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BIOLOGISTS HAVE A RESPONSIBILITY TO INTERPRET

I AM HAPPY to have this opportunity to address the readers of THE CANADIAN FIELD-NATURALIST.

The natural sciences are enjoying increased attention at the moment. This is evident at the academic level by the increased interest in ecology, which links the various natural sciences through study of the relationships between animals, including man, and their environment.

On the popular level, I am struck by the immense and rapidly growing interest in natural science, as shown by statistics on attendance at interpretative programs, the box-office success of wildlife films, the increasing numbers of outdoor science schools for children, and the popularity of non-technical articles and books on the natural sciences.

Within those Branches of my Department in which you are probably most interested — National and Historic Parks and the Canadian Wildlife Service — we are starting a new enterprise, interpretative centres. The first major nature interpretation centre in any National Park in Canada was opened in 1966 in Point Pelee National Park. As you know, Point Pelee Park faces in intensified form the pressure of over-use which threatens most of our parks and challenges policy makers. The first Wildlife Service interpretative centre will be opened near Midland, Ontario, this year.

We are establishing these centres to teach something of the meaning of our natural resources of land and wildlife, and to explain why we have preserved these parts of our heritage. We hope that interpretation will encourage more sophisticated use of our parks and so help to relieve pressure on them. Also, I believe that interpretation can increase the recreational values and satisfactions of using comparatively small natural areas, and also serve as a gateway to increased appreciation of the whole landscape of Canada. We are short of space in some parks, and a pleasant talk on the ecology of a bog followed by a guided tour, or a canoe trip down a wild river, uses less space and provides a more rewarding experience than a high-speed automobile trip through six National Parks.

Without interpretation, there is very great danger that our parks will be regarded merely as large chunks of real estate in which any type of recreation may be carried on. There is still little public understanding of many vital issues in conservation, the role of predators and the high cost of pollution, for example. Someone has wisely said that conservation education has to be continuous, because we are dealing not with a fixed audience, but with a constant parade of people.

Preservation of our natural resources can be justified by utilitarian considerations, but depends as well on aesthetic, psychological, and ethical factors. This makes us more dependent on public opinion than some other government activities. If we are to channel this immense popular interest in nature toward sensible use of the environment, we need the help of biologists and naturalists to offer their views to politicians, to write letters, to give speeches, to take the time and effort to translate their expertise in words that non-technical audiences can grasp.

Naturalists are a minority — that is all the more reason for them to be an aroused, vocal, and zealous minority. I think it would be in the interests of all of us.

THE HONOURABLE MR. ARTHUR LAING,
MINISTER OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT,
OTTAWA

Mailing date of this number: 17th May 1968

THE NIDULARIACEAE OF CANADA

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Introduction

The small gasteromycetous fungi known as the Nidulariaceae or Bird's Nest Fungi are widely distributed throughout Canada and seem to have invaded almost every ecological niche. Northward they extend at least to the Yukon; to the south they occur even in the dry areas along the United States border in the western provinces; they are common in British Columbia in the west and are abundant in the larger eastern provinces. Distribution records, of course, trace the paths of botanical collectors and do not (at present at least) give a complete picture of distribution.

Although the majority of Nidulariaceae are likely to be found growing in moist woodlands, in pastures or in gardens where compost has been added to the soil, they are by no means confined to such habitats. A few examples only of more unusual habitats are given: in the far north they have been found growing upon old rotted sleigh runners; in the Rocky Mountains they may occur on high alpine scree (Brodie, 1966); in the badlands of southern Alberta (Red Deer Valley) they grow on the tops of buttes and hills, often among cacti and sagebrush.

Botanists who keep their eyes focussed on the ground (as must those who collect fungi) are certain, sooner or later, to come upon Bird's Nest Fungi. When conditions for growth and fruiting are good, carpophores may occur in great quantities and be very conspicuous. It is, however, a very different matter when one goes into the field deliberately to look for Nidulariaceae. The fungus cups are small (from barely visible to ½ inch high), many are greyish or wood-brown in colour, and intensive searching is required to find them. This being so, after over twenty years of searching, I am still astonished that, only rarely, do I return from the field empty handed.

Lloyd (1906) pointed out many years ago, that continental North America is not rich in species of the Nidulariaceae. Even if the southern areas of the United States are included, probably no more than 12 species and varieties of these fungi can be claimed. Europe likewise has very few species.

In contrast to the paucity of species thus far recognized in continental North America, at least twice as many species are known to occur in the nearby Caribbean islands (Brodie and Dennis, 1954).

