLARD *Anas platyrhynchos*. Spring and fall migrant in low numbers. Observed 7-30 May, 7 August. Fairly common in shallow ponds and marshes at low to moderate altitudes in southwest Yukon and northern B.C., but rare at high altitudes. Observations of this species were made by Shortt (M.-C.) in July 1944. May breed occasionally in timberline marshes, although as yet no proof is available.

CANADA GOOSE *Branta canadensis*. Spring and fall migrant, but rare in spring after 6 May. One seen 19 May 1957. Flock of 22 flew southward on 31 August 1957.

LESSER SNOW GOOSE *Chen hyperborea*. Flock of six seen 3 May. Migrate south in late September according to a hunter at a road maintenance camp at mile 75.

*PINTAIL *Anas acuta*. Not previously recorded as breeding in alpine areas of B.C. or Yukon, although common in grassy marshes at lower altitudes. Uncommon in Chilkat Pass, but two breeding pairs were found at mile 75. Nest found 29 May contained five eggs, four of which hatched 25 June. Brood of six downy young seen 24 June. Broody females seen 25 June 1958 and 20 July 1959 at mile 75.

*GREEN-WINGED TEAL *Anas carolinensis*. Common in muskegs or marshes at low elevations in the region, but rare in alpine wetlands, probably because of the scarcity of these wetlands. Brood of seven young (two to four days old) seen 1 July at mile 75, and other pairs may have nested in the vicinity. Two males observed at head of Kelsall River on 2 July 1958.

(*)AMERICAN WIDGEON *Mareca americana*. Scarce spring migrant (one seen 19 May) and scarce fall migrant (13 August). Brood seen July 1944 at mile 85 (M.-C.), so the species must nest in the pass occasionally. Not seen in 1958 or 1959.

SHOVELER *Spatula clypeata*. Known from

one carcass found 27 May 1957, apparently partly eaten by a fox.

*GREATER SCAUP *Aythya marila*. Clarke (MS) observed several broods of young at mile 84 on 19-20 July 1944. Not seen 1957-1959.

LESSER SCAUP *Aythya affinis*. Three seen September, 1957 at mile 66. Pair observed at mile 83, 24-30 June 1958; several males seen on other ponds in same period. Future studies may reveal a few breeders in Chilkat Pass.

(*)BARROW'S GOLDENEYE *Bucephala islandica*. May have nested at Kelsall Lake, but no proof obtained. Two pairs and an immature male seen 14 July 1957, single hen seen 2 July 1957 and 28 June 1958. Common breeder in ponds in the boreal forests of the region.

OLDSQUAW *Clangula hyemalis*. Female or young male seen on Kelsall Lake 25 June 1958.

HARLEQUIN DUCK *Histrionicus histrionicus*. Two males seen feeding at head of Kelsall River where it flows out of Kelsall Lake, 25 June 1958.

SURF SCOTER *Melanitta perspicillata*. Three males observed 18 July 1959 on pond at mile 83.

COMMON MERGANSER *Mergus merganser*. Two males seen, head of Kelsall River, 2 July 1958.

*MERGANSER *Mergus* sp. Brood of four flightless young on Kelsall Lake, 14 August 1957. Godfrey (1951) found broods of both species of *Mergus* in the summer of 1959 within a 50-mile radius of the pass, so that the present record could be of either *M. serrator* or *M. merganser*.

*SHARP-SHINNED HAWK *Accipiter striatus*. Uncommon breeder in isolated patches of white spruce. One nest found with three young not capable of flight, but out of nest, 24 July. The young could fly two days later. Present throughout the period of study in 1957, but not seen in 1958 or 1959.

*GOLDEN EAGLE *Aquila chrysaetos*. Common breeder in Chilkat Pass. Three empty nests found, at least one of which was used in 1957. Immatures seen more often than adults. Only one Bald Eagle was observed in the alpine area. There is apparently a well-defined ecologic separation between the eagles wherever they are found together in interior regions, the Golden Eagle hunting in alpine habitats, the Bald Eagle in forested country.

BALD EAGLE *Haliaeetus leucocephalus*. One seen passing overhead at mile 75 on 13 August 1957.

(*)MARSH HAWK *Circus cyaneus*. Scarce spring migrants, common in autumn, and seen twice in summer (5 and 8 July 1957). It is probable that a few pairs breed in the pass each year, although the species is much more common at lower elevations. One male and one female, possible paired, seen daily at mile 75 from 15 June to 4 July 1958.

(*)GYRFALCON *Falco rusticolus*. Probable rare breeder. One pair may have nested in 1957 in a high alpine valley at an altitude of 4000 feet at the head of Datalaska Creek, mile 77. Both members of the pair were seen 23 May, circling and calling near a cliff. No nest was found. On 27 and 28 August 1957 a single, dark (immature?) Gyrfalcon was seen as it hunted along the marshes bordering the Haines Road at mile 75. Not seen in 1958 or 1959. No previous known breeding records.

PIGEON HAWK *Falco columbarius*. Identification uncertain, as all observations were of single birds seen briefly: 7 and 8 May, 14 August 1957.

SPARROW HAWK *Falco sparverius*. Rare spring migrant (one seen 29 May). Common fall migrant 20 August to 10 September.

*WILLOW PTARMIGAN *Lagopus lagopus*. Abundant resident, reaching densities of 50 pairs per square mile. Peak of hatching 25 June to 3 July 1957; 20-23 June, 1958; 1-6 July 1959. Lives in summer at altitudes of 3000 to 3900 feet.

*ROCK PTARMIGAN *Lagopus mutus*. Common locally on some mountains. Resident at elevations of 3500 to 4500 feet.

*WHITE-TAILED PTARMIGAN *Lagopus leucurus*. Less abundant than *L. lagopus*, but more common than *L. mutus*. Breeds in high, rocky, parts of mountains, usually between altitudes of 4000 and 6500 feet.

SANDHILL CRANE *Grus canadensis*. One seen 22 May 1957.

*SEMIPALMATED PLOVER *Charadrius semipalmatus*. Breeds at any altitude on the gravelly shores of waterways. Probably more common in Chilkat Pass than in forested regions nearby (M.-C.; Drury, 1953). A brood of two downy young was seen on Datalaska Creek, mile 76, 10 July 1957. Species present from 15 May to 9 August.

KILLDEER *Charadrius vociferus*. Status uncertain. One seen 21 and 22 June and 3 July 1958, on a gravel bar bordering Dataleska Creek, mile 75. The Killdeer often was chased for short distances by Semipalmated Plovers which were nesting in the vicinity. Previously seen in summer below timberline at Atlin, B.C., about 100 miles from Chilkat Pass (M.-C.).

AMERICAN GOLDEN PLOVER *Pluvialis dominica*. Common in migration from 14 May to 22-24 May. Copulation was observed 19 May between two birds in a flock of 19 at mile 75. Banfield (1953) saw the species in Chilkat Pass and at other points in southwest Yukon, and was of the opinion that they nested in the region. It is quite certain that they did not nest in the areas of Chilkat Pass covered in the present study.

COMMON SNIPE *Capella gallinago*. Scarce migrant. Dates seen: 16 May (one), 19 May (two winnowing), 20 May (two), 12 August (one). Male seen at mile 83 on 24 June 1958. Although not found breeding in Chilkat Pass, it would not be surprising if future investigations revealed a small population of breeding birds.

GREATER YELLOWLEGS *Totanus melanoleucus*. Scarce spring migrant. Flock of 10 seen 8 May, and a few accompanied flocks of *T. flavipes* from 8 May to 15 May. Two seen on gravel bar at the head of Kelsall River, 2 July 1958. None seen in 1959.

(*)LESSER YELLOWLEGS *Totanus flavipes*. Breeds above and below timberline, as records of Rand (1944) and my own observations indicate. Common breeder in Chilkat Pass (although no nests were found, many pairs were observed on territories for several weeks in May, June and early July). Seen 8 May to 14 July. As was the case with most other shore birds nesting in the pass, the Lesser Yellowlegs left in July. Not seen in 1959 because of my late arrival in the area.

SOLITARY SANDPIPER *Tringa solitaria*. Rare fall migrant. Single birds seen 2 August and 13 August 1957.

*WANDERING TATTLER *Heteroscelus incanum*. Rare breeder in Chilkat Pass. One seen 25 May. On 15 July a bird was seen on Dataleska Creek; it called and displayed like a bird with young. Adult observed 4 July 1958 at mile 66 which behaved in a similar fashion. One previous nesting record for the area (11 July 1944; M.-C.).

(*)LEAST SANDPIPER *Eriola minutilla*. Common spring migrant and probable breeder. The only summer records in 1957 were 4 July and 12 August, but in the first instance the bird gave an intense distraction display. Least Sandpipers were seen daily from 21 June to 4 July 1958. One collected 22 June 1958 for verification of identity; it was a female, and the largest ovum measured 2.1 mm. Listed by M.-C. as migrant only. One seen 4 July 1949 by Godfrey (1951).

(*)SHORT-BILLED DOWITCHER *Limnodromus griseus*. Common spring migrant and nester. Seen 11 May to 27 July 1957 and daily during my stay in 1958. Only one previous summer record for B.C. (Tupper Creek, Peace River District; M.-C.), so that the pass may be one of the few breeding areas of this species in B.C.

(*)WESTERN SANDPIPER *Ereunetes mauri*. Spring migrant and possible rare breeder. Arrived with Least Sandpipers 15 May; last seen August 12.

(*)HUDSONIAN GODWIT *Limosa haemastica*. Pair of Godwits appeared at mile 75 on 3 June 1957. They set up a territory and were conspicuous on it until 27 July, when they left the area. No nests or young found. In 1958 a pair was present on the same area between 22 June and 4 July; again, no positive evidence of breeding was obtained. Not seen in 1959. There is little doubt that they were of this species, although none was collected. M.-C. spring records: Tupper Creek (8 May 1938); Atlin (11 May 1936 and 6 May 1932).

*NORTHERN PHALAROPE *Lobipes lobatus*. One of the most common shore birds at the pass. Seen 22 May to 27 July 1957, mostly as pairs or small groups of adults and young. Flock of 23 seen at mile 83 on 30 June 1958; this may have been a communal feeding area as other flocks were noted here from 15 June to 4 July, and pairs nested on much smaller pools nearby. The only other nesting record from B.C. is also from the Haines Road (14 July 1944; M.-C.).

*HERRING GULL *Larus argentatus*. Breeds in small numbers in the pass; main breeding area is the outlet of Kelsall Lake. Adults seen throughout the summer in 1957 at a refuse dump at mile 76, and in late July two large flying young were seen. Two downy chicks seen at outlet of Kelsall Lake 2 July 1958; five adults were present also. Probably more common around lakes and rivers in southern Yukon (Godfrey, 1951), but never recorded previously as nesting in B.C.

*MEW GULL *Larus canus*. Most abundant breeding gull in the pass. Nine nests found, all containing two or three eggs; five clutches hatched on 21, 22 and 27 June 1957, and 19 and 20 June 1958, near mile 75. All nests on ground except one, which was on the top of a 25-foot spruce. Arrived 8 May, departed first week in August. Also common below timberline in same region (Drury, 1953).

*BONAPARTE'S GULL *Larus philadelphia*. Common nester. Seen 9 May to 3 August. Five nests found, all in isolated spruce at edge of small tundra pools. Two nests hatched 21 June, one 24 June. One nest used in 1957 and 1958. Breeds at lower altitudes in the region as well.

*ARCTIC TERN *Sterna paradisaea*. Common breeder at Kelsall Lake, with pairs scattered elsewhere on the flats. Male collected for identification 2 July 1958. Downy chicks seen 3 July 1957 at mile 75. Breeds on Atlin Lake and observed by Godfrey (1951) and Drury (1953) in southwest Yukon and at mile 85 Haines Road.

SHORT-EARED OWL *Asio flammeus*. One seen 13 May. Three seen in late July 1959. Recorded 15 July 1944, from mile 70 (M.-C.).

RUFUS HUMMINGBIRD *Selasphorus rufus*. Summer transient. Several seen 26 and 29 July 1957. Could not be distinguished in the field from Allen's Hummingbird (*Selasphorus alleni*), but the ranges are quite distinct. M.-C. give one record from the Haines Road (14 July 1944).

(*) YELLOW-SHAFTED FLICKER *Colaptes auratus*. Probably breeds in patches of spruce woodland on some lower mountain slopes. Seen occasionally from 8 May to early September.

*SAY'S PHOEBE *Sayornis saya*. Common breeder, both in buildings and on alpine cliffs. Nests: in shed, mile 75, hatched 29 June; same shed, 25 June 1958 (young); shack, mile 83, six young with eyes not open 28 June 1958; cliff, altitude 4000 feet, mile 68, 28 June 1958 (four large young); cliff, mile 66, altitude 3800 feet, 4 July 1958 (five large young); shack, mile 83, 16 July 1959, five young out of nest. Seen 23 May to 13 August. One previous nest record from the area (12 July 1944, mile 85 Haines Road; M.-C.).

*HORNED LARK *Eremophila alpestris*. Abundant spring and fall migrant; common nester in grassy areas at 4500 feet and on dry, open shrub communities at 3000 feet. Nest containing five eggs seen 15 June. Arrived before 7 May, and migrating flocks were present from late August to 10 September. Recorded from alplands of the region by all investigators.

VIOLET-GREEN SWALLOW *Tachycinetta thalassina*. Common spring migrant 8 May to 17 May. Common in fall in Atlin region (M.-C.).

*TREE SWALLOW *Iridoprocne bicolor*. Pair arrived 13 June 1957, built nest in building at mile 75, then left after incubation began, and were not seen again after 1 July. Pair seen at mile 75 from 15 to 20 June 1958. Telegraph Creek, B.C., (latitude 58°N) is the most northern breeding area previously recorded in this region (M.-C.).

*BARN SWALLOW *Hirundo rustica*. Pair hatched four young in camp building, mile 75, 30 June. Another pair completed a nest 11 June, laid four eggs from 17 to 21 June, and hatched four young on 8 July. Young left the latter nest 27 July, and were present in camp until 2 September. Five pairs nested at mile 75 in 1958, with young in nests 24 June to 4 July. Brood found just out of nest near Atlin in a mining shack at 5000 feet on 22 August 1957. One previous nesting record for Atlin (1913; M.-C.).

(*) GRAY JAY *Perisoreus canadensis*. Adults and young seen rarely in patches of spruce woodland.

*BLACK-BILLED MAGPIE *Pica pica*. Two nests found in Chilkat Pass, both in spruce. A pair raised one young out of a clutch of six eggs (hatched 20 June). Another pair raised one young in a nest used in 1957 by Sharp-shinned Hawks; the young magpie was nearly ready to fly on 18 June 1958. Flocks of four to seven common in late July, becoming more scarce in late August.

(*) COMMON RAVEN *Corvus corax*. Nests not found, but birds common all summer, especially around refuse dump at mile 76.

(*) ROBIN *Turdus migratorius*. Common spring migrant, present before 7 May; occasional breeder in spruce; abundant migrant 1-17 August, especially in higher hills. Latest record 3 September.

(*) HERMIT THRUSH *Hylocichla guttata*. Probably breeds in areas of dense brush in the pass. Heard singing in May, and encountered in small numbers in early August. Speciment collected 2 July 1958 for verification of identity.

(*) GRAY-CHEEKED THRUSH *Hylocichla minima*; (*) SWAINSON'S THRUSH *Hylocichla ustulata*. These two thrushes are treated

together because of the rarity with which they were identified in the present study. Apparently of similar habitat preference as the Hermit Thrush. *H. ustulata* was found breeding in Chilkat Pass in 1944 (M.-C.). All three species of *Hylocichla* seen by Rand (1944), Godfrey (1951) or Drury (1953) in brushy or forested parts of southwest Yukon. Banfield (1953) recorded *H. minima* in Chilkat Pass.

*WATER PIPIT *Anthus spinoletta.* Common spring migrant, arriving 14 May. Flocks seen until 22 May. Breeds in alpine areas at altitudes of 3700 to 4500 feet. Nests: 15 June, six eggs; 15 June, six eggs; 20 July, four young hatching.

*TOWNSEND'S SOLITAIRE *Myadestes townsendi.* Rare breeder. Pair seen at altitude of 4500 feet on 29 June 1957, with male singing. Six seen at high altitudes, mile 97, on 30 June 1958. One nest with four eggs found at 4000 feet on Mount Reilly, 19 July 1959. No summer records in M.-C. for the region, but the species migrates through Atlin, B.C. and was recorded in summer (1 August) by Godfrey (1951) at mile 123 Haines Road, and by Drury (1953) at mile 134.

BOHEMIAN WAXWING *Bombycilla garrula.* Rare summer visitor. Flock of eight seen 10 July 1957; two seen 3 July 1958. Common fall migrant in August, especially in spruce woodland.

NORTHERN SHRIKE *Lanius excubitor.* Common migrant in late July and August. Last observed 3 September. One breeding record for mile 80 (1944; M.-C.).

YELLOW WARBLER *Dendrioca petechia.* Rare summer visitor. Records: 20 June 1957, three, including one singing male; 28 June 1957, one bird; 17 June 1958, one male; 20 June 1958, male singing. All records are for mile 75. Seen 17 July 1944 by Shortt (M.-C.), with no evidence of breeding, at mile 80. Godfrey (in letter) saw three adults, of which two were collected, between miles 84 and 85, on 25 July 1949, and says that Clarke took one at mile 86 on 16 July 1949.

BLACKPOLL WARBLER *Dendroica striata.* Rare migrant. One male seen 20 May. One previous record for the Haines Road (19 July 1944; M.-C.).

MYRTLE WARBLER *Dendroica coronata.* One spring record; 14 May 1957. On 7 August 1957 a small flock of Myrtle Warblers was seen at the east end of Kelsall Lake. It is posible that some of the birds were *Dendroica auduboni.*

*WILSON'S WARBLER *Wilsonia pusilla.* Abundant breeder. Arrived before 8 May, and last seen 29 August. Three nests: three young hatched from three eggs, 16 July; four young hatched out of five eggs, 4 July; nest with five eggs found 20 June 1958.

RUSTY BLACKBIRD *Euphagus carolinus.* Seen only 8-10 May. Spring and fall migrant at Atlin (M.-C.).

*ROSY FINCH *Leucosticte tephrocotis.* Breeds in areas above 4000 feet where rocky ledges are common. Seen 14 May to 31 July, but may have been present at high altitudes until the middle of August. Adult seen feeding young on Mount Seltat, mile 60.

*COMMON REDPOLL *Acanthis flammea.* Abundant spring and fall migrant and common breeder. Nest with three eggs 26 May, four on 27 May, but deserted by 13 June. No previous breeding records for the area. Flocks of as many as 30-40 adults and young seen after late June, often at altitudes higher than those used for nesting.

*SAVANNAH SPARROW *Passerculus sandwichensis.* Abundant breeder. First seen 9 May, and still present 10 September. Nests: 13 June (four young); 25 June (five young); 29 June (four young); 5 July (four young); 18 June (four eggs); 25 June (five eggs); 28 June (five eggs); 1 July (four eggs); 4 July (five eggs hatched by 12 July); 1 July (four eggs). Nest found 17 June 1958 contained five eggs.

(*)SLATE-COLORED JUNCO *Junco hyemalis.* Spring and fall migrant in small numbers, and possible breeder in spruce woodland. Seen 9 May to 6 September. Reported in shrubby forest openings and above timberline only a few miles from Chilkat Pass by Drury (1953).

*TREE SPARROW *Spizella arborea.* Abundant breeder and seen throughout the summer. Fifteen nests found in 1957, seven of which provide data on hatching dates and number of young: 10 June (four); 20 June (five); 22 June (four); 24 June (four); 24 June (three); 26 June (four); 7 July (five). Average clutch size of 14 nests was 4.7. Nests (1958): 16 June (four young about three days old); 27 June (four eggs).

(*)BREWER'S SPARROW *Spizella breweri.* Shortt (M.-C.) recorded this species at mile 85 in 1944, when one juvenile was seen. Clarke (MS) found it abundant in alpine areas along the Haines Road in 1944 and

collected one adult at mile 85. None were seen in 1957–1959, although several males were observed at Atlin above timberline in 1958.

*WHITE-CROWNED SPARROW *Zonotrichia leucophrys*. Abundant breeder, although not as numerous as Tree or Savannah Sparrows. Seen 8 May to 28 August. Nests; 9 June (four young); 30 June (three young); 30 June (three young); 5 July (four young); 8 July (three young). Nest found 27 June 1958 had five eggs. According to Swarth (1922) the White-crowned Sparrow and Golden-crowned Sparrow are separated altitudinally during the breeding season (the latter species higher). I found that both nested close together on the flats of Chilkat Pass, but only the Golden-crowned Sparrow nested at the upper edge of the zone of shrubs (up to about 3800 feet).

*GOLDEN-CROWNED SPARROW *Zonotrichia atricapilla*. Abundant breeder. Seen 9 May to 3 September. Three nests found: 10 June (four young); 23 June (four young); 18 June (five eggs).

(*)LINCOLN'S SPARROW *Melospiza lincolnii*. Breeds in wet, shrubby marshes at timberline. Arrived in May, and seen in June and July. One Atlin breeding record (1924; M.-C.).

*FOX SPARROW *Passerella iliaca*. Seen 9 May to 2 September. Breeds in brushy parts of the flats, especially where willow and birches are between five and seven feet in height. No nests were found, but juveniles were seen in July. Drury (1953) saw this species at Pine Creek, 90 miles north of Chilkat Pass along the Alaska Highway in forested areas.

LAPLAND LONGSPUR *Calcarius lapponicus*. Abundant spring and fall migrant. Seen 7-14 May, and often after September 1. Observed by Banfield (1953) at Burwash Creek Summit on 7 June 1951, and Edith Creek Summit (both areas in southwest Yukon) on 17 June 1951.

SMITH'S LONGSPUR *Calcarius pictus*. Two seen in dry, savannah-like community at 3000 feet near Kelsall Lake on 25 June 1958. A specimen collected by me 9 June 1958 at headwaters of Wright Creek, near Atlin, in similar habitat. Earlier, Clarke (MS) collected the female of a pair near Kelsall Lake (17 July 1944); this bird had a large brood patch. There are only three other records of this species in B.C. that have been published (M.-C.): extreme southeastern B.C., 15 May 1858; Kispiox Valley, Skeena River region, 25 August 1921; Swan Lake, Peace River District, 27 May 1938. The specimen collected at Atlin was identified by Dr. Ian McTaggart Cowan, Head, Department of Zoology, University of British Columbia, and is now in the U.B.C. collection.

(*)SNOW BUNTING *Plectrophenax nivalis*. Common spring and fall migrant (7-25 May, 3-6 September). Several seen in high alpine areas at miles 97, 68, 66 and 69 in 1958. Female collected 4 July 1958 at mile 66 had three follicles about 2.1 mm in diameter. Preferred habitat seemed to be at altitudes above 4500 feet, usually along the rocky shores of permanent, glacier-fed pools. Often seen in same areas as White-tailed Ptarmigan and Rosy Finches. This is the first indication of breeding in B.C.

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Received for publication 25 November 1958

A STUDY OF WOODCHUCKS ON AN ONTARIO FARM

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In view of the large numbers of woodchucks (*Marmota monax rufescens*) in many sections of the United States and southern Canada, it is somewhat surprising that comparatively few biological investigations have been made of this animal.

Although Hamilton (1934) and Grizzel (1951) have contributed much to our knowledge of the life history and ecology of the woodchuck, these authors have gathered little detailed information about the population of a localized area. The present authors, therefore, decided to study the woodchuck population of a 150-acre farm in southern Ontario. Since this farm was owned and lived on by the senior author, he was able to obtain a continuous picture of changes in the woodchuck population. As no hunting of woodchucks was allowed on the farm during the years 1954-1958 inclusive, data on mortality factors through natural causes may be considered valid.

Description of the Study Area

The study area is located in Puslinch Township, Wellington County, southern Ontario, at latitude 43° 30′, on a recessional moraine; agriculturally it is marginal.

The main soil type is Dumfries loam. The soil is well drained and apt to be droughty during the middle of the summer. The profile exhibits the characteristics of the Gray-brown Podzolic soil group. The topography is irregular; it includes gravelly knolls, level outwash pockets, small ponds and marshes. Numerous stone piles are present on the area.

Outwash pockets, covering about 20% of the farm, are reasonably fertile, and are mainly in improved pasture. Permanent pasture covers about 57% of the area, woodlots about 7%, recent reforestation about 6%, and ponds and marshes about 10%.

Study Period

The study lasted six years. During the first three years, 1953 to 1955, a preliminary investigation consisted of about two censuses per week while the woodchucks were active. Data were also collected on crop rotation, grazing pressure, and the presence of woodchuck burrow systems.

A more intensive study began in 1956 when daily field trips were made during the periods February 22 - March 22, May 22 - June 10, July 18 - July 28, and August 4 - August 16. During 1957 intensive field work was carried on almost continuously throughout the periods February 17 - March 31 and April 26 - August 22. An average of four hours and forty minutes was spent daily in the field during the latter period. The 1958 field work was limited to the period February 23 - March 21.

Methods Used

During the months of February and March data were obtained on emergence from hibernation and on movements. Throughout the months of May and June daily records were made of the number of woodchucks and litters present, and the size of the litters. Live trapping was started in June. Censuses and live trapping operations were continued in July and August.

Detailed observations of movements and behavior were made during spring and summer from an observation tower 12 feet in height overlooking two adjoining ten acre fields of improved pasture. These fields were selected for more careful observations since they were considered to have a higher population of woodchucks.

Collapsible live traps (9″ x 9″ x 27″), made by the National Live Trap Company at Tomahawk, Wisconsin, were used to trap woodchucks. The animals were subsequently marked and released. In 1956 the trapped animals were toe-clipped, and in 1957 they were tagged on each ear with Ketchum Clincher Tamperproof wing tags.

The census procedure in 1956 and 1957 was as follows: (1) daily censuses over the same route, (2) spot checks throughout the day from selected vantage points, (3) intensive censuses varying from one to four hours daily from the observation tower, (4) checks of burrow systems to determine their usage by woodchucks, and (5) live trapping to augment observational data in determining the actual population of the 150-acre area. Trapping with leg-hold traps was also started late in 1957.

Binoculars and a spotting scope were used in the censuses. All sight observations were recorded daily on a map of the entire study area and on another one of the two ten-acre fields in front of the observation tower.

Observations of woodchucks in a strip 100 yards beyond the farm boundaries were recorded to obtain some idea of transient animals and of those whose home range was only partially in the study area.

Hibernation

Beginning of hibernation

Observations made from 1953 to 1955 inclusive suggested that very few woodchucks were active during September, and possibly that some hibernation started late in August. Careful observations were made during September and October 1956. All observations were restricted to the early afternoon, since field work during 1953-1955 indicated that in the fall woodchucks appeared only during the warmer part of the day. Only limited activity occurred during late September. Observations made on September 18, 20, 22, 24, 26 and 28, lasting 75 minutes on the average, resulted in one woodchuck record for September 22, 24, and 26. In October no woodchucks were seen above ground, nor were there any signs of activity about the burrows, such as fresh digging or grazing. It seems probable that all animals had started to hibernate by October 1.

During August woodchuck activity decreased considerably. A special effort to trap woodchucks was made in August 1957, but the catch was low. Some animals, seen lying near the mouths of burrows into which traps had

been dug were not caught. This reduced activity may be associated with the onset of hibernation.

Records kept on the activity of three penned-up woodchucks during 1957 showed that these animals remained active long after the free-living specimens had started hibernation, even during days of low temperatures. The last observation of an active penned-up woodchuck was made on November 30.

Emergence from hibernation

The entire study area was surveyed regularly in 1956, 1957, and 1958 for the emergence of woodchucks. At least two complete and several incomplete censuses were made each week during late February and March. Data on the location of hibernation sites, time of investigation and observations of woodchucks were recorded on maps each day a field check was made. Because there was generally adequate snow on the ground in the first half of March during the three years mentioned, tracks of a recently emerged animal could readily be discerned.

The first dates of emergence in our study area were March 5, 9 and 6 for the three years, respectively. Track data and activity around burrow openings indicated that most of the woodchucks emerged two or three days after the first ones appeared above the surface. Some animals moved widely between dens immediately after emergence.

By studying fresh tracks and the clearing of snow from a burrow, evidence was collected concerning dens that were considered used as hibernation sites. Observations indicated that eight burrow systems were used for hibernation three years in succession, eight were used two years in succession, and eight used only once. Three of the burrow systems that were occupied during three consecutive years had also been used in the two previous winters.

Activity after first emergence

Soon after emergence woodchucks attempted to open up burrows they had apparently used the previous year. Tracks showed that these animals had no difficulty in finding the exact location of burrows, even when these were completely covered by snow. Often a heavy crust prevented them from opening a burrow. On one occasion a woodchuck broke through a one-inch crust to emerge from its burrow. Sometimes a woodchuck had to dig through as much as three feet of snow in order to get out. Müller-Using (1957) found that the alpine marmot (*Marmota m. marmota* L.) also may dig through a thick layer of snow.

Woodchucks do not come to the surface every day after their first emergence. They may remain underground for several days during cold spells.

Yearlings (small-sized animals considered as such) appeared to emerge later than adults. In 1957 the first yearling was observed on March 31, 22 days after the first emergence of adults, and in 1958 the first yearling was seen on March 24, 18 days later than adults.

Soon after emergence, woodchucks are active during the day. From March 5 to 20, individuals were observed any time during the day between 7.20 a.m. and 4.00 p.m., E.S.T.

Population Appraisals

Litters

Our first litter was seen in 1956 on May 22. It seems reasonably certain that during the period May 22 to 30 (see Table 1) other litters were detected on, or fairly close to the time they had emerged. In 1957 our first litter was

Table 1. Sizes of woodchuck litters, 1956 and 1957

Litter size	First date observed	First known date of dispersal of young	Remarks
A. *Known litter sizes* (8) (based on three or more observations)			
5	May 23, 1956	May 27	
4	May 22, 1956	May 30	
4	May 25, 1956	June 3	
4	May 13, 1957	?	
4	May 24, 1957	?	
4	May 31, 1957	June 11	one killed by a fox
3	June 7, 1956	?	
2	June 3, 1957	June 10	
B. *Actual litter size unknown* (10) (based on one or two observations)			
4	May 29, 1956	May 30	Litter sizes estimated, as animals could not be kept under observation because of tall vegetation, disturbances, etc.
4	June 5, 1956	June 7	
3	May 24, 1956	?	
3	June 6, 1957	?	
2	May 28, 1956	?	
2	May 30, 1956	?	
2	June 5, 1956	?	
2	June 6, 1956	June 6	Young animals on the move, not observed near a den
2	June 7, 1956	June 7	
1	June 8, 1956	June 8	

June 9, May 31, June 9 — last observations of young at dens

recorded on May 13, and it is believed that the last emerged on May 31. In the area of Ithaca, New York, Hamilton (1934) observed the first young on May 19. In southeastern Iowa, Scott and Klimstra (1955) saw their first litters on May 13, 1946; May 2, 1947 and May 30, 1948.

Woodchucks produce one litter per year; it varies in size from 4 to 8 (Grizzell). From autopsies of gravid females Grizzell found the mean litter size to be 4.6, and Hamilton 4.07.

We observed what we considered to be thirteen different litters in 1956. Live trapping records indicated that at least one additional litter was present. In 1957 five litters were observed, and four lactating females were live-trapped in locations other than where the known litters were observed. Threfore it was estimated that in that year at least nine litters were produced in the study area. Rapid growth of the vegetation during 1957 made it harder to locate litters than in 1956. This may explain the difference in the number of litters tallied in the two years.

TABLE 2. RED FOX PREDATION ON WOODCHUCKS

Date of Observation	Evidence of kills by foxes
March 13, 1956	1 adult woodchuck (evidence: tracks of a fox at kill site).
May 27, 1956	1 yearling (skull and skin near entrance of fox den).*
June 1, 1956	1 adult woodchuck chased an adult fox that was trying to catch one of its young.
June 6, 1957	1 tail of a juvenile woodchuck (found near fox den).
June 7, 1957	1 tail of a juvenile woodchuck (found near a fox den).
June 11, 1957	3 juvenile woodchucks (skull and skin near entrances of fox den).
June 12, 1957	2 juvenile woodchucks (skull and skin near entrance of groundhog burrow).

*To prevent repetition of records all remains of woodchucks were removed around the fox den on day of observation. Ages were estimates, based on available evidence.

The sizes of litters observed during 1956 and 1957 are shown in Table 1. The average size of litters that were seen three or more times is 3.75, or close to the mean based on autopsies for the northeastern Unitd States, whereas the size of litters seen only once or twice is 2.5. This lower average suggests that a litter should be observed several times before any conclusion is drawn about its size.

Mortality data

References in the literature about natural mortality do not provide much definite information.

This discussion will be restricted to predation as a mortality factor. Among the mammalian predators, Seton (1928) lists the red fox (*Vulpes fulva*) as the most important one. Grizzell (1951) includes foxes and dogs as the chief species. He also lists the bear (*Ursus americanus*) as a predator. Scott and Klimstra (1955) demonstrated red fox predation on woodchucks. Grizzell (1951) lists hawks and owls among the raptors. Müller-Using (1956) mentions predation by the Eagle Owl (*Bubo bubo*) on juvenile marmots. The Craighead brothers (1956) list one woodchuck as prey of the Red-tailed Hawk (*Buteo jamaicensis borealis*).

Few data on predation on woodchucks were collected during our study. The area is inhabited by red foxes, skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), the occasional mink (*Mustela vison*) and some Great Horned Owls (*Bubo virginianus*). A pair of red foxes raised their litters just outside the study area in 1956 and 1957. The evidence obtained on fox predation in 1956 and 1957 is listed in Table 2. Our data suggest that fox predation may be effective on juvenile woodchucks. Scott and Klimstra (1955) also suggest that the red fox may inflict mortality among young woodchucks because these authors found woodchuck remains in a greater percentage of fecal passages from spring and early summer than in those from late summer and early fall.

Evidence is inconclusive as to whether foxes capture woodchucks close to the den where their pups are reared. In 1956 one woodchuck was observed twice with her three young near her burrow, which was situated only about

Table 3. Observations of juvenile woodchucks in 1957*

Month	Total number of field checks per month	Total number of juveniles observed per month	Maximum number of juveniles observed per field check
May	24	21	7
June	23	56	7
July	25	16	3
August	19	6	0

*Average daily observation period: 4 hours, 40 minutes.

50 feet from a fox den. Mr. H. G. Merriam (personal communication) saw an adult woodchuck remain undisturbed even though it was only 10 paces from an occupied fox den. On the other hand, on June 12, 1957, skulls of two juvenile woodchucks were found in the entrance of a woodchuck burrow that was inhabited on May 31 by a female woodchuck and three young and was located about 50 feet from the fox den. Later during the same day a young fox, when startled at the mouth of this woodchuck burrow, entered it, and remained inside for two hours.

Predation may be high in early spring, particularly during March, when the woodchucks move widely over the snow-covered ground. Fox and skunk tracks regularly led to woodchuck burrows during that month and this may suggest a special interest. Skunks and raccoons inhabited woodchuck burrows in the study area, but no evidence was collected on predation by these species on woodchucks.

Dogs caused some mortality among woodchucks on the study area. Although only one yearling is known to have been killed in this way, it seems likely that other woodchucks fell victim since at least three dogs were roaming the area regularly.

No actual kill by raptors was observed. However, on June 7, 1956, one Red-tailed Hawk was seen trying to catch a juvenile woodchuck. On several occasions during 1957 a male Marsh Hawk swooped at adult and juvenile woodchucks, but did not make contact. Only once did this hawk hit a woodchuck with his talons.

Deaths through human agency were considered to be low in the study area in 1956 and 1957. Hunters were kept out as much as possible, and we have no knowledge of any animals shot. A boy killed two woodchucks in 1956 and two animals died in live traps during the summer of 1957.

Highway fatalities may be frequent, particularly among juveniles. (See the section entitled *Dispersal of juveniles.*)

In 1957 juveniles were not seen as often in July and August as they were in May and June (Table 3). This scarcity may be partially due to predation; seven juveniles were killed by foxes during the spring (Table 2). One litter consisting of four young first observed on May 28 decreased to only one young in five days. However, one or more young may have left the den.

Population censuses

Hamilton (1934) states that the woodchuck was an uncommon animal at one time and that there is little doubt that it was once a forest animal. He suggests that it is now essentially an edge animal, where woodlots, meadows and pastures are interspersed. He believes the densest populations are present on flat to slightly rolling land, well studded with rocks and large stones. His description fits reasonably well the present-day conditions in Ontario. However, compared with estimates made by Seton (1928) and Hamilton (1934) for New York State, population densities in southern Ontario as we have observed them are not very high.

In order to assess the woodchuck population in the study area during 1956 and 1957, various approaches were tried. These included counts of (1) the early spring population based on location of hibernation dens of various woodchucks, and on sight records of individuals; (2) the late spring population based on located litters, on litter sizes, and sight records of other individuals; and (3) the late summer population, just before the first animals start to hibernate.

The results obtained are unsatisfactory insofar as a population assessment of the study area is concerned. Part of the problem lies in the difficulty of determining what percentage of the animals observed was transient.

In 1956 the early spring (March-April) population was estimated at 31.

During the period May 22 to June 10, daily checks were made of the entire study area. Maximum counts of 19 individuals were obtained on May 22 and 23. By reference to a map showing the accumulated daily observations of various woodchucks, the population of adults and yearlings was estimated at 40 individuals. An actual count of litters and litter sizes showed the number of juveniles to be at least 38. The total population was then 78. However, using a mean of 3.75 for litter sizes and multiplying this by the total number of litters observed (13), we arrived at a juvenile population of 49 and a total population of 89 animals. The total population by early June was therefore considered to range from 78 to 89, or less than two acres per woodchuck.

From a population estimate of 15 woodchucks in the two 10-acre fields that were carefully observed from the observation tower, and of 18 animals for the remainder of the study area, it is assumed that in early August at least 33 animals were present. This is a low estimate compared with the early June figure.

In 1957 insufficient censuses were made during early spring to allow for a population estimate. However, a detailed census was made later, between April 26 and May 31, when conditions for observations were ideal, that is, when growth of vegetation was just beginning and the animals were readily seen. An attempt was made to classify the population into three groups, based on the percentage of time that the woodchucks spent within the boundaries of the study area. These groups were: (1) residents, more than 90%; (2) semi-residents 50-90%; and (3) transients, less than 50%. Owing to too few and sometimes unsatisfactory observations it proved impossible to adequately assign individuals to these groups. The combined total of resident and semi-resident animals was estimated at 47 adults and yearlings, or a somewhat higher population than observed in 1956. No attempt was made to assess the juvenile population for 1957 as tall vegetation made observations difficult.

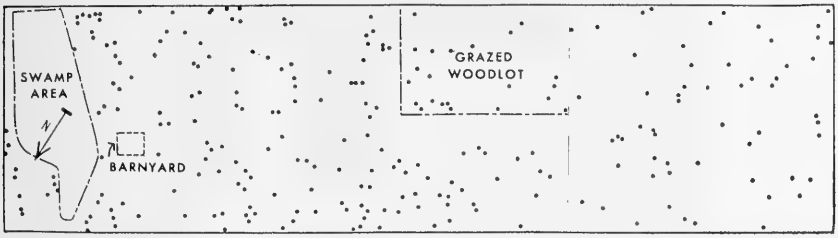

Figure 1. Map of the 150-acre farm showing the locations of burrow systems of woodchucks present during the period 1954-1958. The westerly 50 acres are separated from the easterly 100 acres by a dotted line.

Insufficient data were collected in early August 1957 to allow for an estimate of the population present during that month.

Distribution and utilization of burrow systems

Figure 1 shows all the burrow systems present in the study area from the spring of 1954 until the fall of 1957. A burrow system is an arbitrary unit: all openings more than 25 feet apart are considered to belong to a separate system.

The total number of burrow systems was 240. Among these, 18, or 7.5% of the total, had been established since the fall of 1956. This suggests that each year only a relatively few new burrow systems were established.

Observations indicated that new burrow systems were established by juveniles or yearlings between the middle of June and the end of July. It also appeared that many of the established burrow systems were used by several generations of woodchucks.

A minimum of 14 per cent of the burrow systems was used as hibernation sites during the winters 1955-1956, 1956-1957 and 1957-1958. Only three of these, or slightly more than one per cent of the total number of burrow systems, were located on the westernmost 50 acres, where poor range conditions existed, whereas 31 were considered occupied by hibernating animals in the eastern 100 acres.

Figure 1 shows that the density of burrow systems was lower in the westerly 50 acres than in the easterly 100 acres of the study area. There were no woodchucks in the swamp area and very few near the buildings. Assuming that 15 acres of swamp and one acre of barnyard were uninhabited, there were 2.2 burrow systems per acre in the eastern part of the farm and 1.0 in the western part.

We noticed that not all of the burrow systems present in the study area were utilized. Therefore, records of burrows that were considered to be in disuse were kept from early 1957 on. In an effort to determine whether a burrow was being utilized, stones and sod were thrown into the entrance to block it. Subsequently, checks were made for evidence of digging, tracks, and grazing on the vegetation about the mouth of the burrow. From this survey it is estimated that 56 per cent of the burrows were utilized during May 1957.

With reference to the matter of burrow utilization by woodchucks it should be stated that a few burrows were used by skunks, raccoons and foxes and that cottontail rabbits used some burrows during the colder parts of the year.

During June the picture changed, particularly after June 10, when many of the young had dispersed. Apparently many unoccupied burrows are taken over by juveniles.

All burrows that showed evidence of utilization were not necessarily inhabited continuously: plugging experiments indicated that in many instances they were utilized for only a few days or possibly only a few hours.

Population densities and land use

On the farm under study, farming is a marginal enterprise.

The westerly 50 acres, which have not been plowed for at least 25 years, are covered mainly by Canada blue grass (*Poa compressa*), but also by common timothy (*Phleum pratense*) and numerous herbs. Goldenrod (*Solidago* spp.) is gradually taking over more and more acreage as an almost solid stand. Oxeye daisy (*Chrysanthemum leucanthemum*), devil's-paintbrush (*Hieracium aurantiacum*), and common mullein (*Verbascum thapsus*) are also widely distributed. This land has never been manured or fertilized. Because of droughty soil the pasture is usually in a very poor condition during late July and August. This portion of the farm has a low carrying capacity for livestock and also for woodchucks (see Figure 1). Fluctuations in the woodchuck population of this area have been small during the 1953-1958 period.

Of the easterly 100 acres only about 40 per cent has been under cultivation during the last decade. The rest of the tillable land has not been plowed or fertilized for at least 25 years. A swamp and an open-grown woodlot cover the front of the farm. A woodlot which has been pastured continuously, covers 11 acres (Figure 1), and two plantations of conifers, established in 1954 and 1957, cover 9 acres.

A correlation seems to exist between the availability of certain forage crops, crop rotation, and the population densities of woodchucks. Grizzell (1951) stated that woodchucks show a definite liking for certain fields — soybean, clover, alfalfa, clover-grass, and corn fields are preferred — but that they seldom use wheat and other grain fields.

Cursory observations during 1953, 1954 and 1955 suggested that there were higher woodchuck populations on the improved parts of the farm. More detailed investigations verified this observation.

Two examples of a relationship between crop rotation and woodchuck population densities noted during the period 1953-1958 in the cultivated fields of the easterly 100 acres will be given: (1) One field, which had been plowed up in the fall of 1952, was left in fallow during 1953 and was seeded with a mixture of alfalfa, clover, and timothy in the spring of 1954. Starting in 1955, one hay crop was harvested each year. The following evidence was obtained of population changes: 1953, 1 burrow system, no woodchucks observed; 1954, 1 burrow system, no woodchucks observed; 1955, 8 burrow systems, at least 1 woodchuck present; 1956, 11 burrow systems, at least 4 woodchucks present; 1957, 13 burrow systems, at least 7 woodchucks present. These data indicate that the woodchuck population increased with the availability of

better forage. (2) Another ten-acre field, which in 1951 had been seeded to a mixture of alfalfa, clover and timothy, and which still contained a reasonable amount of alfalfa by 1953, was just about devoid of anything but timothy by 1954. It had a high woodchuck population during 1953 when at least 8 individuals were shot. Despite the fact that woodchuck hunting was stopped after 1953, the population never increased: from 1954 until 1957 the maximum number of different animals seen at any one time was three.

Live-Trapping Data

Live-trapping was initiated in 1956 and continued on a more intensive scale in 1957 to obtain information about the activity and movement pattern of marked animals. In 1956 restricted live-trapping efforts were made from June to September. In 1957 a maximum of 20 traps was used during the period May 14 to September 1. Early in the season, selective trapping was carried out: whenever an animal had been under observation for some time and knowledge of its sex was desired, traps were set out to catch it. A live-trap was dug in at each entrance of a burrow system in which a woodchuck was thought to be present. Subsequently traps were checked at intervals until an animal was captured or signs of escape were observed.

Trapped animals were weighed, identified as to sex; marked with a lacquer and tagged in their ears. Dyes proved unsatisfactory since they could not be easily observed from a distance of 100 yards or more. Yellow, red and white lacquers, or combinations of these, showed up well from a distance. Lacquer adhered well to hair and some of the marked animals could be identified for at least two months. One animal trapped in August of 1956 was retrapped the following spring with some lacquer still adhering to its fur.

During May most of the trapping was carried out in the two fields in front of the observation tower in order to trap, tag, and mark as many individuals as possible for intensive observation. More extensive trapping was done during early June to trap juveniles at natal dens. During July and early August trapping took place in several parts of the study area.

Twelve animals were taken in 1956 and 44 in 1957. Five of the 1957 animals were recaptured once and three twice.

During August 1957 only six captures were made. Woodchucks appeared reluctant to emerge from their burrows, or came to the burrow entrance without tripping traps. In addition, leg-hold traps were set to obtain more information about the whereabouts of marked animals at the end of the study period. This effort was not very successful since several woodchucks escaped after wringing off a leg. Five specimens were collected.

Movements

Daily movements

Commonly, on their daily foraging trips, woodchucks stay within a radius of about 100 feet of their dens. However, sometimes they go on extensive forays, as illustrated in Figure 2. Juveniles, particularly during dispersal, and adult males may move widely during one day. On June 12, 1957, for example, one marked adult male was observed moving a distance of 300 yards in a period of ten minutes. Several other similar widespread movements were observed during the course of the study period.

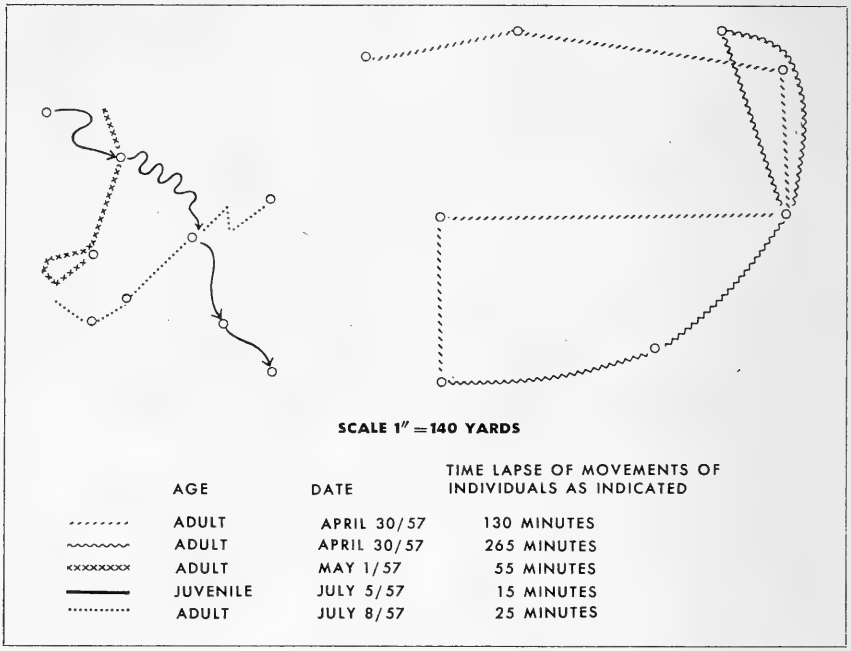

FIGURE 2. Examples of movements of various woodchucks on certain days during the spring and summer. Burrow systems are indicated by circles.

Changes in movement pattern

Extensive travels are undertaken by some woodchucks after emergence from hibernation and later in shifting their home range. One animal was observed to move about one quarter of a mile on March 19, 1956.

Grizzell (1951) found in his trapping studies that males traveled widely in spring. He also observed a movement to field dens in late spring and a reverse movement to hibernation dens in the fall. We could not find evidence of such a movement pattern in our study.

The movement pattern of woodchucks changed in our study as the season progressed. In May and June movements appeared rather restricted. However, during July there was a general increase in distances traversed and in the degree of activity of both adults and juveniles. This increase may have been due to seasonal changes in the availability of food.

Utilization of runways

The use of runways by woodchucks is well known. Runways are worn in the vegetation between various burrows and favored feeding spots, particularly during late spring. Well-defined runways may be as much as sixty feet in length.

Woodchucks, if alarmed while away from their burrows, use these pathways to escape rather than take a straighter short cut through the vegeta-

tion. When they find obstructing vegetation in a newly established runway, they chew it off. Newly planted Scotch pines were eliminated in this fashion. When, for some reason, a woodchuck has to travel fast through dense vegetation and away from a runway, it will not run as it normally would on a runway, but it will take long arching bounds.

Dispersing juveniles and wandering yearlings were often found to ignore runways on their travels.

Dispersal of juveniles

Contrary to the statement of Hamilton (1934) that the young often stay with the female parent throughout the summer and first winter, our observations suggest that this is not generally the case. Our findings are that either the juveniles may leave the natal den on their own accord and establish new home ranges for themselves or that the female may abandon her young, at least for a while. King (1955) similarly found that young prairie dogs may move long distances, attempt to colonize any suitable habitat, and seldom return to their original natal area.

Juveniles may disperse from their home burrow by one of three methods: (1) They may follow the female to another burrow system. This may be entirely voluntary or under inducement of the female. We recorded two of the latter instances. On June 7, 1956, one adult appeared from a burrow followed by a young animal which was subsequently grabbed by the parent and dragged over a distance of about one yard. Then the juvenile followed the adult to another burrow system. On May 24, 1957, a female (sex known through live trapping and marking) moved one of her young about one yard by grasping it by the neck. She then dropped it and led it to a new burrow about 30 yeards away. (2) They may on their own accord follow trails made by the female, or other woodchucks. (3) They may use chance movements. In such cases a juvenile will stray off existing trails, and move about in a zig-zag course (Figure 2) until a burrow system or some other shelter is sighted. Between early June and August numerous observations were made of juveniles moving in an indefinite manner through the study area. For example, one marked animal was observed on June 6, 1957, wandering aimlessly through a field about 350 yards from its home den. This animal was so far from any burrow system that it was easily run down and caught. On June 10, 1957 another juvenile was seen to leave the natal burrow and to proceed in an indefinite, exploratory course across a hill. After some wandering, it noticed a burrow into which it disappeared for a few minutes. Subsequently, it walked up a hill and disappeared out of sight. The natal den was kept under observation for the rest of the day, but the juvenile did not return.

Rock piles are used frequently by young woodchucks during the dispersal period. Five observations of juveniles using rock piles were made in June and July, 1957.

As suggested by data in Table 1, juveniles generally do not remain around the natal den much longer than a few days after first emergence. In 1957, the first observation of dispersal was made on May 24, and in 1956, on May 27. Juveniles either establish themselves at untenanted burrows, or dig new ones.

Grizzell (1951) found that juveniles may travel considerable distances after leaving the home den. We agree with this statement. For example, on July 27, 1960, one young woodchuck traveled over one quarter of a mile in a two-hour interval.

Other evidence of dispersal of juveniles was obtained by recording road kills. During the period June 30 to August 8, 1957, 13 juveniles and three adults were found along seven miles of road.

On May 31, 1957, a female left her young at the natal den and moved away on her own. Some time afterwards she returned to her litter. On June 4, 1957, another female was observed to leave her young. One of the juveniles that was left by this female and an adult male were trapped on that same day at the natal den.

Some natal dens may be deserted completely by the female and her young. Two burrow systems from which young emerged on May 28 and 30, 1956, appeared deserted from June 22 onward. Subsequently, the burrows were blocked and checked regularly. They were not used again until early September. The possibility that live-trapping may induce a female and her litter to move prematurely should not be overlooked.

The observations of wandering juveniles and highway kills of a high percentage of young lead us to believe that juveniles disperse during their first summer, and start new homes for themselves.

HOME RANGES

The extent of the home range of a woodchuck varies with location and the availability of food. It appears that woodchucks do not inhabit the same home range throughout their entire life span, but that they may shift their ranges. This does not imply that an individual may not return sooner or later to its first home range.

Grizzell (1951) suggested that where food is readily available in large quantities and cover is suitable, movements are restricted to a small area. Conversely, where food and cover are sparse, the home range may be large. He also observed that animals in populations of a low density moved much more extensively than those in a population of a high density. This is a corollary of his first finding, since where food is plentiful, population densities are high. In our study we found the same situation to prevail. On alfalfa-timothy fields, where ample food and cover were available, movements were much more restricted than on marginal pasture land with sparse vegetation.

Shifting of home ranges has been observed for woodchucks and related species by other workers. Seton (1928) stated that a woodchuck may move one mile or more to find a suitable location if it needs a change in home range. He also refers to a statement by Soper that Franklin's ground squirrels have been observed to appear in a locality where none was seen the previous summer, sometimes to disappear after only a few weeks. King (1955) also found that certain black-tailed prairie dogs moved to the periphery of their range.

In our study, juveniles and yearlings were found to move around extensively. Among the adults, males shifted around more than females. This became apparent when the movements of marked males were plotted on a map.

Data collected on marked individuals show that females use a rather restricted (or primary) range around the natal den during a period before the young are born up to a few days after they first emerge, and a more extensive (or secondary) range during the rest of their active period. During May and early June, usually two burrow systems, situated relatively close together, were used. When juveniles start to disperse, females extend their range gradually. To illustrate this change in movements we have selected the records of three females from our data and we have plotted the burrows utilized by them (Figure 3). There is little overlap in burrow utilization between these three ranges. This may be due to the low density of the woodchuck population on that part of the farm. Where food and cover were abundantly available there was frequent overlapping of movements and utilization of burrows (Figure 4).

Acknowledgment

We wish to thank Mr. H. G. Merriam for reviewing this manuscript and for providing us with critical comments.

Summary and Conclusions

1. The woodchuck (*Marmota monax rufescens* Howell) population of a 150-acre farm in southern Ontario (latitude 43° 30′) was studied. Extensive work was done during the years 1953, 1954 and 1955, and intensive work during 1956 and 1957.

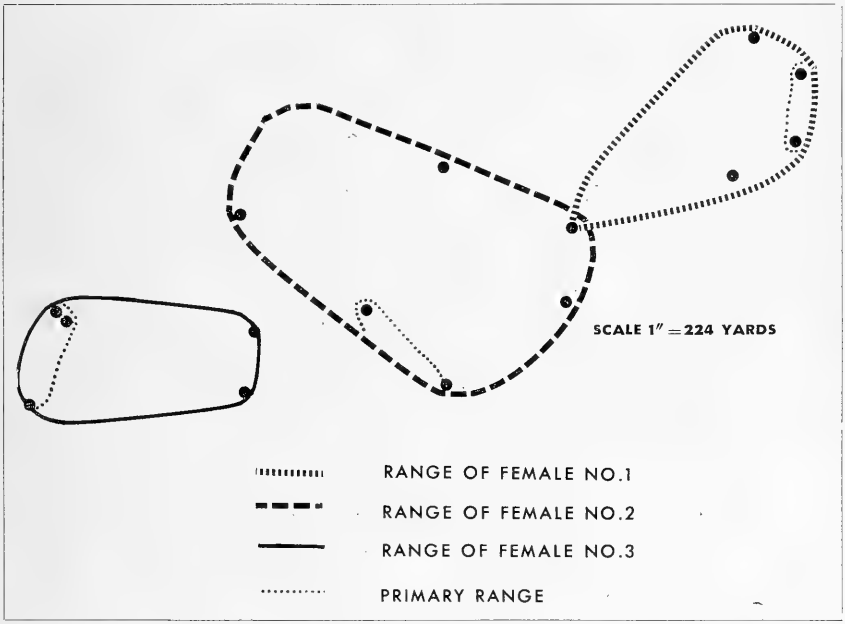

Figure 3. Home ranges of three female woodchucks. The dotted, or primary ranges were used in the spring. The more extensive, or secondary ranges were used during the rest of their active period. Black circles indicate burrow systems.

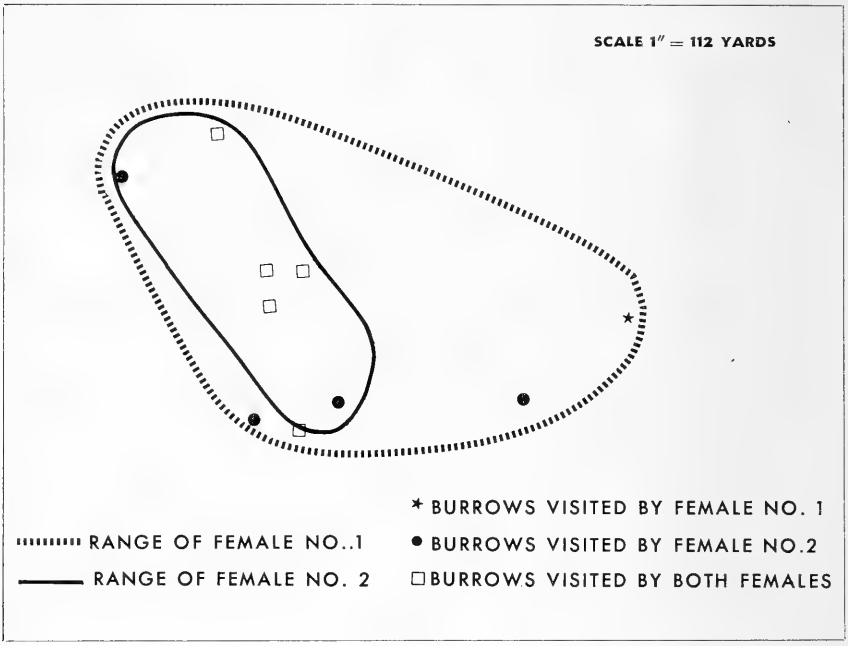

FIGURE 4. Overlapping home ranges of two females in good habitat.

2. Data were obtained on initiation of and emergence from hibernation. The latest observation of a woodchuck was made on September 28, 1956, and the earliest observation on March 5, 1956.
3. Certain burrow systems were repeatedly used as hibernation sites. Burrows covered with snow, used during the previous season, were readily located and opened up.
4. The first observation of a litter was made on May 13, 1957. The average number in newly emerged litters was 3.75.
5. The red fox appeared to be the main predator.
6. Censuses of the resident population produced unsatisfactory results, partly because of the difficulty of determining what percentage of the animals observed was transient.
7. Population densities of woodchucks were correlated with land use. Populations were higher on land that was fertilized and seeded with pasture mixtures than on unfertilized, permanent pastures.
8. Live-trapped woodchucks were identified to sex and marked with lacquers to study their movement pattern. The extent of home ranges varied with environmental conditions, particularly the availability of food. Dispersal of juveniles started by late May or early June. Runways between burrow systems were used intensively, particularly when the vegetation was tall.

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Received for publication 20 November 1959

REVIEWS

Woodland Ecology

By Ernest Neal. Toronto, Heinemann, 1953. 107 p. $1.70.

This small, well-written book brings together in compact form many of the fundamental ideas of the science of ecology. It documents four years of season-long fundamental ecological studies as carried on in an English woodland.

Since the book is written about conditions in the County of Somerset in southern England most of the species of plants and animals referred to will be unfamiliar to Canadian naturalists. However, the reader can easily picture a Canadian wood, similar to the one described by the author, and there repeat the studies he and his students at Taunton School carried out in Thurlbear Wood.

Beginning with general considerations of woodlands the author passes through floral composition, physical habitat factors and the food cycle in animal habitats. After discussing methods of finding animals of sizes up to that of the badger, he goes on to review food relationships, and adaptations for feeding, protection, reproduction, life history and dispersal. Following a brief discussion of animal numbers the author concludes with a well-chosen series of suggestions for the study of woodland ecology.

The suggestions regarding simple equipment and methods for ecological studies in woodland are of wide application. As a guide for studies in woodland ecology the book deserves to be more widely read by field naturalists than has been the case since its publication in 1953. The general ecological considerations will encourage its use in habitats other than woodland.

A short bibliography and a brief index complete the book. Nine photographs and sixteen figures complement the text. A cloth binding would be more durable than the hard paper cover supplied. The text is free from errors; the type though small is well spaced and easily read. The size, 5 by 7½ inches, will fit most field-jacket pockets.

V. E. F. Solman
Canadian Wildlife Service

Preparing Insect Displays

By A. A. Wood. Ottawa, Queen's Printer, 1958. 87 p. $3.00.

A. A. Wood's work on insect displays has justly received widespread and popular acclaim, as well as highest praise from entomologists. Before his recent retirement from the Canada Department of Agriculture, Mr. Wood wrote an account of his various methods and media;

this small but comprehensive book is the result.

The author begins with brief descriptions of methods of collecting and rearing insects and preserving both immature and adult insects as well as plant material. He then describes the various processes involved in preparing molds, making casts and coloring the finished object.

Dr. Wood's subject matter is presented with authority because it embodies many years of work. He became interested in nature at the age of seven, was encouraged by Dr. William Saunders, received his first instruction in the preparation of specimens from the late John Marden, continued work at the National Museum, Washington, D.C., and constantly improved his techniques with the passing of years. What he has learned he has imparted, with the result that his book is one of the finest publications on this subject. It is clearly written, amply illustrated, and concisely presented. Those involved in the preparation of exhibition displays will find it of inestimable value.

F. A. URQUHART
Royal Ontario Museum

The Earliest Geological Treatise (1667)
By NICOLAUS STENO (Niels Stensen). Translated from *Canis Carchariae Dissectum Caput*, with introduction and notes by Arel Garboe. Toronto, Macmillan, 1958. 51 p. $2.50.

Nicolaus Steno was born in Copenhagen in 1638 and studied anatomy and medical science there; at the age of twenty-two he went abroad to continue his training and investigations and carried out most of his work in Italy. He died in 1686 at Schwerin, Germany.

Steno's chief interest in natural science was anatomy, and it was his studies in this field that led him to geology. In 1666 a huge shark was caught in the Mediterranean and the Grand Duke of Tuscany ordered its head to be sent to Florence for study by Steno. A problem at the time concerned how so-called 'tongue stones' (*glossopetrae*) found in rocks came to be there. Comparison of these forms with the actual teeth found in the modern shark's head convinced Steno that the tongue stones were also sharks' teeth. In an appendix to his anatomical work on the shark's head he gave arguments for this interpretation and suggested how other organic forms as well could be fossilized, a conclusion, of course, fundamental to geology.

The present volume consists of a brief biography of Steno, the Latin Text of the appendix referred to with a page-by-page translation into English by Dr. Axel Garboe, the chief authority on Steno's geological works, and in addition a bibliography and notes by him relating to the translation.

F. A. ALCOCK
Former Director
National Museum of Canada

OTHER NEW TITLES

Food Habits of Migratory Ducks By HARRY G. ANDERSON. Urbana, State of Illinois, Natural History Survey Division, 1959. 50 cents (Bull. Ill. nat. Hist. Surv. 27(4): 289-344)

The Vascular Flora of Southeastern Iowa By ROBERT AUSTIN DAVIDSON. Iowa City, State University of Iowa, 1959. 102 p. $1.50 (St. Univ. Ia Stud. nat. Hist., Vol. 20, No. 2)

Cold Acclimatization in the Golden Hamster By Richard L. Farrand. Iowa City, State University of Iowa, 1959. 29 p. 50 cents (St. Univ. Ia Stud. nat. Hist., Vol. 20, No. 3)

Night-lighting: a Technique for Capturing Birds and Mammals By RONALD F. LABISKY. Urbana, State of Illinois, Natural History Survey Division, 1959. 11 p. Free (Biol. Notes, Urbana. No. 40)

An Ecological Analysis of the Avifauna of St. Lawrence Island, Alaska By FRANCIS H. FAY and TOM J. CADE. Berkeley, University of California Press, 1959. 149 p. $1.50 (Univ. Calif. Publ. Zool. 63:73-150)

The Morphology and Anatomy of American Species of the Genus Psaronius By JEANNE MORGAN. Urbana, University of Illinois Press, 1959. 108 p. $3.00 (Illinois biol. Monogr. 27)

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Other abbreviations should be used sparingly. The better-known terms of measurement follow CSA Specification Z85-1943 *Abbreviations for Scientific and Engineering Terms* or the equivalent of the American Standards Association (Z10.1-1941).

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Can. Field Nat.	Vol. 74	No. 3	p. 147-170	Ottawa, July-September 1960

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The Canadian Field-Naturalist

VOLUME 74 JULY-SEPTEMBER 1960 NUMBER 3

SOME MAMMALS OF RIDING MOUNTAIN NATIONAL PARK, MANITOBA

JAMES R. TAMSITT*
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THIS REPORT is based on a small collection of mammals obtained in July 1958 during two short field trips to Riding Mountain National Park, Manitoba. This park is 140 airline miles northwest of Winnipeg and occupies the greater part of a plateau bearing the same name. The plateau is characterized by sharply defined escarpments along the east and north sides, and the average elevation is approximately 2000 feet. The rise from the Manitoba plain east of the hamlet of Norgate to the top of the plateau is approximately 950 feet, and from Dauphin on the north 1000 feet. The greater part of the park lies within the Canadian Life Zone, and most is within the Northwestern Coniferous Forest Belt. A mixture of white spruce (*Picea glauca*) and aspen poplar (*Populus tremuloides*) is characteristic of much of the area, although tamarack (*Larix laricina*), willow (*Salix* sp.) and alder (*Alnus* sp.) are frequently encountered in areas of poor drainage.

Twenty-three specimens of eight species were trapped in three localities in the park, and observations were made on two additional species. On July 7, traps were set near the west shore of Moon Lake, 20 miles south of Dauphin, in a small treeless grass meadow, and on a moderately steep slope in dense underbrush among aspen and spruce. This lake possessed sandy beaches, and the trapping sites were well drained and free of wet depressions and muskegs. On July 19, traps were set near the southwest shore of Whirlpool Lake, the largest of the lakes on the escarpment. This lake, six miles northeast of Wasagaming, is a muskeg lake completely surrounded by bog tree and shrub associations, and traps were set among spruce and tamarack in areas of dense cover where the ground was extremely wet. The third locality, 12.5 miles south of Dauphin, was trapped July 20, and traps were set on a steep slope near a trail leading from the Dauphin Lookout on the north escarpment to Edwards Creek, approximately 250 feet below and east of the lookout, and along a cut bank adjacent to the creek. Dense stands of spruce and aspen covered the slope and the banks of Edwards Creek, and areas adjoining the creek were dense with grasses, ferns and other bog plants.

Forty small traps of the type recommended by Blair (1941) were used to secure most of the specimens, although a majority of the shrews taken at the Whirlpool Lake locality were obtained from tumble-in traps constructed by removing the tops of large fruit cans and imbedded flush with the ground.

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Mailing date of this number: 30 August 1960

In earlier reports Green (1932) and Soper (1953) had described the mammalian fauna of the park, and their reports were freely relied upon. Richard E. Phillips of Cornell University and Hugh Boyd of the Waterfowl Trust, Slimbridge, England, accompanied the author on the second of the July trips, and their aid and companionship were greatly appreciated. Jennifer Walker of the University of Manitoba supplied invaluable field notes on the gray squirrel *Sciurus carolinensis hypophaeus,* and the trips were financed in part by research funds granted by the University of Manitoba. The specimens are in the collection of the Royal Ontario Museum, Toronto, Ontario.

Annotated List

Common Cinereous Shrew *Sorex cinereus cinereus* Kerr. Soper (1953) and Green (1932) found this shrew to be widely distributed in the park, occupying nearly all types of habitat in the Canadian Life Zone. This species was not taken at the Edwards Creek locality nor at Moon Lake but was relatively abundant in the more mesic situations near the shore of Whirlpool Lake. All but one of the five adult females obtained from this locality were taken from tumble-in traps, and their average measurements were 92.2 (80-106), 39.6 (38-44) and 11.9 (10.8-13.3) mm. None of these females contained embryos.

In a review of the American long-tailed shrews by Jackson (1928), measurements given for specimens from Turtle Mountain, North Dakota, and the locality of Aweme, Manitoba, varied considerably, and Jackson could not refer them specifically to *S. c. haydeni* or *S. c. cinereus.* Measurements of the five specimens from Whirlpool Lake, however, agree more closely with measurements given by Jackson for *cinereus* from Mamie Lake, Wisconsin, than with those given for specimens of *haydeni* from Lostwood, North Dakota. Three specimens of the short-tailed *haydeni* obtained at Delta, Manitoba, averaged 1 mm less in total length and 4.6 mm less in tail length than the Whirlpool Lake specimens.

Manitoba Short-tailed Shrew *Blarina brevicauda manitobensis* Anderson. An adult male was taken from a live trap set adjacent to the cut bank of Edwards Creek near the Dauphin Lookout, and two specimens, an adult male from a live trap and an adult female from a tumble-in trap, were secured near the southwest shore of Whirlpool Lake. Green (1932) regarded this shrew as scarce on Riding Mountain and peculiar to the east and north slopes. Soper (1953), however, referred to specimens from Clear Lake to the south and Edwards Lake toward the north but did state that populations were thinly and locally distributed on the high ground of the plateau. The three adults averaged 127.3 (125-131), 26.7 (25-28) and 15.7 (15.0-16.6) mm.

Gray Eastern Chipmunk *Tamias striatus griseus* Mearns. Green (1934) trapped two specimens of this species, one from the eastern escarpment above Norgate and the other from the north shore of Clear Lake, and his records first established this squirrel among the fauna of the park. At the time of the report by Soper (1953), this species had not been seen in the park north or west of Clear Lake. The single specimen reported here was taken on the slope above Edwards Creek near the Dauphin Lookout and in the same general habitat of the red squirrel *Tamiasciurus h. hudsonicus.* This specimen, a lactating female, measured 224, 108, 30.4 and 15.1 mm. Since the report by Soper (1953) this squirrel has apparently invaded many new areas in the park and extended its range at least toward the north escarpment, approximately 20 miles north of Clear Lake.

Hudson Bay Red Squirrel *Tamiasciurus hudsonicus hudsonicus* (Erxleben). These squirrels were most frequently seen in coniferous growth at camping sites located throughout the park. On July 20 an adult male was found dead 5.5 miles west of Norgate on the dirt road passing from Norgate toward the crest of the eastern escarpment. A second specimen, an adult female that measured 338, 126, 46.6 and 24.5 mm was taken in a trap set on the slope above Edwards Creek.

Minnesota Gray Squirrel *Sciurus carolinensis hypophaeus* Merriam. Neither Green (1932) nor Soper (1953) recorded this species in their accounts of the mammals of

Riding Mountain, and the observations given below constitute the first records of this squirrel in the park. On July 20 a large gray squirrel was seen by Jennifer Walker in the vicinity of Packhorse Creek, approximately three miles northwest of the east entrance to the park. This locality is situated at the edge of the Canadian Life Zone, and the dominant trees of the area are white spruce, jackpine and aspen. On the same date one of the wardens stationed at the east entrance told me that in July he had seen a gray squirrel on several occasions in trees near the buildings there.

During the past 35 years this squirrel has rapidly extended its range north beyond the international boundary. In his biological survey of North Dakota, Bailey (1926) mentioned the appearance of the gray squirrel in the southeastern part of the state along some of the timbered stream valleys north of Fargo. Since his publication this squirrel has been found in many areas throughout the northeastern third of North Dakota, although it is still largely confined to the Red River and its tributaries (Hibbard, 1956). In Manitoba within recent years the gray squirrel has been reported in the Red River Valley as far north as East Selkirk and west along the Assiniboine River drainage to Portage la Prairie (Anderson, 1946). Criddle (1932) has taken this squirrel at the locality of Aweme, and Soper (1946) has records from North Kildonan, Lake Jessie, nine miles west-northwest of Morris, the south shore of Lake Winnipeg and Treesbank. Soper (1946) stated that this squirrel has a very limited range in Manitoba, occurring chiefly in the heavily wooded valleys of the Red River, and Nero (1958) found this squirrel occurring normally in southeastern Manitoba west to Ninette.

On July 22 Mr. William Carrick, Toronto nature photographer, obtained a gray squirrel 11 miles northwest of Portage la Prairie near the small hamlet of Westbourne. A second specimen was collected by the author on July 9 from an oak bluff three miles south of Delta, a hamlet 16 miles north of Portage la Prairie. After the squirrel had established itself in the Portage area, it most likely moved northwards along the wooded banks of the White Mud River toward the escarpment of Riding Mountain. The range of the gray squirrel in Manitoba is undoubtedly in a state of expansion, and the species appears to be moving northwesterly along timbered river valleys and also to be occupying many of the irregularly distributed upland oak bluffs of the Manitoba plain.

MICHIGAN WHITE-FOOTED MOUSE *Peromyscus maniculatus bairdii* (Hoy & Kennicott). Ordinarily this species is common or abundant throughout its range in the park and widely represented in various types of environment, from prairie tracts to mixedwood forest (Soper, 1953). At Edwards Creek the white-footed mouse was the most common of the rodents trapped, and two juvenile females and two adult males were secured at this locality. One specimen, a young adult female, was trapped at Moon Lake, but none were obtained from the wet habitats near Whirlpool Lake. The two adults averaged 162.0 (151-173), 72.0 (68-76), 19.0 (18.8-19.1) and 15.4 (15.3-15.4) mm.

PLAINS RED-BACKED MOUSE *Clethrionomys gapperi loringi* (Bailey). According to Soper (1953) this mouse is one of the most common small rodents on Riding Mountain. It ranges throughout the entire area from prairie-parkland to heavy coniferous forest and occupies practically all available habitats. Although individuals were not taken in the bog areas of Whirlpool Lake, where only shrews were trapped, an adult female and a young adult female were obtained from the moist bank of Edwards Creek and an adult male and an adult female from the wooded slopes of Moon Lake. The three adults averaged 136.7 (125-146), 37.0 (33-39), 18.0 (17.8-18.3) and 12.4 (11.0-13.6) mm.

DRUMMOND'S MEADOW MOUSE *Microtus pennsylvanicus drummondii* Audubon & Bachman). Soper (1953) found this species generally ubiquitous in the park but particularly in preferred habitats such as meadows, brushy semibog areas, and grass and sedge lowlands. None were taken at Whirlpool Lake nor at the Edwards Creek locality, but a young adult female and an adult pregnant female were trapped at the small meadow near Moon Lake. The pregnant female had seven small embryos and measured 150, 40, 17.5 and 10.6 mm.

HUDSON BAY JUMPING MOUSE *Zapus hudsonius hudsonius* (Zimmerman). Soper (1953) found this rodent to be relatively scarce in the park but could not describe it as rare. He secured only two specimens, one from Swanson Creek and the other from Vermilion River, and in both cases the animals were trapped on boggy stream margins

grown to grass and willows. Green (1932) obtained several specimens on the southern border of the coniferous area of the north escarpment. A single specimen, an adult female which measured 233, 138, 29.8 and 15.3 mm, was trapped on the bank of Edwards Creek.

PRAIRIE LONG-TAILED WEASEL *Mustela frenata longicauda* Bonaparte. Green (1932) reported this weasel as numerous in the park, and on July 8 an individual of this species was found dead on the paved park highway 4.8 miles north of Wasagaming. The skin and skeleton, however, were flattened by traffic and not salvable.

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Received for publication 15 December 1958

NOTES ON THE MIGRATION OF DRAGONFLIES IN SOUTHERN ONTARIO

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SEVERAL recent papers on dragonfly migration (Lack and Lack, 1951; Burton and Owen, 1954; Bagg, 1958) have pointed out that the behavior of migrating dragonflies on reaching barriers formed by mountain ridges or the sea coast is very similar to that of migrating birds. Bagg (1957, 1958) has also shown that autumn emigration of dragonflies from the northeastern United States usually takes place in the same weather conditions as that of birds, that is, immediately after the passage of cold fronts. This paper, describing two spectacular migrations of dragonflies, observed in southern Ontario, furnishes additional evidence for the same conclusions.

OBSERVATIONS

September 16, 1958

The first movement was seen close to the shore of Lake Erie, near Wheatley, on September 16, 1958. A cold front had passed through the area in the early hours of the morning, and the afternoon was fine after morning drizzle; there

was a light north wind at the level of the scattered clouds, but little or no wind at the ground. Watching from 2.30 p.m. until 5.30 (E.S.T.), I saw some 320 Sharp-shinned Hawks *Accipiter striatus* and 310 Broad-winged Hawks *Buteo platypterus* migrating WSW at a high altitude, parallel to the lake shore but mainly between one and two miles inland. At the same time a vast number of large dragonflies (apparently *Anax junius*, though none was positively identified) was also passing WSW, mainly between a quarter and half a mile inland, only a few being so far south as to be within sight of the lake or more than a mile inland. Although I could see by no means the whole width of the stream, I estimated from sample counts that I could see about 500 dragonflies passing per minute. The movement continued for at least three hours, and the total number which passed in this period must have approached, if not exceeded, 100,000.

September 18, 1958

Two days later I visited the north shore of Lake Erie near Port Stanley. The center of an active depression had passed through the area during the previous evening, and drizzle continued through the night, gradually giving way during the morning to fine weather, with a light to moderate north wind. An enormous migration of hawks began as the weather cleared, over 20,000 Broad-winged Hawks and many hundred Sharp-shinned Hawks and American Kestrels *Falco sparverius* passing west during the day. There was also a steady westward movement of small land birds (mainly Barn Swallows *Hirundo rustica* and Goldfinches *Spinus tristis*), which reached a peak of 500 to 700 per hour in late morning, and 500 to 1000 Chimney Swifts *Chaetura pelagica* were seen flying east during the day. Dragonflies (probably mainly *Anax junius*) began to pass west at about 11 a.m., but only very small numbers (at most two or three per minute) were visible from the top of the cliffs, where I spent most of the day. However, when I left at 4 p.m. I found an enormous movement proceeding some half to three-quarters of a mile inland, and from sample counts during the half hour I remained I estimated the rate of passage to be over 300 per minute. Although I should emphasize that I saw only a few thousand dragonfles in all, the total number which passed during the day was probably in the tens of thousands.

Observations at Point Pelee

Unfortunately I had no opportunity to make observations in the same areas in other weather conditions, but I saw a number of dragonflies migrating at Point Pelee between September 14 and 17, 1958. A small number flew down to the point on the mornings of both the 14th and 15th, and on the latter day, in hot weather and a moderate southwest wind, at least 25 flew southwest over the lake. A few which flew into the 'Heligoland' trap at the point were definitely *Anax junius** and are the basis for the sight identification of the other dragonflies mentioned in this paper. On September 16 I saw no dragonflies during the wet morning, but as the weather cleared at midday a southward

*E. M. Walker, in a letter quoted by Bagg (1958), has described the status of this species in Ontario. It is not known to hibernate in the province, but emigrates in autumn and returns from the south in spring. However, the spring immigrants probably belong to a different generation from those which emigrate in autumn — a common feature of insect migration (Williams, 1958).

passage of up to 3 per minute started down the east side of the point. There was heavy rain throughout September 17, and I did not see a single dragonfly near the point.

Mr. J. Woodford, who also saw some of these insects, informs me that he has seen small numbers of dragonflies flying southwest across the lake from the point in previous autumns, and on occasion has seen as many as 50 *Anax junius* self-caught in the trap. It seems unlikely that large numbers of this species migrate past the point in normal circumstances, but my observations there do help to confirm that their migration is halted by rain and is released when the weather clears.

Discussion

Although my negative observations are less conclusive than Bagg's, the two large migrations that I saw strongly support his suggestion (Bagg, 1958) that dragonfly migration takes place mainly in the polar air following the passage of cold fronts or the clearance of depressions. It is possible that this correlation is exaggerated by the action of northwest winds in drifting the insects sideways and concentrating them against 'guiding lines'; this effect is certainly important in producing large concentrations of migrating hawks along the shore of Lake Erie. However, the dragonflies I saw on September 16 could not have been concentrated in this way, for there was practically no wind at all at the level at which they were flying.

Three main explanations have been put forward for the observed correlation between autumn bird migration and the passage of cold fronts:

1. The influx of cold air behind a cold front usually favors the development of vertical circulation (thermals) in the atmosphere, and this is known to aid the flight of hawks (Rudebeck, 1950).

2. The fall in temperature after the passage of a cold front may at times reduce the supply of insect food so seriously that insectivorous birds must emigrate immediately to avoid starvation.

3. The passage of a cold front is usually followed by clear weather with light or moderate north or northwest winds, and these conditions are probably very favorable for southward migration (Svärdson, 1953; Nisbet, 1957).

Of these explanations, Bagg (1958) has suggested that the first might apply also to dragonflies, but those which I saw were traveling in low and direct flight, and could not have gained assistance from rising air currents. Nor could food-shortage have caused the first large migration I saw, for afternoon temperatures on September 16 were still in the high seventies. As in the case of small insectivorous birds (Svärdson, 1953), which also migrate early in autumn, dragonfly migration is most likely to be an adaptation to *potential* shortage of food, and the most cogent explanation for their migration after cold fronts is the favorable weather which prevails in these circumstances. Of course, the greater plausibility of this explanation need not altogether exclude consideration of the others.

My observations of large numbers of dragonflies flying parallel to the shore of Lake Erie also provide additional support for Bagg's (1958) suggestion that these insects usually avoid crossing large bodies of water by turning along their shores. Williams (1958), however, quoted cases of insects migrating

across lakes, and this paper gives similar observations from Point Pelee. Evidently the reactions of migrating dragonflies to topographical features are very variable, like those of birds (Thomson, 1953).

There is clearly a great need for further field studies of these aspects of dragonfly migration, and one of the main functions of this paper is to point out that the north shore of Lake Erie is an ideal place for such observations. Indeed, as I myself discovered, it is possible to see in this area spectacular migrations of dragonflies and birds in progress at the same time. There are many interesting parallels between the two phenomena, and comparative studies at the same place could greatly increase our understanding of both.

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Received for publication 13 July 1959

AMERICAN WIDGEON AND PINTAIL IN THE MARITIME PROVINCES

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AMERICAN WIDGEON *Mareca americana*

IN AUGUST 1957, I observed a female American Widgeon and six young at Amherst Point, Nova Scotia. According to Tufts (1957), this represents the first record of the species breeding in Nova Scotia. During the summer of 1957, I observed a few scattered pairs and single males on Prince Edward Island, which suggested the possibility of widgeon breeding there. Consequently, I made a special effort to note the location of any pairs and single birds observed during the 1958 aerial survey of Prince Edward Island and to follow up my observations by a search on the ground.

I observed approximately twenty adult widgeon on an aerial survey of Deroches Point Ponds on July 6, and during a ground survey of the same area on July 9 I observed three broods: one on Deroches Point Pond and two in the adjacent ponds. Two broods, numbering ten and eleven birds respectively,

were in the downy stage; eleven birds in the third brood were almost fully feathered. All broods were accompanied by females. In August, with the aid of a Labrador retriever I captured and banded seven flightless young widgeon in this same area. As Godfrey (1954) does not include the American Widgeon in his "Birds of Prince Edward Island", the above observations represent the first record of this species breeding there.

In the six years following Godfrey's 1952 survey, the American Widgeon has become fairly common on Prince Edward Island, both as an autumn migrant and a winter resident. George Bruce, caretaker at Black Pond Sanctuary, near Souris, reported flocks of approximately 200 widgeon in the sanctuary in October 1957, and approximately 180 birds there in October 1958. I observed 35 birds at Condon's Pond, near Murray River, on October 10, 1957. Three male widgeon spent the winter of 1953-54 at Moore's Bird Sanctuary near Montague, and were banded by Harvey Moore, the sanctuary caretaker, in December 1953. The number of widgeon wintering at Moore's Sanctuary has increased steadily since their first appearance in 1953; 27 birds wintered there during the winter of 1957-58 and at least 40 birds were present at the sanctuary on December 5, 1958. One of the three birds banded in 1953, an adult male, was present at the sanctuary on December 11, 1957, and it, along with some of the others banded in the winters of 1954-55 and 1955-56, has returned each winter to the sanctuary.

Some fairly large flocks of American Widgeon have been observed in Nova Scotia during the 1956 and 1957 fall migrations. Tufts (1957) reported that a flock of 85 to 100 or more birds were observed by members of the Nova Scotia Bird Society in the Lawrencetown Beach area, Halifax County, in October and November, 1956. A flock of about the same size was observed in the same area during the fall of 1957. Elton Pace, superintendent of the Provincial Wildlife Park, Shubenacadie, N.S. (personal communication), observed a flock of 75 to 100 American Widgeon at Tatamagouche, N.S. on October 26, 1957. The above observations suggest an increase in the numbers of American Widgeon migrating through Nova Scotia because prior to 1956 the species was considered an uncommon visitor to the province.

PINTAIL *Anas acuta*

The first record of Pintail breeding in the Maritime Provinces was obtained by Peters (unpublished report, Bureau of Biological Survey, U.S. Department of Agriculture, 1938) in the New Brunswick–Nova Scotia border region. Boyer (1951) gives a detailed account of the species' increase in that area from the time of its discovery in 1938 up to and including 1950. In May 1950, Boyer observed 57 pairs and 29 other adults in the Midgic Marsh area of New Brunswick.

Pimlott, in an unpublished report of the Canadian Wildlife Service, 1948, observed a single male in the upper estuary of the Hillsborough River above Mt. Stewart, Prince Edward Island, in June 1948. More recently on May 30, 1957, I observed a pair and four adult males in the same area. However, at the time of the survey by Godfrey (1954) there were no breeding records of Pintail available for Prince Edward Island.

On July 22, 1957, D. A. Munro and I observed four broods of Pintail during a survey of the Hillsborough River above Mt. Stewart. Nine young in one brood were in the downy stage; two broods, each consisting of seven young, were partly feathered; and ten birds in the fourth brood were almost fully feathered. All broods were accompanied by females. Twenty-nine other adults were observed during the survey, which covered that part of the estuary extending from Mt. Stewart to Cherry Hill. I observed four broods of Pintail in the same area during the 1958 breeding season. One brood of four birds observed on June 24 was completely feathered although unable to fly. Two broods of eight birds were in the downy stage; eight birds in the fourth brood were partially feathered.

The Hillsborough estuary is the only area on Prince Edward Island where I have observed Pintail during the summer months. A few are observed in other areas of the island during the spring and fall migrations, and from one to three birds have been wintering at Moore's Bird Sanctuary since the winter of 1955-56. Three Pintail were banded by Moore at the sanctuary on March 22, 1956.

It is of interest to note that the nesting areas of the two known colonies of Pintail breeding in the Maritimes, one at Midgic Marsh, N.B., and the other on the Hillsborough River, P.E.I., are located in marsh land that was originally diked and reclaimed by the early settlers and has since fallen into disrepair. These areas, which are relatively flat, produced the bulk of the marsh hay for which the Tantramar and Hillsborough marshes were once famous. Drainage and reclamation activities have been renewed in the Midgic Marsh area of New Brunswick since 1950 and the Pintail colony has decreased to one or two breeding pairs. I observed only one pair of Pintail there during the spring of 1957 and a single male in May 1958.

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Received for publication 7 January 1958

BIRD OBSERVATIONS IN THE QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA

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From July 4 to August 30, 1957, as a member of a National Museum of Canada field party collecting marine invertebrates in the Queen Charlotte Islands of British Columbia, I had good opportunity to observe the bird life of this area. I kept detailed day-to-day record of birds observed and the more unusual observations are set forth here.

The Queen Charlotte Islands are located just south of the Alaska panhandle and separated from it by Dixon Entrance. Hecate Strait lies between the Queen Charlotte Islands and the mainland of British Columbia.

Most observations were made on Graham Island in the vicinity of Queen Charlotte City and Masset, at Tlell and Port Clements, and on Moresby Island at Sandspit and Alliford Bay. August 7 to 13 was spent in a circumnavigation of the Islands, south from Queen Charlotte City by way of Juan Perez Sound, Hippa Island, Langara Island and Masset, and from there back to Queen Charlotte City. Most seabird observations were made in this period.

Annotated List

Northern Fulmar *Fulmarus glacialis* (Linnaeus). This species, which Munro and Cowan (1947) state enters inshore waters occasionally and is common offshore, was observed within a few miles of land as well as offshore on several occasions.

A dark-phase bird observed August 8 between Scudder Point and the Copper Islands, Hecate Strait, was patchy whitish-brown with a brown-circled yellow bill. About 14 in somewhat similar plumage were observed on August 13 in Dixon Entrance about ten miles north of the entrance to Masset Sound, Graham Island. On the same day one light-phase Fulmar was seen about fifteen miles north of Tow Hill and another near the buoy off Rose Spit, Graham Island. On August 23 another light-phase bird was seen on the water about two miles ENE of Cape Edensaw, Graham Island. On August 24 a well-mottled dark-phase bird was seen in Dixon Entrance about five miles ENE of Seath Point, Graham Island. On August 30 up to 10 dark-phase Fulmars at one time were seen among thousands of Shearwaters in Hecate Strait.

Pink-footed Shearwater *Puffinus creatopus* Coues. This species was observed on 3 occasions: August 8, one ten miles south of Gowgaia Bay, west coast of Moresby Island; August 9, one resting on the water off Portland Bay, west coast of Moresby Island; August 13, one following the ship for a short time in Dixon Entrance, 10 miles off the entrance to Masset Sound, Graham Island.

Munro and Cowan (1947) consider this species "a regular but scarce summer visitant" to pelagic waters of British Columbia.

Pale-footed Shearwater *Puffinus carneipes* (Gould). A single bird, believed to be of this species, was observed in Dixon Entrance, fifteen miles north of Tow Hill, Graham Island. This bird was uniformly sooty-brown on underparts, back and wing-linings and had a whitish bill tipped with brown. The feet appeared light yellow. The flight resembled that of a Pink-footed Shearwater or Fulmar rather than that of a Sooty Shearwater. Munro and Cowan (1947) record sight observations and specimens of this species from Queen Charlotte Sound.

Sooty Shearwater *Puffinus griseus* (Gmelin). This species was sporadically abundant well offshore in Hecate Strait and Dixon Entrance and off the west coast of the Queen Charlotte Islands. Some records are as follows: July 4, about 8000 flying over a calm sea or resting in groups of 500 or more in Hecate Strait, off Rose Point, Graham Island; August 1, about 500 off Kitgoro Point, west coast of Moresby Island; August 7, about 50 seen in about four hours in

Hecate Strait, about ten miles off the northeastern coast of Moresby Island; August 8, 400 between Alder Island and Scudder Point and at least 4600 between the Copper Islands and Houston Stewart Channel, Moresby Island; August 9, about 300 between the entrance to Tasu Sound, Moresby Island and Marble Island, off the west coast of Graham Island; August 12, more than 5000 between the Tian Islets and White Point, Graham Island; August 13, at least 15,000 were observed in Dixon Entrance off Rose Point and along the east coast of Graham Island from Rose Point to Lawn Point; August 30, more than 10,000 were observed in a northeasterly gale between Dixon Entrance and the middle of Hecate Strait off Prince Rupert, B.C.

SLENDER-BILLED SHEARWATER *Puffinus tenuirostris* (Temminck). July 4, a single bird, probably of this species, among an estimated 8000 Sooty Shearwaters off Rose Point, Graham Island. August 9, one off Marble Island, west coast of Graham Island, among Sooty Shearwaters. August 12, one four miles off White Point, Graham Island, among 2000 Sooty Shearwaters. August 13, one in Hecate Strait, 10 miles ENE of Cape Ball, Graham Island. August 30, two seen in Hecate Strait, midway between Rose Point, Graham Island and Stephens Island, off the mainland of British Columbia.

Munro and Cowan (1947) state that this species is "abundant in late summer and autumn" in pelagic and coastal waters of British Columbia.

BRANT *Branta bernicla* (Linnaeus). A rather tame Brant was observed as close as forty feet on the gravel beach at Spit Point, near Sandspit, Moresby Island, on August 7. It appeared to have light underparts, with the black of the neck extending only as far as the lower breast; for this reason the author is uncertain to which subspecies this bird belonged.

RUDDY TURNSTONE *Arenaria interpres* (Linnaeus). A single bird was noted on August 7 at Spit Point, near Sandspit, Moresby Island, in a flock of Black Turnstones and Western Sandpipers. Munro and Cowan (1947) consider it scarce on the coast of British Columbia.

LESSER YELLOWLEGS *Totanus flavipes* (Gmelin). A single bird was seen at the mouth of Hiellen River near Tow Hill, Graham Island, on July 4. Another was on the flats of the Yakoun River delta near Port Clements, Graham Island, on August 19. Munro and Cowan (1947) consider this species rare on the coast.

RING-BILLED GULL *Larus delawarensis* Ord. An adult and a juvenile of this species were observed at Sandspit, Moresby Island, on August 7, among 350 Glaucous-winged Gulls and 15 Herring Gulls. Munro and Cowan (1947) list no records from the Queen Charlotte Islands.

SHORT-BILLED GULL *Larus canus* (Linnaeus). An adult was observed in the entrance to Logan Inlet, between Tanu and Moresby islands, on August 7. Another was seen off Entry Point, Masset Sound, on August 23 and one at Masset on August 29. I was impressed by the scarcity of this species in summer in the Queen Charlotte Islands as compared to its relative abundance along the shores of southern Vancouver Island at the same time of year.

MARBLED MURRELET *Brachyrhamphus marmoratus* (Gmelin). While the mystery of the nesting place of the Marbled Murrelet remains unsolved, I am able to add a few observations. On the evening of July 31 many birds of this species were seen feeding on the calm waters of Security Cove, Moresby Island. As darkness came on they became restless and called piercingly. In semidarkness some birds were seen flying to and returning from the forest.

A native of Masset informed me that two Indians had found a Marbled Murrelet's nest in a stump at Naden Harbour, Graham Island, but the story has been discredited by competent authorities.

VIOLET-GREEN SWALLOW *Tachycineta thalassina* (Swainson). This species was observed only once: a pair was seen among Tree and Barn swallows at Port Clements, Graham Island, on August 19.

COMMON CROW *Corvus brachyrhynchos* Brehm. A pair of this species was seen in the trees near the edge of a large salt marsh at Tlell, Graham Island, on July 5. These birds called frequently and did not associate with nearby Northwestern Crows *Corvus caurinus*, a separate species. The Common Crow, apparently, does not occur regularly in the Queen Charlotte Islands.

COWBIRD *Molothrus ater* (Boddaert). A female Cowbird was observed feeding on the ground near a herd of cows on August 17 at Queen Charlotte City. Munro and Cowan (1947) state that the species is "casual" in the Queen Charlotte Islands.

LAPLAND LONGSPUR *Calcarius lapponicus* (Linnaeus). A flock of 8 birds of this species was seen on the gravel beach at Old Masset on August 26. These birds were in winter plumage for the most part, one or two showing traces of chestnut on the nape. A single bird was seen in the short grass of Delkatla slough near Masset on the same day. Mr. Ronald Stewart of Masset told me that this species is regular in occurrence in late summer. Munro and Cowan (1947) list no records for the Queen Charlotte Islands.

REFERENCE

MUNRO, J. A., and I. McT. COWAN. 1947. A review of the bird fauna of British Columbia. Victoria, British Columbia Provincial Museum.

Received for publication 10 January 1959

OBSERVATIONS OF SOME CARNIVORES BY WARDENS IN THE MOUNTAIN NATIONAL PARKS OF CANADA

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IN 1944, MR. H. U. GREEN, then a special warden of Banff National Park, inaugurated a system of collecting observations on wildlife species. Park wardens were asked to file an observation card on all species seen while working in their respective districts. In 1951, Dr. A. W. F. Banfield, then Chief Mammalogist, Canadian Wildlife Service, expanded that system to include all mountain national parks. Information to be recorded included time and place of observation, number of animals observed, sexed and aged if possible, their actions at the time, and general weather conditions.

The information that follows has been compiled from cards on file at the office of the Canadian Wildlife Service in Edmonton, and is concerned with grizzly bear (*Ursus horribilis*), cougar (*Felis concolor*), timber wolf (*Canis lupus*) and wolverine (*Gulo luscus*). Records extend from 1951 to 1957 and are from the national parks of Banff, Glacier, Jasper, Kootenay, Waterton Lakes and Yoho. Although such observations are fragmentary, it is thought they provide interesting glimpses into the natural history of these species.

Acknowledgments are extended to the park wardens for supplying these observations.

GRIZZLY BEAR *Ursus horribilis*

BANFF PARK. Of 88 reports, the earliest seasonal observation was on April 5, 1957, and the latest autumn record was on November 8, 1956.

On July 24, 1957, Warden N. F. Woledge noted at Sawback Creek that a female, which had two yearlings with it, raced out at a car as it went by and stayed on the road until the young had gone out of sight.

GLACIER PARK. Warden N. C. Gardner observed the following incident in a heavy alder area at the junction of Hermit Trail and Rogers fire road on July 23, 1951: "I had evidently driven between this bear and her cubs and she came up over the road and ran closely behind the jeep I was driving, 300 yards or better. Judging from the speedometer this bear was able to attain 30 m.p.h.

The cubs were not in evidence. Witnesses to this occurrence were my wife and Dr. G. M. Atkin of Banff, Alta."

On April 17, 1952, in the Asulkan Valley, Warden Gardner found the tracks, apparently one day old, of two grizzlies that had been moving down from a hibernation site to a slide area in Illecillewaet Valley. He reported: "Upon finding the tracks of the above animals I backtracked them to an elevation of over 7000′ where I found they had been disturbed by a large avalanche and had come out of their hibernation spot. This was a cave-like overhang under rocky bluffs. Evidently the two animals had hibernated together. The direction of the overhang faced S.E. The avalanche had come from the side of Mt. Afton above, crossed a bench above the bluffs then had come over the bluffs, clearing the cave overhang and falling immediately in front. This whole area is very hazardous and I was not able to remain long enough to fully examine the place as the snow was starting to come over again in small avalanches. It was interesting to note that the two bears chose the least hazardous route from the cave overhang to the valley below making good use of the small timber belts and not crossing the avalanche paths except where very necessary."

JASPER PARK. Of 172 reports, the first and last seasonal observations were as follows. 1951: May 26, November 20, (track on December 9); 1952: May 8, September 15; 1953: May 17, October 27; 1954: May 17, October 31; 1955: May 14, November 15; 1956: May 14, November 6; and 1957: April 21 (track on April 6), November 18.

On August 29, 1952, Dr. Banfield reported two adults and a yearling grizzly at the Jasper Lodge incinerator; they chased black bears away. In subsequent years Warden F. Burstrom kept careful watch at this locality and discovered that several grizzlies could be seen quite regularly in late evening. The maximum number seen at once by Warden Burstrom each year was: 7 on August 20, 1953; 6 on August 13, 1954; 11 on July 7, 1955; 12 on July 6, 1956, and 9 on September 5, 1957.

On October 19, 1956, at the warden's cabin at Hoodoo seven miles down the Snake Indian River from Snake Indian Pass, Warden L. Tremblay observed four grizzlies traveling together, an adult female with a cub and another female with a yearling. They "came up from Snake Indian Lakes. While eating dinner at the cabin they came up on the porch and stayed for about ½ hour. Then they crossed the river and angled up into the mountains."

WATERTON LAKES PARK. On May 24, 1952, Warden R. L. Hand reported that skiers had chased a grizzly out of hibernation at Cameron Lake.

YOHO PARK. Warden N. C. Gardner reported that a grizzly shot at Lake O'Hara Lodge garbage dump on July 26, 1952 was extremely stunted and weighed not more than 200 pounds although it was an adult.

COUGAR *Felis concolor*

BANFF PARK. Dr. Banfield reported that a caretaker flushed two cougars from a culvert on the Banff golf course on January 7, 1952.

JASPER PARK. On December 17, 1954, Warden G. C. Wells saw an adult cougar and two kittens feeding on a freshly killed bighorn sheep at Snake Indian bridge.

TIMBER WOLF *Canis lupus*

BANFF PARK. On November 4, 1951, at the Third Vermilion Lake, Warden G. H. Ashley saw four wolves, one with a mangy tail and another apparently sick. The sick animal "moving in a semi-crouch, was second in crossing the lake. When across, it lay down on the east shore, where the first animal suddenly attacked it. The other two followed closely and joined the attack. The skirmish moved off into the willows and out of sight."

Warden W. McPhee reported the following incident on March 30, 1956. "At 10.00 a.m. March 30, was at garage at Windy Cabin – noticed a bighorn bounding over a ridge at timberline on S. side Bare Mt. with a wolf in pursuit. Sheep ran into deep snow when wolf jumped on it. Went in house to get field glasses to watch. I then went on skis to where sheep was, about 500 yards from house. As soon as I left yard, the wolf left. Found sheep (yearling male) lying on its back with feet in air. Stomach had been torn open and intestines and stomach exposed, throat was also torn. Sheep was still alive and I shot it. Animal had not been eaten. The wolf did not return. The wolf was very dark in color. A bighorn ewe was standing nearby during the incident."

WOLVERINE *Gulo luscus*

BANFF PARK. On July 24, 1951, Warden W. C. Taylor saw three wolverine at Baker Creek. He reported: "These wolverine were playing and could have been a family of young, but looked full grown."

Two wolverine "either fighting or mating" were seen by Warden A. S. Anderson at Mile 88, Banff-Jasper Highway on March 14, 1957.

At the Aylmer Lookout tower, Mr. N. Titherington reported that a wolverine had used at various times over a period of four years a particular rock, some 300 yards from the tower, as a favored lookout viewing the surrounding alpine meadow. This it usually occupied in late afternoons and early evenings. At night it came to the wood yard at the cabin.

On July 7, 1957, a four-year-old bighorn ram passed within 30 yards of this rock. The wolverine quickly left it and both animals ran from view. Soon the wolverine reappeared; it was assumed to have been after the ram.

JASPER PARK. On July 22, 1954, three miles west of Little Heaven Cabin, Warden G. Wells ran three wolverine with a horse and put two of them up a tree. On August 22, 1954, Warden Wells saw two wolverine "playing" at Glacier Pass.

On April 9, 1957, Warden L. Tremblay saw two wolverine, one possibly a yearling, traveling along Welburn Creek.

KOOTENAY PARK. On January 27, 1954, Mr. F. A. Bryant saw a wolverine on the Banff-Windermere Highway near Hawk Creek. He clocked it at 15 mph and this speed was maintained when the car slowed down.

Received for publication 14 January 1959

NOTES

First Record of the Varied Thrush in the Maritime Provinces

The first occurrence of the Varied Thrush *Ixoreus naevius meruloides* (Swainson) in the Maritime Provinces was authenticated with the collection of a male bird at Stanley, New Brunswick, on March 25, 1960. This bird was first seen in mid-November 1959, when it appeared at feeding stations operated by Mr. and Mrs. R. S. Foreman and Mrs. Elsie Hickey. During the winter it was observed several times each week by these persons and by a neighbor, Mrs. E. Sellick.

Recognized as not being a Robin (as originally supposed), it was, on comparison with colored plates, tentatively considered by Mrs. Hickey to be a Varied Thrush. Mrs. Hickey, from correspondence with Mr. W. A. Squires, Curator of Ornithology, New Brunswick Museum, was further convinced of the identity of the bird and the writer was requested by Mr. Squires to attempt to verify the record. A trip was made to the area on March 22 by the writer and Mr. H. Haswell, Fish and Wildlife Division, New Brunswick Department of Lands and Mines, but the bird was not observed. The bird was seen by the local observers several times on March 24 and Mr. Haswell and the writer again visited the area the following day. This time the bird was seen and verified as being a Varied Thrush. After a short period of observation it was collected and is No. 574 in the writer's collection.

During the winter the bird fed on suet, oats, oatmeal and bread crusts in company with a large group of Blue Jays, Starlings, House Sparrows, Purple Finches, Black-capped Chickadees, Downy Woodpeckers, and Hairy Woodpeckers. At the feeding station it was observed to be somewhat pugnacious, driving the larger jays away from the food material. Apparently it had fared well during the winter as the bird had a relatively large amount of subcutaneous fat.

The Fifth Edition of the *Check-list of North American Birds* (1957) refers eastern North American records to the subspecies *Ixoreus naevius meruloides* (Swainson), and W. Earl Godfrey, National Museum of Canada, has determined our New Brunswick specimen as belonging to that subspecies also. Only one other eastern Canadian record is known, this from Manicouagan, Quebec, in August 1890. Four records from Staten Island and Long Island, New York, cover the period from before 1848 to 1936. Two records from New Jersey in 1851 and 1936-37, and one from Massachusetts in 1864 complete the eastern occurrences of the species. All records are from late fall to early spring.

N. Rae Brown

Faculty of Forestry
University of New Brunswick
Fredericton, New Brunswick
4 April 1960

Further Notes on Interspecific Competition Among Hole-Nesting Ducks

An earlier note (Erskine, Can. Field Nat. 73:131, 1959) described a joint clutch of Barrow's Goldeneye and Bufflehead eggs, in the Chilcotin district of British Columbia. On June 9, 1959, W. D. McLaren and the writer visited the same nest and trapped a female Barrow's Goldeneye *Bucephala islandica* (the same individual banded upon that nest in 1958) upon a clutch of 10 eggs of that species. The nest also contained the corpse of a female Bufflehead *Bucephala albeola*, which was damaged upon both sides of the head and which was estimated to have been dead for about a month. It now seems probable that the female Goldeneye actually killed both this bird and the two dead Bufflehead found in the nest in 1958.

The ready acceptance of nest boxes by both Goldeneye species indicates that suitable natural nest sites (such as this

one) are actually in short supply. A nest box some 200 yards from this nest was used successfully by a Goldeneye this year, and Bufflehead used two natural sites, one only 12 yards from the 'morgue,' near the same slough.

Another nest box, by a slough two miles to the south, contained only Barrow's Goldeneye eggs when visited by L. G. Sugden of the B.C. Game Department on May 13. However, on June 7 a female Bufflehead was flushed from the box, which now contained six Bufflehead eggs and eight Goldeneye eggs. The same clutch was also present on June 9 and June 22, and on the latter date a female Bufflehead was trapped on the nest and banded. The writer last visited this box on July 16; at this time it contained three partly incubated Bufflehead eggs (one of which was cracked and dried out), one dead Bufflehead young, two addled Goldeneye eggs, and one dead Goldeneye young. Presumably the other two young Bufflehead and five young goldeneye left the nest successfully. About a quarter of a mile to the west on the same slough a female Bufflehead was accompanied by two Goldeneye young, estimated to be about three weeks old. These were thought to be the survivors of this nesting, since poor survival was general in young of Bufflehead and Goldeneye this year, probably because of adverse weather when the young were small. No young Bufflehead were seen on this slough, although two other broods of Goldeneye were present.

Interspecific competition for nesting sites also occurs in other areas where these species breed; H. W. Burns, of Leduc, Alberta, writes me that he has on several occasions found clutches of Common Goldeneye including one to three Bufflehead eggs. However, the Bufflehead is unique among hole-nesting ducks in that it is less abundant through most of its breeding range than are the Flickers (*Colaptes* spp.) which make its holes. This relative availability of nesting sites is undoubtedly of advantage in that it reduces competition for larger cavities; competition with other ducks would tend to eliminate this, the smallest species. Apparently this is the only known case of a Bufflehead incubating the joint clutch, and it is possible that the Goldeneye had deserted its eggs before the Bufflehead commenced laying in the box.

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21 September 1959

Heermann's Gull in Barkley Sound, Vancouver Island

Two adult Heermann's Gulls *Larus heermanni* were observed on a floating log in Imperial Eagle Channel, Barkley Sound, on the west coast of Vancouver Island on August 1, 1955. A single Heermann's Gull was observed on August 10 of the same year in Georgia Strait, midway between Nanaimo and Vancouver. This appears to be farther north than the species regularly occurs, though Munro and Cowan, in *The Bird Fauna of British Columbia*, 1947, report a record from Alert Bay.

ERIC L. MILLS
141 Stonehenge Road
Beaconsfield, Quebec
10 January 1959

Greenland White-fronted Goose on the St. Lawrence River

ONE OF THE relatively few bird subspecies easily recognizable in the field is the Greenland race of the White-fronted Goose *Anser albifrons flavirostris* Dalgety & Scott. As Delacour (Waterfowl of the World, Vol. 1: 111, 1954) expressed it, "Live Greenland White-fronts look extremely different from all others on account of their very dark colour and bright orange bill." The bills of the other subspecies are pink.

On June 20, 1959, as my wife and I drove southwest along Route 10 paralleling the St. Lawrence, we spotted several Canada Geese in a marshy bay just beyond the village of Pointe au Pere,

near Rimouski. Since these were the first geese we had seen on our trip, we stopped to look at them. Near the half-dozen or so Canada Geese, but acting as an individual rather than as a member of a flock, was a single yearling Greenland White-front. It was close enough to enable us to make out the white mark at the base of the bill, much narrower than in adult birds. The underparts were quite uniformly colored, lacking the black mottling of the adult. The very dark color, especially of the head and neck, and the brilliant orange bill were most striking, especially when compared with birds of the North American subspecies *A. a. frontalis* seen the following day at the Quebec zoo. The June date of this observation is quite exceptional.

Almost all of the subspecifically identified records of White-fronted Geese in the eastern United States and Canada have proved to belong to the Greenland form, and it is not unlikely that a few individuals may migrate to the Atlantic seaboard of North America every year. Most of these are probably young birds; the two individuals I have seen alive (the one described above and one seen March 27, 1958, at Pea Island, North Carolina; see Chat, 22: 45, 1958), a New Jersey specimen I have recently examined, and a Quebec specimen described below, were all in their first year.

Only one specimen from Quebec is definitely known to have been of the Greenland race. This bird, preserved as a skeleton in the National Museum of Canada, was banded as a "juvenile" on July 29, 1946, at Christianshaab, west Greenland, and was captured "from a flock of about a dozen similar birds" at Métis Beach, Quebec, in late September, 1946 (Hewitt, Bird-banding, 19: 124, 1948). It is of interest to note that Métis Beach is only about 23 miles northeast of the site of our observation near Pointe au Pere.

Three other specimens of White-fronted Goose of undetermined subspecies have been taken in Quebec (Cap St. Ignace, Cap Tourmente, Lac Jacques Cartier), and there is a sight record of three individuals on Lake St. Louis near Montreal. I am indebted to W. Earl Godfrey of the National Museum of Canada for information on the previous Quebec records of the White-fronted Goose.

KENNETH C. PARKES
Carnegie Museum
Pittsburgh 13, Pennsylvania
August 11, 1959

An Observation of Interspecific Strife Between Barrow's Goldeneye and Lesser Scaup

ON JULY 22, 1959, a small pothole was visited south of Riske Creek, British Columbia. One brood each of Mallard, American Widgeon, Blue-winged Teal, Barrow's Goldeneye and Lesser Scaup was noted. While watching the ducks from a distance of about 70 yards I saw the adult female Barrow's Goldeneye *Bucephala islandica* repeatedly rush the hen Lesser Scaup *Aythya affinis*, chasing her from the vicinity of the latter's brood. On one of these attacks, the goldeneye rushed the scaup brood, grasped a downy in her bill and repeatedly pecked it as she flapped along the surface. After a few seconds of this activity, she abandoned the apparently dead scaup and returned to her own brood. Subsequent examination of the dead scaup revealed severe bruises about its head and neck.

It is probable that the presence of the writer and two assistants precipitated this display of strife between the two species. It is believed the outside disturbance caused the female scaup and her brood to invade the territory of the Barrow's Goldeneye. Unfortunately, time did not permit the determination of what might have been the undisturbed distribution of the ducks on the pothole.

LAWSON G. SUGDEN
Canadian Wildlife Service
Edmonton, Alberta
28 October 1959

A False Hermaphrodite Sparrow Hawk

A FEMALE Sparrow Hawk, *Falco sparverius*, (collected September 21, 1931, at Kingsville, Essex County, Ontario; R.O.M. No. 31.9.23.1), when dissected, disclosed undeveloped ovaries, which were flat and milky in color and, after 24 hours of immersion in alcohol, slightly granular in appearance. The oviduct was traced to the cloaca. However, the plumage of this specimen is esentially that of a male. The tail is hazel-brown above with one subterminal black bar and pale tip, but with some hazel between these two patterns. The wing-coverts and tips of the secondaries are dull blue-gray, with black markings appropriate to a male, but with some suffusion of hazel on the tips of the former and along the shafts of the latter where the black pattern is present. Ventrally, the streaked pattern is slightly sharper and darker than is usual for females and on the sides and flanks the markings are more nearly black and formed into dots. The general condition of the plumage suggests that this bird is approximately 15 months old.

L. L. SNYDER

Royal Ontario Museum
Toronto, Ontario
20 February 1959

The Drumming of the Ruffed Grouse

AMONG THE several excellent photographs by Goodnow in the September 1959 issue of *Field and Stream* (Vol. 64, No. 5, pages 50 and 51) there are front views of a Ruffed Grouse *Bonasa umbellus* in the act of drumming. Certain of these pictures have tended to crystallize discussions the writers have had from time to time with respect to sound production by the grouse's beating wings.

Modern photography has disproved the theory that the wings beat against each other, either above or beneath the bird, and the theory that the sound is produced by the wings striking the prominence (stump, log or ant hill) on which the bird is standing. It was also formerly thought that each thump was the result of the collective vibrations of the flight feathers each time the wings beat forward, or forward and upward. It now appears that something additional may be involved.

In the preparation of a study skin of the Ruffed Grouse it is difficult to attain correct imbrication of the primary feathers. Normally, each feather, from the proximal or inside position outward, overlaps the next. Even after drying in place there is a strong inclination toward disarray of the primaries when a specimen is handled. This suggests that there is some special adaptation in the grouse's wing, perhaps in the angle of insertion of the primaries into the integument, which facilitates reversed imbrication.

It is our suggestion that on the forward stroke of the wings of a drumming grouse the primaries slide off one another, under tension, into a reversed imbrication and in so doing produce the thumping sound. The mechanics and the sound effect is not unlike thumbing and releasing the corner of a stiff cardboard. Normal imbrication is attained on the back stroke, without sound, by the wide separation of the primaries.

Although we cannot be sure of the sequence of Goodnow's pictures it is clearly evident that in some, such as the second from the top on page 50 and the upper left on page 51, feather imbrication has become reversed. The pale notched pattern on the outer vanes of the primaries is exposed on under-wing view, though the feathers are not spread apart. The primaries are in reversed imbrication.

It is suggested that persons with slow-motion films of a drumming grouse inspect them with this theory in mind.

L. L. SNYDER
T. M. SHORTT

Royal Ontario Museum
Toronto, Ontario
22 September 1959

REVIEWS

Poisonous Amphibians and Reptiles: Recognition and Bite Treatment

By Floyd Boys and Hobart M. Smith. Springfield, Illinois, Thomas, and Toronto, Ryerson; 1959. 149 p. $5.25.

If this book had gone to press two years ago, the dean of American herpetology, K. P. Schmidt, would surely be alive today. No one could read this sobering, succinct, informative little volume without having his fear or appreciation or respect, as the case may be, of poisonous amphibians and reptiles greatly enhanced. This book should be read by naturalists and physicians, for few persons really know which species are poisonous, how the poison works, and what measures to take in cases of poisoning.

Readers should find some of the following sobering facts of interest. Certain tropical frogs have a poison that can cause instantaneous death if injected into humans. It is commonly used on arrows and spears. Several of our common Canadian toads and frogs could cause death if they were eaten raw. Death from snake bite may ensue from one minute to one month after the injection of poison. Snake venom is a startling, complex substance, and to date, eleven fractions have been isolated. Included in these is one substance that destroys the body's ability to fight bacteria. Another fraction stimulates the liver to produce substances that damage other parts of the body.

The subject treatment is thorough and includes descriptions of the poisonous species, their poisons, the physiological action of the poisons, the resultant symptoms (*early* through *late*, or *too late*, as the case may be), and the details of treatment. In the latter section there is information for the victim, the first-aider and the physician, which makes it possible for the untrained person or an experienced doctor to provide the correct treatment at the correct time.

J. Sherman Bleakney

Secrets of the Animal World

By F. J. Pootman. Translated by Mervyn Savill. London, Souvenir Press, and Toronto, Ryerson; 1959. 176 p. $4.00.

This is a fine introduction to the strange and the unusual in the lives and habitats of animals. It covers a wide range of topics from the sinister courtship antics of the female garden spider to the complex family relationships of a herd of elephants in their native haunts. The author has selected from the wide range of literature that deals with habits of wild animals accounts that are, from the human point of view, the most extraordinary, and he has presented them in a most readable form. Needless to say, *Secrets of the Animal World* is a most entertaining book that will delight amateur naturalists and find ready acceptance among those who have no particular interest in natural history.

One of the most engaging chapters deals with man's closest relatives, the apes and monkeys. The author draws particularly on the experience of zoo keepers who probably know more about these animals than anyone else. Another chapter deals with the remarkable migration of the fur seals to the remote Pribiloff Islands in the northern Pacific where the old bulls fight off the bachelor males who try to steal their wives and the females bring forth their young and mate with the bulls in whose territories they have ventured. At the other end of the earth, the penguins are carrying on equally incredible courtship antics, the males presenting their betrothed with pebbles as a symbol of their devotion and both parents sharing the incubation of the single egg by placing it in their webbed toes. In New Guinea on the other hand, the male bower bird is building elaborate little huts, decorated with bright flowers and glittering stones, in which he will court his somber female, and thereby persuade her to build her nest nearby. These and many other absorbing accounts fill the pages of this fascinating book.

The twenty-nine black-and-white photographs are well reproduced and show many of the activities of the animals mentioned in the text. Most naturalists who have once picked up this book will find it hard to lay it down.

AUSTIN W. CAMERON

The Birds of the Saskatchewan River, Carlton to Cumberland

By C. STUART HOUSTON and MAURICE G. STREET. Regina, Saskatchewan Natural History Society, 1959. 205 p. $1.50 (Special Publication No. 2)

This publication brings together a surprising amount of well-documented information on the birds known to occur at present and in the past along the Saskatchewan River between Carleton and Cumberland. It is more than an annotated list.

The historic Saskatchewan River was for more than a century the main interior route to the Northwest. The first specimens known to science of some of our birds were taken along the Saskatchewan by naturalists accompanying these early expeditions. The original descriptions of such birds as Forster's Tern, Olive-sided Flycatcher, Clay-colored Sparrow, Gray-crowned Rosy Finch, and Smith's Longspur are based on such specimens. Carlton House and Cumberland House are type localities familiar to all who do taxonomic work on North American birds. Yet few taxonomists know very much about these points and the descriptions of them in this publication are therefore of especial interest.

The senior author has made a commendable study of the scant records left by the old naturalists who worked along the Saskatchewan, particularly those of the first and second Franklin expeditions. For instance, through the study of Thomas Drummond's itinerary, in an obscure botanical journal, overlooked by ornithologists, he shows that the type locality of *Sterna forsteri* is in Saskatchewan instead of Manitoba as has been heretofore supposed.

The annotated list of birds contains 259 species together with an additional seven the status of which is considered hypothetical. Significant data are derived from the records of such early naturalists as Blakiston, Richardson, and Drummond through to those of contemporary observers. For each species the seasonal and relative numerical status are given under five geographical headings: Carlton to Cumberland, Carlton, Prince Albert, Cumberland House, and Nipawin. The junior author's mature knowledge of the Nipawin region is a feature of the contemporary work. Of 241 species known to occur in the Nipawin region he has established the breeding there of 141. The authors point out that Nipawin may be the site of the earliest record of the Passenger Pigeon in western Canada (July 24, 1691).

The introduction contains much information of historical and biographical interest (pages 5-21) and there are many usefully interpreted historical data scattered through the annotated list. At the end there is a valuable bibliography, which, incidentally, would seem to convey some idea of the extent of the authors' search for source material. This is a lot of information for the modest price asked.

W. EARL GODFREY

The Shell Book

By JULIA ELLEN ROGERS. Revised. Boston, Branford, no date. 503 p. $8.00.

Few publications have inspired more readers to become energetic shell collectors than this famous book. Fortunately, in the latest revision none of its freshness or happy enthusiasm has been lost through misguided editing, and except for the replacement of a few outdated illustrations and modernization of the nomenclature, it has been left just as it was written many years ago.

The book contains 121 chapters distributed among five parts: How to Know Shells, Univalves and Chitons, Tooth Shells, Bivalves, and Cephalopods. Well over 1000 of the best known and most attractive species are described and they are depicted by eight color and

103 black-and-white illustrations. There are two indexes, and an authoritative list of modern shell names by Dr. Harald A. Rehder. Numerous interesting paragraphs on the economic importance, biology, and structure of mollusks are also included and the whole is written in an engaging nontechnical style that will appeal to everyone.

On the negative side—and there are flaws in every book—it must be admitted that the dust-jacket statement "this volume is the recognized authority on the shells of the world" is just not true. No single volume can be *the* recognized authority on a complex group containing over 100,000 species. Recent advances such as the newly defined class Monoplacophora are omitted and the various families have not been presented in modern taxonomic sequence. Finally, the revised edition bears no date, an oversight that will inconvenience librarians and compilers of bibliographies.

Such deficiencies are relatively minor, however, and the *Shell Book* is still the most comprehensive and readable work on the land, marine, and fresh-water shells of the world. Anyone interested in shells will find it well worth the purchase price.

A. H. CLARKE, JR.
National Museum of Canada

The Book of Wild Pets

By CLIFFORD B. MOORE. Boston, Branford, 1954. 553 p. $6.50.

The text being reviewed is a 1958 reprinting of a text originally released in 1937. The book contains a great deal of information on the natural history and suggested methods of handling in captivity a very wide range of animals from small aquatic invertebrates to mammals as large as a white-tailed deer. It also includes many animals not usually thought of as 'pets' and ranges through reptiles, including even gila monsters. In addition to a large section on birds in captivity, there are 60 pages on means of attracting birds, of providing houses for them and of dealing with unwanted species.

Since the book was written in 1937, and has not been revised since that time, many modern construction materials, techniques, and devices of use in the care of captive animals, are not discussed. In certain phases of animal care, very rapid developments have occurred in the past decade and many readers will search in vain for reference to the use of antibiotics and vitamin preparations for control of disease and infection. In the care of fish the modern use of prepared pelleted foods, which simplify storage and handling, is not treated.

Some readers will be disturbed by the anthropomorphism that occurs in sentences such as the following: "Fish generally prefer things that way"; but the text is well written although reproduced by photolithography, it is quite easy to read. The reproduction of some of the more than 300 illustrations could be improved but, in general, the pictures are helpful in understanding material dealt with in the text. Typographical errors are few.

It is hoped that in future editions it will be possible to have this useful book brought up to date so that persons holding animals in captivity will have the benefit of the rapid advances made in the field during recent years.

VICTOR E. F. SOLMAN
Canadian Wildlife Service

Landscaping With Vines

By FRANCES HOWARD. New York, Macmillan, 1959. 230 p. $6.50.

The Macmillan Company has long been the gardener's friend. The big Bailey *Cyclopedia* and the smaller *Hortus Second*, Rehder's *Manual* and the newer pruning guide by Christopher are all Macmillan publications. A few years ago we were treated to *Shrubs and Vines for American Gardens* by Donald Wyman. Now we are given a book devoted entirely to vines.

A vine is one type of plant that has to be chosen most judiciously and cared for with more than usual attention. In her

introduction, Frances Howard provides a lot of common sense and necessary warning. In her main text, where she describes some 350 species, the author presents brief accounts of the proper uses of the vine, what it looks like and how to grow it. Then at the end the vines are listed under landscape use, in such subjects as screens, shade, ground cover.

It is regrettable that more care was not given to some fine points, for the book might have become a standard work on the subject. The Rehder zones of hardiness, it is true, are of only general horticultural value, but if included at all the zone might have been given in the main section with each species and not just in an appendix that lists the vines hardy in the various zones.

The arrangement of the main text is irritating. As an example, in the genus *Euonymus* the species *coloratus*, *gracilis*, *minimum*, *kewensis* and *obovatus* are listed under the main heading *Euonymus fortunei*. Then, too, the attempt to indicate pronunciation of the scientific name does, in fact, do nothing more than mark the accented syllable. And even here we are often left in doubt. The reader might well think that, on p. 39, *asparagoides* is made up of five syllables, whereas the *oi* is not a diphthong but two separate vowels.

The book in its very full coverage shows the result of much research. It makes a good contribution to a fascinating subject, landscaping with vines.

ROBERT A. HAMILTON

Country Hours

By CLARK LOCKE. Drawings by Thoreau MacDonald. Toronto, Ryerson, 1959. 105 p. $3.50.

In the brief preface to this book the author is careful to state that "these sketches do not represent the findings of a naturalist—but of an observer." His object is simply to discover beauty and pleasure in the country's face, and to share in the rewards of observation and memory with all who may be interested."

This he has done very well indeed. His style flows easily and succeeds in recalling to the reader's mind the sounds and smells, the atmosphere of the seasons, the intimate events of country life. The use of quotations, gleaned from many sources, does not seem excessive as the quotations are short and apt and merge into the context without extra effort. There is ample evidence that the author reads widely, has practiced long his style of writing and has been a country dweller in all seasons.

There are thirty-nine sketches in the book. None are more than two pages in length. Probably some readers would appreciate a more exhaustive treatment of subject matter in an occasional essay, if for no other reason than varying the sameness of essay length. The table of contents skillfully places the essays in groups under suggestive headings: "The Changing Scene," "Furtive Feet," "Flutter of Wings," "Lesser Breeds," "Barnyard Worthies."

Thoreau MacDonald provides at least one drawing, of half-page size, to illustrate each essay. Native birds, familiar mammals, barnyard scenes and landscape silhouettes have been appropriately created to give emphasis to each word picture of the author.

This pleasing book shares its attractiveness with the prose of its author, the drawings of its illustrator and the superior quality of type, paper and binding chosen by its publisher. These latter items add up, no doubt, to the rather high price for such a small volume. Not a book for the voracious reader, it is rather that type of little volume to be placed on the living-room table or at the bedside, to be picked up whenever a recess of a few moments will allow the luxury of a return to mental reflections such as depicted by *Country Hours*.

ROWLEY FRITH

Past President
Ottawa Field-Naturalists' Club

The Natural Thing

By PIETER W. FOSBURGH. New York, Macmillan, 1959. 255 p. $4.75.

There are few Canadians, in the eastern provinces at any rate, who have not visited the Adirondacks. Winter and summer the mountains and lakes of this region make their picturesque appeal to our citizens. This book is for them. It will introduce them to facets of Adirondack life that the tourist rarely has the opportunity to see. It tells of the permanent residents, both human and of lesser breed, who make their living there and of the conflicts that often arise between economic exploitation on the one hand and esthetic on the other.

The author was for ten years the editor of the *Conservationist*, the house organ of the New York State Conservation Department. He divides his text into six sections: the problem of exploiting the land; the animals, including an interesting mammal known as the goyd (which Webster spells "guide"); some human "characters"; the vagaries of the Adirondack seasons; hunting and hunters; storms, forest fires and the problems raised by them. Conservation is the weft of this multicolored warp.

Written in easy style the book loses nothing from the author's ability to make humorous asides. The first essay will open the eyes of the city dweller who has the urge to satisfy his atavistic longing for the bucolic. But it is spoiled by the second, which is little more than a précis of the first; the rock pools for the trout, the dead doe, the impudent hunters, the brown torrent, the logged-off timber, the long dead-end road all turn up again. But this time they have a rather used look. Some of the essays, for example those on pages 65 and 74, gave this reviewer the impression that they are unfinished, as if the author got tired of them before he could properly round them out.

The last section, a description of a storm and a fire, gave at first the impression that it was too detailed. It is, however, vividly done and the reader puts down the book with some understanding of the devastation and of the incredible waste of human resources occasioned by a forest fire. This section makes the book worthy of attention. One wonders, though, whether in these days of the paperback the price ($4.75) is not a bit too much.

REV. FARRELL E. BANIM
St. Patrick's College
Ottawa, Ontario

Thousand Acre Marsh

By DUDLEY CAMMETT LUNT. New York, Macmillan, 1959. 174 p. $3.75.

Although the author has chosen for his title "Thousand Acre Marsh," the subtitle of the book is "A Span of Remembrance." The remembrances cover many habitats in Maine and Delaware in addition to the marsh mentioned in the title.

In his foreword the author mentions a friend whose ambition in life was to acquire experiences worth owning. He felt they were the only real wealth in the world. They were subject to no tax, required no insurance and provided no problems for executors. They were really personal and could be relived in the mind for a whole lifetime. The author agreed with his friend's views and has written a series of descriptions of his own "experiences worth owning."

The experiences recounted are arranged with reference to the four seasons. From the catching and cooking of a large speckled trout on a Maine stream in spring, through the sounds and odors of a still July night, the pounding of the surf in a fall northeasterly gale to the rare majesty of a winter thunderstorm, they cover many natural events whose simplicity is a form of beauty.

Mr. Lunt's description of natural events are presented in musically descriptive terms and phrases that are a pleasure to read. He has succeeded admirably in presenting the beauty of nature's many moods as he has observed them in a variety of habitats. His readers will envy his large collection of "experiences worth owning" and will enjoy sharing them, albeit vicariously. They may be en-

couraged to look more closely at those happenings around them which, in the hurry and confusion of modern urban living, are too often passed unseen and unappreciated.

Victor E. F. SOLMAN
Canadian Wildlife Service

Flora of Alberta

By E. H. Moss. Toronto, University of Toronto Press. 1959. 546 p. $10.00.

Because of wide ranges in latitude and altitude, Alberta has great variation in climate and flora. Its plants include those of arid grassland, saline depressions, parkland prairie, foothill meadows, montane forests, alpine tundra, taiga, and subarctic muskeg. The meeting of floristic elements of both Cordilleran and Boreal affinity also makes it an interesting area phytogeographically. In producing this "manual of flowering plants, conifers, ferns and fern allies growing without cultivation in the Province", Professor Moss has completed a formidable undertaking and in doing so has rendered genuine service to all serious students of the regional flora. Formerly it was necessary to consult works bearing on contiguous areas, or local lists of species, in order to pick up strands of information about the Province's plants.

The manual confines itself rather strictly to technical descriptions of genera and species and to dichotomous keys for identification; there are no illustrations, no introductory advice on systematic matters, and no dressing of plant lore intended to assist or attract the casual naturalist. Various ecological aspects of the province's vegetation have been monographed by the author in earlier publications. To treat 1820 entities within 500 pages of text has meant cutting wordage to a minimum and conciseness has been necessary; indeed, precision and conciseness admirably mark the work as a whole, as does a definite conservatism in systematic treatment.

Numerous species mentioned are not yet represented by actual herbarium specimens from the province and their inclusion in the text, while of decided help to most users, will be a source of uncertainty to those plotting total distributions. Nevertheless, as a result of this substantial and authoritative basis it may be expected that some of the taxonomic and phytogeographic difficulties that have retarded knowledge of the flora may now be quickly cleared up. A fine standard of arranging, printing and paper has been set by this excellent and welcome contribution to Canadian botany.

W. G. DORE

The Freshwater Fishes of New Brunswick: a Checklist with Distributional Notes

By W. B. SCOTT and E. J. CROSSMAN. Toronto, Royal Ontario Museum, 1959. 45 p. $1.50 (Contr. R. Ont. Mus. Zool. Palaeont. 51)

Local lists have two values; they are useful to local students and they constitute the raw materials for more comprehensive studies.

The need for a work on the fresh-water fishes of New Brunswick is indicated by the fact that "not since the 1896-1900 period . . . has there appeared a comprehensive work on the fresh-water fish fauna of New Brunswick." Even at that date much of the available information was due to Moses H. Perley's catalogue published in 1852.

The present list is based on the results of a survey by the authors and on published information.

The 46 species recorded include not only species confined to fresh water but also anadromous and catadromous fishes. Two are new records for the province; introduced species number five.

J. R. DYMOND

OTHER NEW TITLES

Hawks and Owls: Population Trends from Illinois Counts By RICHARD R. GRABER and JACK S. GOLDEN. Urbana, State of Illinois, Natural History Survey Division, 1960. 24 p. Free (Biol. Notes, Urbana. No. 41)

Winter Foods of the Bobwhite in Southern Illinois By EDWARD J. LARIMER. Urbana, State of Illinois, Natural History Survey Division, 1960. 35 p. Free (Biol. Notes, Urbana. No. 42)

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The CANADIAN FIELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

About the . . .

CHRISTMAS BIRD CENSUS

At a council meeting of the Ottawa Field-Naturalists' Club on November 3, 1960, it was reluctantly decided to discontinue publication of the results of the Christmas Bird census in the CANADIAN FIELD-NATURALIST. Compilers who wish to have their report published elsewhere may get suggestions from Mr. W. Earl Godfrey, Associate Editor, National Museum of Canada, Ottawa, Ontario.

Articles

Notes

Reviews

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The Canadian Field-Naturalist

VOLUME 74 OCTOBER-DECEMBER 1960 NUMBER 4

SYSTEMATIC RELATIONS OF CLETHRIONOMYS IN THE PACIFIC NORTHWEST

WALTER SHEPPE*

Department of Zoology, University of British Columbia, Vancouver 8, British Columbia

MOST OF the races of *Clethrionomys* in the Pacific Northwest, that is, Oregon, Washington and British Columbia, were originally described as distinct species. Modern authorities assign them to only two species, though intergradation between races has not been satisfactorily demonstrated. This paper is an attempt to clarify the relations of certain of these races. The two species now recognized are *C. gapperi*, which occurs across much of the northern part of the continent, and *C. occidentalis*, which occurs on the Pacific coast from California to British Columbia. The ranges of these species approach each other in western Washington and extreme southwestern British Columbia, but apparently they do not meet (Dalquest, 1948; Cowan and Guiguet, 1956).

C. gapperi and *C. occidentalis* are not very different from one another, and there is geographic and individual variation within each which parallels the specific differences. In general *gapperi* is brighter red and has a more distinct dorsal stripe, whereas *occidentalis* is darker and the dorsal color tends to extend onto the sides. The undersurface usually is gray in *gapperi* and buff in *occidentalis*. These pelage differences are no greater than those found within both species.

In the samples examined, *occidentalis* had a relatively longer tail than did *gapperi*, as indicated by scatter diagrams of tail length against body length. This character has not been fully analyzed.

Bailey (1897) and Hall and Cockrum (1952) list various cranial characters which differ in the two species, but most of these are highly variable and do not hold when large series are examined. No entirely reliable cranial characters have been found, but two have proved to be of some value. In *occidentalis* the auditory bullae are larger and more inflated, and the molar teeth are more heavily built, than in *gapperi*. The latter character was apparent on inspection, and was verified by measuring the width of the first loop of the third upper molar with an ocular micrometer under 18-power magnification. Molar width in the samples examined averaged 0.75 mm in *C. g. saturatus*, 0.86 in *C. o. occidentalis*, and 0.89 in *C. g. californicus* (Table 1).

In the Northwest these species seem to converge in a number of characters. The generally dark-colored *occidentalis* is lightest on the northwest coast, whereas the generally lighter-colored *gapperi* is darkest there. In the samples examined, the length of tail in relation to the body is greater in *C. o. californicus*

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Mailing date of this number: 28 November 1960

from California and Oregon than in *C. o. occidentalis* from Washington, but in both it is distinctly greater than in *gapperi*. The bullae of *californicus* are slightly more inflated than those of *C. o. occidentalis*. These convergences

TABLE 1. WIDTH OF FIRST LOOP OF THIRD UPPER MOLAR IN SAMPLES OF *Clethrionomys*

Race	Number of Specimens	Range (mm)	Mean (mm)
saturatus	21	0.65–0.85	0.75
caurinus	11	0.65–0.85	0.74
nivarius	22	0.70–0.90	0.79
occidentalis	64	0.70–0.95	0.86
californicus	21	0.75–1.05	0.89

could be interpreted as intergradation between *C. occidentalis* and *C. gapperi*, but they could also be the result of parallel adaptations to the local environmental conditions. In the absence of contact between these forms it is not possible to determine their relationship, but it seems best to retain them as distinct species for the present.

The following races are recognized from Washington and southern British Columbia: *C. g. saturatus*, from east of the Cascades – British Columbia Coast Range; *C. g. cascadensis*, from the Cascades of Washington and extreme southern British Columbia and the southern British Columbia Coast Range; *C. o. occidentalis*, from the Puget Sound lowlands west to the Pacific Ocean, except for the Olympic Mountains. The race *nivarius* occupies the Olympic Mountains, and the race *caurinus* occupies most of the British Columbia coast.

Various authors have disagreed on the specific assignment of these last two races. Cowan and Guiguet and others have assigned *caurinus* of the northern British Columbia coast to the species *C. gapperi*, but Hall and Cockrum (1952) place it in *C. occidentalis*. None of these authors has presented any evidence for his decision. Hall and Cockrum examined five specimens, two of them from outside the range of *caurinus* as recognized by Cowan and Guiguet. I believe that these specimens must be assigned to *gapperi*, though they differ from other races of this species in some details. They have the small, flat bullae of *gapperi*, and their molar width averages 0.74 mm, compared to 0.75 for *C. g. saturatus* and 0.86 for *C. o. occidentalis*. Scatter diagrams show that they have relatively short tails, similar to those of *saturatus*.

Hall and Cockrum (1953) assign all *Clethrionomys* from the southern coast of British Columbia to *caurinus*, but Cowan and Guiguet indicate that the lower Fraser delta is occupied by *C. o. occidentalis* and the Cascades and southern British Columbia Coast Range by *C. g. cascadensis*. I have examined three specimens of *Clethrionomys* from the lower Fraser delta; all resemble *C. o. occidentalis* closely. *Clethrionomys* specimens that I have trapped in the southern Coast Range (Mount Seymour) were *gapperi*, probably *cascadensis*. This occurrence of a race of *gapperi* on the coast between the ranges of *C. o. occidentalis* and *caurinus* makes it geographically improbable that the latter race belongs with *occidentalis*.

Another race of uncertain relations is *nivarius*, of the Olympic Mountains of Washington. Dalquest (1948) and others have assigned it to *gapperi*, though its range is surrounded by that of *C. o. occidentalis*. Hall and Cockrum (1952), on the basis of two specimens, assign it to *occidentalis*. In molar width (0.79 mm) it is intermediate between *saturatus* (0.75) and *occidentalis* (0.86), but it resembles *occidentalis* more closely in tail length and inflation of bullae and I believe that it belongs to this species.

Specimens examined (in the collection of the United States National Museum unless otherwise noted) are as follows. *C. g. saturatus*: 6 miles S of Nelson, B.C. (type locality) — 21. *C. g. caurinus*: Inverness, B.C. — 2; Lund, B.C. (type locality) — 9. *C. g. cascadensis*: Yakima Indian Reservation, Wash. — 18. *C. o. occidentalis*: Neah Bay, Wash. — 65; Point Grey, Vancouver, B.C. — 1 (University of British Columbia Museum of Zoology); Stanley Park, Vancouver, B.C. — 1 (Museum of Vertebrate Zoology, University of California); Port Moody, B.C. — 1. *C. o. nivarius*: Canyon Cr., 3 miles S of Solduc R., Wash., 3550 ft — 11; headwaters of Cat Cr., Wash., 4500 ft — 6; Happy Lake, Wash., 4900 ft — 3; 2 miles SW of Mt. Angeles, Wash., 6000 ft — 1; near head of Solduc R., Wash., 4400 ft — 2; Elwha Basin, Wash., 2750 ft — 2; Mt. Elinor, Wash., 4000 ft (type locality) — 2. *C. o. californicus*: Astoria, Ore. — 3; Oregon City, Ore. — 1; Otis, Ore. — 4; Wells, Ore. — 1; Yaquina Bay, Ore. — 1; Alton, Calif. — 2; Alton Jct., Calif. — 5; Crescent City, Calif. — 2; Carsons Camp, Mad R., Calif. — 1; Humboldt Bay, Calif. — 1; Mendocino City, Calif. — 1.

SUMMARY

Clethrionomys gapperi and *C. occidentalis* tend to converge in certain characters in the Northwest, but there is no evidence that they intergrade. The race *caurinus* belongs in the species *C. gapperi*. The British Columbia coast is occupied, in order from south to north, by *C. o. occidentalis*, *C. g. cascadensis*, and *C. g. caurinus*. The race *nivarius* of the Olympic Mountains probably belongs in the species *occidentalis*. The northwestern forms are therefore arranged as follows:

Clethrionomys gapperi saturatus (Rhoads)
Clethrionomys gapperi caurinus (V. Bailey)
Clethrionomys gapperi cascadensis Booth
Clethrionomys occidentalis occidentalis (Merriam)
Clethrionomys occidentalis nivarius (V. Bailey).

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Received for publication 26 January 1959

ENTOMOLOGICAL INTEREST IN A RARE GROVE OF HACKBERRY AT CARLETON PLACE, ONTARIO*

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IN THE November-December, 1942, issue of the CANADIAN FIELD-NATURALIST, Herbert Groh published an account of the occurrence of hackberry (*Celtis occidentalis* L.) in the Ottawa district. He emphasized the rare and curiously local occurrence of a forest tree with an unusual distribution. There is no

FIGURE 1. Hackberry grove on limestone outcrop, Carleton Place, Ontario.

indication in his article that more than a few specimens of this tree existed at any of the Ontario and Quebec localities. Having known these facts for several years, I was agreeably surprised to encounter a large group of hackberry trees (Figure 1) while I was fishing along the Mississippi River at Carleton Place. I have never heard this grove mentioned in conversation with field naturalists and I am convinced that this is the exact locality that Mr. Groh stated in his article (1942): "Ontario: south side of Mississippi River, near foot of rapids, Carleton Place, A. H. D. Ross, June 11, 1909 (Can)." The nearest comparable grove is on Point Pelee, in southernmost Ontario, 500 miles to the southwest.

*Contribution No. 3917, Entomology Division, Science Service, Canada Department of Agriculture, Ottawa, Ontario.

Easily accessible to any interested person, the trees extend over a ten-acre area of sedimentary limestone outcrop on the property of The Bates and Innes Woollen Mill Company. The northern side of the grove is heavily populated with young trees as well as mature trees that bear fruit abundantly. The largest tree, estimated to be at least 100 years old, has a trunk four feet in diameter. Several large trees have been preserved for shade and ornament on the lawn adjacent to the mill and it is fortunate for future entomological investigations that this rare grove has had the protection of private property for so many years.

Since I collected two specimens of the beetle *Agrilus celti* Knull on hackberry leaves where I was fishing along the river edge, the rare opportunity of collecting insects associated with such a large stand of hackberry so far north in Canada immediately presented itself. I revisited the area on July 18 and 31, 1958, with some interesting results. A total of 60 specimens of *Agrilus celti*, which was fairly common, was collected. In the Canadian National Collection of Insects there is a series of this species taken from hackberry at Point Pelee, Pelee Island, and Leamington, near Pelee. There seem to be no other Canadian records of this species. Also, 20 specimens of *Agrilus lecontei* Saunders, which appeared to be less common than *A. celti*, were collected. In the Canadian National Collection there is a series of this species from hackberry at Point Pelee and Pelee Island. The only published record for this species in Canada is by Horn (1891), who merely mentioned that the habitat is from Canada to Texas. The series of each species is now in the Canadian National Collection.

On my third visit to the area, I was accompanied by Dr. T. N. Freeman and Mr. George Lewis, of the Entomology Division, who collected many of the beetles and spent considerable time searching for Lepidoptera. They looked particularly for the hackberry butterfly, *Asterocampa celtis* Boisduval & LeConte, a species associated everywhere else with hackberry in woodland areas and one that is easily collected at Point Pelee. Whatever the reason, they found no evidence of larval or adult Lepidoptera of any kind. However, the leaves of many trees were heavily infested with galls caused by jumping plant-lice (Psyllidae) and mines made by larvae of a fly (*Agromyza* sp.). Future investigators may add considerably to our knowledge of the insect fauna of this large northern grove of hackberry.

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Received for publication 6 March 1959

NOTES

Brown-headed Cowbirds in Southwestern British Columbia

ON AUGUST 31, 1959, Mr. and Mrs. Weeden on Nicol Road, near White Rock, British Columbia, asked me to identify three birds that were visiting their feeding table. They did not know what they were but thought they conformed to the description of cowbirds.

The birds were somewhat larger than a sparrow with brownish-gray plumage showing a light tinge of buff; the eyes, feet and short beak were black. I thought they were young cowbirds, but I was loathe to say so, for during my forty years in the Fraser Valley I had never recorded a cowbird, and the published records describe it as a rare straggler.

A couple of snaps were forwarded to Dr. McTaggert Cowan, Department of Zoology, University of British Columbia. He replied that they were undoubtedly Brown-headed Cowbirds *Molothrus ater* and that some had appeared on the University campus in Vancouver for the past three years.

Mrs. Kathleen Munro of Port Kells and Mr. John Vooys of North Surrey report yellow warblers feeding young cowbirds during the past summer.

Mr. T. L. Thacker also informs me of a few sight records of cowbirds in the Hope district of British Columbia between 1923 and 1950.

Dr. G. Clifford Carl, Director of the Provincial Museum, Victoria, reports that there have been many sight records, both of adult and young cowbirds, in the Victoria area this year. He also said that Mr. Art Benson had seen small flocks of cowbirds on Lulu Island.

Evidently the Brown-headed Cowbird is no longer a rare straggler in southwestern British Columbia, including Vancouver Island.

REV. MARTIN W. HOLDOM

Crescent Beach, British Columbia
20 November 1959

Two Records of the Mockingbird in British Columbia

A MOCKINGBIRD *Mimus polyglottos* was observed near the south boundary of Miracle Beach Provincial Park on June 8, 1959. This park is roughly midway between Courtenay and Campbell River on the east coast of Vancouver Island. The bird was observed from a building by four observers with binoculars for two periods totaling 45 minutes. It was active in a gravelly clearing adjacent to the upper beach, alternating between feeding on the ground and perching in the tops of nearby, low-pruned Douglas fir and patches of thick wild rose. The site was open and dry.

On July 9, 1959, another Mockingbird was collected by Mrs. R. G. Miller at Murtle Lake in Wells Gray Provincial Park, roughly 100 miles north of Kamloops, B.C. This bird, a female, is now in the Wells Gray Park collection. According to R. Y. Edwards, who saw both birds reported in this note, the site of this record was a clearing by a cabin on the shore of the lake. Dense, unbroken forest of western red cedar, western hemlock, and other conifers clothes the shores and hills about the lake, which lies at about 3500 feet above sea level.

The closest resident populations of Mockingbirds appear to be in Nebraska (eastern race) and California (western race). Both birds reported here must therefore be regarded as wanderers, far from breeding populations. Munro and Cowan in their *Review of the Bird Fauna of British Columbia* (Victoria, B.C. Provicial Museum, 1947) include the Mockingbird in their extralimital list on the basis of two records from Vancouver Island.

D. STIRLING

Department of Recreation and Conservation
Victoria, British Columbia
9 October 1959

Sand-hiding Behavior in Young White Hake

WHILE skin diving off a sand beach at Prince Edward Island National Park, P.E.I., on 16 and 17 of July 1959, I observed a peculiar habit of young white hake, *Urophycis tenuis* (Mitchill). The hake lay on their sides in the sand with their heads projecting (Figure 1). The

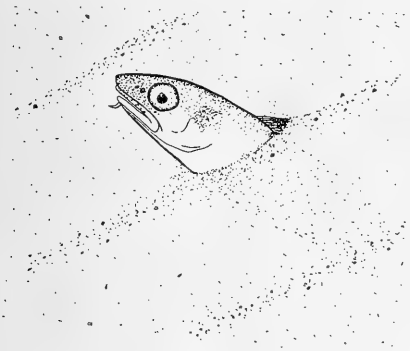

FIGURE 1. White hake buried in sand.

head was turned slightly towards the vertical and was not completely on its side. When closely approached the hake withdrew from the sand and fled. About six specimens, three to four inches long, were observed to behave in this manner. The water was about three feet deep. As the water was clear, the characteristics of the fish could be ascertained and even the barbel could be seen. Positive identification was made by seining and examining specimens.

This peculiar behavior not only hides the hake from its predators but also conceals it from its prey. Similar behavior is recorded for the families Labridae and Serranidae and is thought to have lead to the evolution of the assymetrical Pleuronectiformes (Norman, J. R. A systematic monograph of the flatfishes. Vol. 1. British Museum Natural History, 1934, p. 9).

DON E. MCALLISTER
National Museum of Canada
Ottawa, Ontario
14 December 1959

The Twospine Stickleback *Gasterosteus wheatlandi* new to the Canadian Fresh-water Fish Fauna

A SPECIMEN of the twospine stickleback, *Gasterosteus wheatlandi* Putnam, was caught in fresh water inside the mouth of Jacquet River, Restigouche County, New Brunswick. Although the species is known from marine and brackish waters from southern Newfoundland to Massachusetts it has not been reported from fresh water.

While collecting for the National Museum of Canada I set a minnow trap in a pool of Jaquet River above the beach where it enters Chaleur Bay. The freshness of the water was verified by taste. This set, overnight from July 12 to 13, yielded a ripe male *Gasterosteus wheatlandi*, now catalogued as NMC59-276 in the National Museum. On the evening the trap was set 22 ripe female and males were caught in Chaleur Bay just at the mouth of the river in brackish water.

That this species should be found in fresh water is not surprising since all members of the family Gasterosteidae except *Spinachia spinachia* (Linnaeus) of Europe have been reported in fresh water. Marine species commonly enter less saline waters to spawn.

The paucity of records of *G. wheatlandi* and the previous failure to record it from fresh water may be due to confusion of specimens with the better-known threespine stickleback *G. aculeatus* Linnaeus. *G. wheatlandi* may be distinguished by the following characters: possession of prominent cusps at the base of the pelvic spine; the lack of plates on the posterior part of the body and absence of a keel on the side of the caudal peduncle; the presence of two rays in the pelvic fin; lower numbers of gill rakers, dorsal and anal rays; a deeper body and a shorter caudal peduncle.

The following data were taken from the specimen: standard length 30.0 mm;

length of caudal peduncle 12 times in standard length; depth of body 4 times in standard length; 10 dorsal and 8 anal rays (counting all elements); 10 pectoral rays; 12 principal caudal rays; 15 gill rakers (long and slender); 2 ventral rays; and 6 lateral plates.

DON E. MCALLISTER
National Museum of Canada
Ottawa, Ontario
13 October 1959

REVIEWS

Wildlife Conservation

By IRA N. GABRIELSON. Second Edition. New York, Macmillan, 1959. 244 p. $5.50.

Published in 1941 when Dr. Gabrielson was director of the United States Fish and Wildlife Service, the earlier edition of this book was one of the first to bring to public attention the many problems to be solved in order to ensure continuing availability of wildlife resources. Dr. Gabrielson has put into simple language the relations between soil, water, forests and wildlife that are so thoroughly interwoven that any change in one vitally affects all the others.

In the 18 years between the two editions, wildlife research and management have developed rapidly and the whole concept of wildlife conservation has become a more widely accepted part of our way of life. In revising the book, Dr. Gabrielson, now president of the Wildlife Management Institute, has drawn upon his familiarity with modern developments to bring the book up to date where necessary. He has been careful at the same time not to alter those basic ideas and philosophies which gave the first edition its impact.

To the original 16 chapters, with themes ranging from "Soil and Wildlife," through "Relationship between Forestry and Wildlife" and "Rare and Vanishing Species" to "Wildlife Refugees and their Place in Conservation," he has added a new chapter, "Wildlife on Agricultural Lands." That chapter records an expanding interest in wildlife species that can live on properly managed agricultural land. They are increasing in importance to hunters and nature lovers because of the easy access to their habitat.

The continued presence of those species in useful numbers is threatened by extensive use of chemical insecticides and herbicides and by the use of farming methods that destroy wildlife habitat. Much research is needed to ensure survival of useful populations of wildlife on agricultural lands.

The 32 excellent photographs and 23 of the 24 line drawings of the first edition are retained, some of the latter revised to include up-to-date information on distribution of waterfowl species and location of waterfowl and other game refuges.

Throughout the book Dr. Gabrielson has retained a clarity of expression and idea that will help newcomers to grasp the fundamentals of conservation. A measure of his deep understanding of the whole field of wildlife conservation is demonstrated in the final chapter, "Surmounting the Obstacles to Conservation." His concept of those obstacles 18 years ago has required no revision.

VICTOR E. F. SOLMAN
Canadian Wildlife Service

Rainbow Trout in Mexico and California

By PAUL R. NEEDHAM and RICHARD GARD. Berkeley, University of California Press, 1959. 108 p. $2.50 (Univ. Calif. Publ. Zool. Vol. 67, No. 1)

This paper throws welcome light on the taxonomy of an interesting and puzzling group of fishes: the rainbow trout.

Populations of rainbow trout from many geographic areas exhibit such divergent characters that "over 15 separate and distinct species" have been described including migratory and non-migratory forms.

This paper presents the results of the comparison of 42 characters of 306 speci-

mens from 17 different populations from the headwaters of the Rio de Presidio in southern Durango, Mexico, to Eagle Lake in northeastern California.

The author's conclusions are that "the data presented demonstrate that apparently every character analyzed here in the rainbow complex can be modified by the environment either through direct effects or indirectly through selection. In addition, there seem to be no hereditary characters that define any single population. . . . For these reasons . . . we prefer not to use a formal nomenclature now for the various populations in the rainbow series. Until more information is available, we would tentatively group the members of the rainbow series under the single species name, *Salmo gairdnerii* Richardson."

The decision against the use of trinomials is based on the large number of such names that would have to be used and not on the lack of significant differences between local populations. "Application of the 75 per cent rule would permit naming of many of these as subspecies." If a similar study were extended to the rainbow populations of Oregon, Washington, British Columbia and Alaska, the number of populations recognizable as subspecies would be quite large. The authors recommend that "each group should be fully characterized and, for practical purposes, can be referred to by its vernacular name," for example, Kamloops trout.

Taxonomists tend to be either lumpers or splitters. The former tend to emphasize similarities and minimize differences whereas the latter tend to emphasize differences and minimize similarities. The reviewer does not imply that the authors of this paper are either lumpers or splitters. If they were splitters they could, no doubt, have recognized several new subspecies. Until more information is available as to the relative effect of heredity and environment on the character by which local populations of rainbow trout differ, the reviewer agrees that it is better to apply a single scientific name to the rainbow trout.

A general discussion of the cutthroat series is included in the present paper.

A valuable feature of the paper is the historical discussion of the taxonomy of the rainbow and cutthroat trouts.

J. R. DYMOND

Wildlife in America

By PETER MATTHIESSEN. Introduction by Richard H. Pough, drawings by Bob Hines. New York, Viking, 1959. 342 p. $11.00.

The author, who studied zoology and ornithology at Yale, has searched the records of explorers, settlers, fur trappers, whalers and naturalists to write this account of white man's effect on all forms of wild life in North America. The subject matter is treated regionally: The Outlying Rocks, The Tropical Border, The Eastern Slope, etc.; and emphasis is laid on those species that once flourished, such as the great auk, passenger pigeon (both extinct), bison, bighorn sheep, most of the sea mammals and some of the fish and fowl. At the other extreme is the Devil's Hole pupfish, a minnowlike species found in a forty-by-fifteen-foot remnant of the ice ages, a species with, perhaps, the smallest range of vertebrates in the world.

The illustrations are outstanding and comprise: 8 color and 27 monochrome plates and over 150 halftones of shaded pen-and-ink drawings many of which depict species and subspecies differences, for example, those between the heath hen (now extinct), Attwater's prairie chicken and the prairie chicken; there is also a reconstructed drawing of a sea mink. Other features are: a good index and bibliography, reference notes and two appendices entitled, respectively, "The rare, declining and extinct vertebrate animal species of North America north of the Mexican boundary," and "A chronology of representative legislation affecting North American Wildlife."

The book is written in a style that tends to soften the ravages of the early visitors and settlers, and adds not a little

of the adventurous spirit to the narrative. This does not prevent the author from using quotations to admonish those who are indifferent to the conservation of wildlife, including the present administrations of the U.S. departments of the Interior (for granting leases on refuge lands), and of Agriculture (for promoting the use of pesticides), also the army and air force commands (for trying to extend the testing ranges into game reserves).

The author is critical of naturalists in one period for developing the trinomial system by giving subspecific rank to local races. Subspecies are regarded as such when fertile among themselves and species when infertile. He has to recognize exceptions to this rule; otherwise the dog and the wolf would have to be named as one species as they are interfertile.

The last chapter is a literary dirge for the whooping crane, California condor and other highly specialized species. The impending threats to wildlife, radioactive fall-out and population pressure, are not dealt with, although the latter is not necessarily fatal, for example, in India. It is of interest to note that of three methods of conserving wildlife each has had about the same measure of success. These are: by governmental agencies in America, by the application of religious sanctity to animals in India and by the rigid enforcement of game laws by aristocratic landowners in Europe for their own shooting privileges.

Canadian wildlife is dealt with mostly as an extension of that in the United States and Alaska. Our conservation efforts are briefly mentioned and a good word is said for the Hudson's Bay Company. The book is creditably produced in all its aspects, which makes it valuable for teachers as well as for those interested in wildlife. It is the kind of book that can be left around the house for boys and their fathers to browse in occasionally.

ALAN DEAKIN
Research Branch
Canada Department of Agriculture

Drawings of British Plants, Part Fourteen

By STELLA ROSS-CRAIG. London, Bell, 1960. 39 plates. 10s. 6d.

Flowers have always been a favorite subject for artists, but too often the results have been disappointing to the discerning botanist. Not so with this series of superb line drawings produced at the Royal Botanic Gardens, Kew, in which accuracy and clarity of detail has been a prime objective.

Part Fourteen, treating families Adoxaceae to Dipsacaceae, brings to 620 the number of species so far illustrated by this skillful artist. Important genera included are *Sambucus*, *Viburnum*, *Lonicera*, *Galium*, *Valeriana* and *Dipsacus*.

WILLIAM G. DORE

Flora of the British Isles — Illustrations, Part Two

By SYBIL J. ROLES. A companion volume to the text by A. R. Clapham, T. G. Tutin and E. F. Warburg. Cambridge, University Press, 1960. 119 p. $4.25.

This part, following three years after Part One (reviewed in Can. Field Nat. 72:115, 1958), contains 460 drawings for the families Rosaceae to Polemoniaceae, including such characteristic British plants as the brambles, tormentil, lady's-mantles, rowans, stonecrops, sundews, willow herbs, mistletoe, ivy, umbelifers, spurges, knotgrass, sorrels, docks, nettles, birch, beech, oaks, willows, heathers, sea lavender, primroses, scarlet pimpernel, and gentians. The North American botanist will recognize many species that are similar to or counterparts of those of his flora.

In the interval between the publication of Part One and Part Two, an *Excursion Flora* (reviewed in Can. Field Nat. 74:57, 1960), a condensed edition of the 1952 *Flora* by the same authors, has appeared; it indicates the popularity and importance of the text to students, travelers and botanists in general. Two more parts of illustrations are intended to complete the work.

WILLIAM G. DORE

Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas

By WILLIAM RANDOLPH TAYLOR. Ann Arbor, University of Michigan Press, 1960. 870 p. $19.50.

This carefully detailed manual is a most welcome addition to the literature on marine algae. It is a necessity to phycologists dealing with algae of the region and will also be of great value and interest to workers in other latitudes. It is the more welcome because of the increasing scarcity of copies of the earlier work dealing with a portion of the area, *The Marine Algae of Florida with Special Reference to the Dry Tortugas*, published by the Carnegie Institution of Washington in 1928.

This book is the first complete account of the marine algae of the tropical and subtropical western Atlantic, and correlates the dispersed literature of the region. The author describes it as "in the aggregate a pioneer work" and reminds the reader that "the range of variation in many marine algae is extraordinary, and formal descriptions fail to cover all contingencies." He points out also that not all coasts of the area have been equally well covered by botanists, even though some references appeared as long ago as the late seventeenth century.

The arrangement is much the same as that of the author's *Marine Algae of the Northeastern Coast of North America*. The extensive Catalogue, with keys to families, genera and species, describes 760 species with 140 varieties and forms, "all species likely to be encountered in the area." New taxa are described, eight new species and four new varieties. One new family is established. An interesting feature is the inclusion of "Uncertain Records" the status of which will be clarified in the future or the records abandoned for lack of evidence. Eighty excellent plates, some of which were prepared especially for this book, greatly enhance the value of the catalogue, and the extensive bibliography of 338 references will be greatly appreciated by all who use the manual.

Although it is intended chiefly as a descriptive catalogue, the book is much more than this. The preface and introduction merit close attention. Both hold a wealth of fascinating material, from brief glimpses into early investigations and collections to the present difficulties inherent in ecological researches on the shore. Algal habitats and associations are described and illustrated with 14 photographs. It is indeed unfortunate that the cost of colored plates deprives readers of the fine color photography for which Dr. Taylor is so well known.

Directions for collection and preservation are detailed and helpful.

This book, prepared with the meticulous care so characteristic of the author, is obviously the work of a devoted and painstaking scientist. All phycologists will be grateful for the fine publication, the culmination of Dr. Taylor's tropical studies of thirty years.

CONSTANCE MACFARLANE
Nova Scotia Research Foundation

British Parasitic Fungi

By W. C. MOORE. Cambridge, University Press (Toronto, Macmillan). 430 p. $7.65.

This is a reference book intended primarily for the professional plant pathologist and mycologist. The material is presented in two parts. The first part is a list of hosts arranged alphabetically under both common and scientific names with adequate cross references, and under each host is given a list of the parasitic fungi recorded on it in Great Britain. The second part consists of a list of the parasites, also arranged alphabetically by their scientific names. The names of both perfect and imperfect states are included where known and also important synonyms. Cross references are provided for the various names. For each fungus the citation for the original publication of the accepted combination is given together with the reference to its descrip-

tion in Saccardo's *Sylloge Fungorum*, other important references, annotated references to important British papers, and brief comments on the disease which it causes.

In general, only fungi considered to be parasites are included although it may sometimes be difficult to decide what is a parasite. For example, *Cladosporium herbarum* is included but *Alternaria tenuis* is not. Some fungi that may invade mushroom beds and some Myxomycetes that are not strictly parasites are also listed.

Although the book is limited to Great Britain in scope, the parasitic fungi are so widely distributed that it will be of great value in other areas as well. It will materially aid in the identification of a disease encountered on any of these host plants and will provide immediate access to the literature on these fungi. The author's high reputation for meticulous accuracy and thoroughness assures confidence in the reliability of the citations. This is not a book for light reading but it is an invaluable reference work for the plant pathologist and mycologist and should also be most useful to workers in other branches of agriculture as well.

J. WALTON GROVES

Spring on an Arctic Island

By KATHARINE SCHERMAN. Boston and Toronto, Little, 1956. 331 p. $5.00.

A few years ago the author of this book set out with a party of scientists on a trip sponsored by the New York Zoological Society and the Arctic Institute of North America. Her book, the author tells us, is not a digest of the scientists' findings but rather a personal record of several weeks spent on Bylot Island.

Pond Inlet on Baffin Island was the base of operations, and the happy associations with the Eskimos and other residents of this remote spot make a lively and amusing story. Gathering specimens of plant and bird life, the approach of spring, the persistence of nature to fructify in a brief and uncertain season provide interesting reading. The accounts are told with such charm that the reader shares the author's feeling of having been in the "happiest and most peaceful world we had ever known."

So many books on the Arctic are concerned with the never-ending slaughter of wild life, with man's cunning in exterminating everything that lives, that it is a deep pleasure to read a book of a land where the patient and sensitive observer can find things to delight the eye and touch the heart. And this Katharine Scherman has done.

A. Y. JACKSON
Manotick, Ontario

A Field List of Birds of the Detroit-Windsor Region

By RALPH A. O'REILLY, JR., NEIL T. KELLEY, and ALICE H. KELLEY. Bloomfield Hills, Michigan, Cranbrook Institute of Science, 1960. 40 pages. 50 cents.

A surprising amount of information has been packed into this handy pocket-sized booklet. Its geographic scope embraces five counties in southeastern Michigan (Monroe, Wayne, Macomb, Oakland, and St. Clair) and the three adjacent counties in Ontario (Essex, Kent, and Lambton) in which are found such outstanding Ontario areas for birds as Point Pelee, Rondeau Park, Bradley's Marsh, and Lake St. Clair.

For each of the 286 species known to occur in the area there is a graph that shows accurately the bird's relative abundance and the period of the year when it is present. Species definitely known to nest there are indicated. This authentic information is based on a ten-year survey (1945 through 1954) made by the Detroit Audubon Society and includes the work of 215 observers. In addition there is a field checking list for 12 field trips, a bird calendar indicating changes in the area's bird life by month, a useful annotated list of 12 suggested areas likely to be most productive for bird study, tips for beginners, a map of the area, and an index.

W. EARL GODFREY

The Grasses: Earth's Green Wealth

By ALMA CHESNUT MOORE. New York, Macmillan, 1960. 150 p. $5.00.

This is a series of scholarly and entertaining essays on those important cultivated grasses, wheat, barley, oat, rice, corn, and millets, which provide the bulk of the world's food. Much information on the historical, botanical, agronomic and economic aspects of each species is brought together and presented in an informative and most readable fashion. It is obvious that the author knows her subject well, has consulted the most recent and reliable sources (mainly the United States Department of Agriculture, and has effectively sifted the significant facts from the great mass of information that must be available. There are also fascinating chapters on bamboo, sugar cane, and the soil-building grasses, on their diseases and pests, and their structure. One is soon convinced of the truth of Dr Jenning's prefatory statement, that "were it not for the grasses, civilization as we know it today would not exist."

WILLIAM G. DORE

Cowry Shells of World Seas

By JOYCE ALLAN. Newton, Massachusetts, Branford, 1956. 170 p. $10.50.

In this useful book, Joyce Allan has discussed and illustrated every known species of cowry (class Gastropoda, family Cypraeidae), a group of exquisite marine mollusks, containing about 150 species, which has long been a favorite of shell collectors. Many cowry-like species are treated also. Much careful research has gone into this well-written work and it will be most helpful to anyone who collects tropical or world-wide shells.

It is unfortunate, however, that Miss Allan did not follow her own better judgment and reject the extreme splitting of taxonomic groups perpetrated by some workers. Perpetuation of 52 small genera (many of which contain only one species) within this compact group appears exceedingly unwise to this reviewer and to most other workers as well (see, for example, Alison Kay, *in* Proc. malac. Soc. Lond. 33: 278, 1960). Readers would do well to continue using older generic names such as *Cypraea* for the true cowries and *Trivia*, *Cyphoma*, etc., for related groups and to disregard most of the other genera given in this book. Such a procedure will greatly reduce the difficulty in remembering names and restore the genera to their proper function: that of showing relationship.

Objection must also be raised with respect to Miss Allan's definition and use of subspecies. A true subspecies, by the accepted definition, must be geographically separated from the nominate species and cannot occur "throughout a whole region inhabited by . . . [the nominate] species", as stated on page 11. Also, within a family such as the Cypraeidae where morphology is still the basis of classification, groups below the level of the species must be morphologically distinguishable from the typical form and should not be defined on the basis of locality, the procedure recommended by the author on page 12.

Nevertheless, *Cowry Shells of World Seas* is an exceedingly valuable reference book for the identification of species. The illustrations and discussions are excellent and it will make a worthwhile addition to the library of any shell collector.

A. H. CLARKE, JR.
National Museum of Canada

Aquatic Phycomycetes

By FREDERICK K. SPARROW, JR. 2d rev. ed. Ann Arbor, University of Michigan Press, 1960. 1187 p. $22.50.

This is not a book for popular reading. However, for any naturalist who is interested in aquatic organisms, who has a good microscope available, and who would like to try out the baiting technique for obtaining aquatic fungi, this book could open the door to a fascinating new world. It is a monumental treatise and reference work, comprising a very

complete compilation of what is known of this group of fungi up to the present time. The author has himself made notable contributions in this field.

The bibliography and index alone occupy 83 pages. The treatment is primarily systematic, although the limitation of the subject matter on the basis of habitat precludes a complete taxonomic treatment, since in many of the groups there are closely related species that are not aquatic. In this second edition the work has been enlarged by the addition of the aquatic Saprolegniaceae, Peronosporales, and Entomophthorales. Taxa that have been described since the first edition are included and taxonomic revisions are made, but relatively few new taxa are described in the book. Keys to the orders, families, genera, and species are presented along with descriptions of the species and ninety line drawings illustrating typical species of various groups. A list of substrata with the fungi occurring on them is provided and should prove very helpful in making identifications. For ease in handling, this work might better have been published in two volumes. It is a very important work, indispensable to any well-rounded mycological library.

J. WALTON GROVES

Finches: Songs of Fringillidae of Eastern and Central North America

Recorded by DONALD J. BORRER and WILLIAM W. H. GUNN. Don Mills, Ontario, Federation of Ontario Naturalists, 1960. 2 sides, 12 in., 33⅓ rpm. $5.95. (Sounds of Nature Series, Vol. 6)

This record, the sixth and latest in the popular "Sounds of Nature" series, maintains the high standards set by its companion recordings (see Can. Field Nat. 72: 176). It presents the songs of those species of the bird family Fringillidae (grosbeaks, finches, sparrows, and buntings) regularly found in central and eastern North America.

The songs of 43 species, by 226 different individuals, and totaling some 400 songs are reproduced on the two sides of the record. They were recorded from Hudson Bay to the Gulf of Mexico and from the prairies to the Atlantic coast and include, in addition to the more familiar songs, those of Smith's and Lapland longspurs, Harris's Sparrow, the two crossbills, and the Snow Bunting. A number of song samples are given for most species with varied repertoires.

The songs are conveniently arranged into nine groups that bring together those of greatest similarity, thus affording ready comparison of the sometimes subtle differences. Groups are indicated by visible bands on the record and thus by consulting the alphabetical species index (on the record cover) it is an easy matter to locate and play the song of any one species. Each species is orally identified by Thom Benson.

Anyone genuinely desirous of improving his enjoyment and efficiency in bird field identification should have this and the other records of this superb series. Bird watchers never had it so good!

W. EARL GODFREY

OTHER NEW TITLES

The Trumpeter Swan By WINSTON E. BANKO. U.S. Fish and Wildlife Service, 1960. 214 p. $1.00 (N. Amer. Fauna 63)

Ecology of the Peregrine and Gyrfalcon Populations in Alaska By TOM J. CADE. Berkeley, University of California Press, 1960. 140 p. $2.50 (Univ. Calif. Publ. Zool. 63: 151-290)

An Analysis of Intraspecific Variation in the Kangaroo Rat *Dipodomys merriami* By WILLIAM Z. LIDICKER, JR. Berkeley, University of California Press, 1960. 94 p. $2.00 (Univ. Calif. Publ. Zool. 67: 125-218)

Wildlife Research By THOMAS G. SCOTT. A reprint from "A Century of Biological Research." Urbana, State of Illinois, Natural History Survey Division, 1958. 23 p. Free (Ill. nat. Hist. Surv. Bull. 27:179-201)

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Compiled by JOHN M. GILLETT

An Announcement of the Ottawa Field-Naturalists' Club

At a council meeting of the Ottawa Field-Naturalists' Club held on 15 September 1960, an amendment to Bylaw 9 was approved whereby the fees for 1961 and subsequent years would be as follows: Active Members, $5; Associate Members, $3; Life Members, $150.

Annual Meeting of the Ottawa Field-Naturalists' Club

The annual meeting will be held on Thursday, December 1, 1960, at 8.15 p.m. in the Ottawa Teachers' College, Lisgar Street. Dr. Edward L. Bousfield, retiring president, will give an illustrated talk on his recent trip to Yucatan.

A Note on the Production of this Journal

The Canadian Field-Naturalist conforms to recommendations on the layout of periodicals issued by the International Organization for Standardization. It is set by linotype in Janson. The title is Kennerley. Boldface headings are Bodoni. Coverstock is 'Mayfair' by Howard Smith and text paper is Provincial Paper 'Thriftcoat.' Printing is by The Runge Press Limited, Ottawa, Ontario.

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Manuscripts should be typewritten on one side of nontransparent paper measuring 8½ by 11 inches. Authors are requested to use at least one given name. All text matter, including quotations, footnotes, tables, literature references, and legends for figures should be double-spaced. Only those words meant to appear in italics should be underlined. Every sheet of the manuscript should be numbered.

Webster's New International Dictionary is the authority for spelling. However, in a case of difference in the spelling of a common name, and in the use of a variant name, a decision of a learned society is preferred.

References are made by the author-date system. They should be listed alphabetically and typed at the end of the main body of text. For titles in reference matter, abbreviations follow the rules in the *International Code for the Abbreviation of Titles of Periodicals* and the *World List of Scientific Periodicals*.

Other abbreviations should be used sparingly. The better-known terms of measurement follow CSA Specification Z85-1943 *Abbreviations for Scientific and Engineering Terms* or the equivalent of the American Standards Association (Z10.1-1941).

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