Notwithstanding the small number of species with which we have to deal in Canada, most mycologists have little acquaintance with the Nidulariaceae and are unaware of the great variation within species. I recently studied the collections of Nidulariaceae now housed at Ottawa (DAOM). Among the latter, species of *Cyathus* were often labelled as *Crucibulum* and even such a fungus as *Polyporus conchifer* (Schw.) Sacc., a part of the fruit body of which is cupulate, was labelled *Crucibulum*.

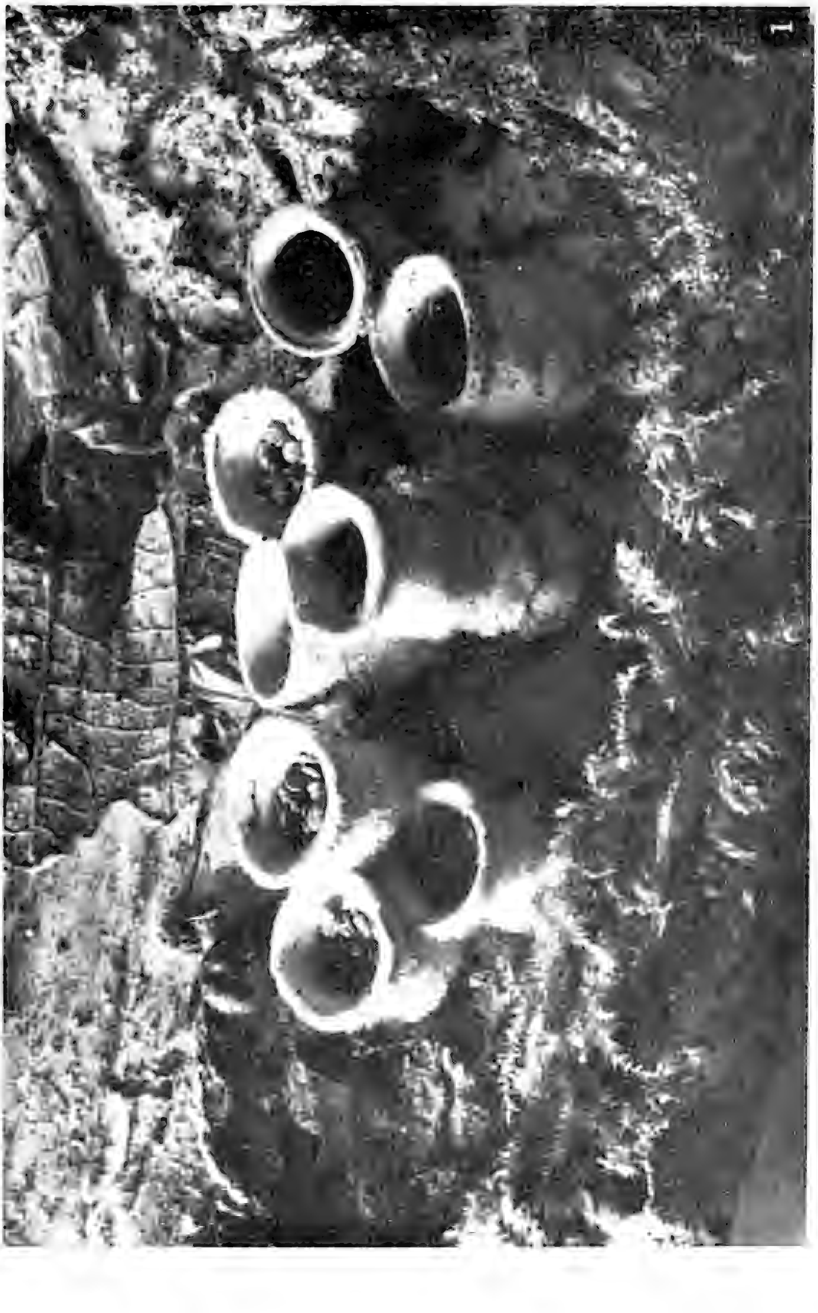


FIG. 1. *Nidula niveo-tomentosa*; note woolly tomentum of outer wall, small wrinkled peridioles and lack of funiculi. Living material ($\times$ 3.3).

Matters are no better in at least some large herbaria of the United States where I have seen such names as *Cyathus colensoi* Berk. a readily recognized Australian species, applied to forms of *C. olla* (Batsch) ex Pers. The extremely variable and ubiquitous *C. stercoreus* (Schwein.) De Toni appears under a great number of names.

Taxonomic work on the Nidulariaceae of North America has been published by White (1902), Lloyd (1906), Coker and Couch (1928) and Smith (1951). Most of the latter treatments, however, have taken little account of the species and forms of Canada. It seems appropriate to list and describe those species of the Nidulariaceae now known to occur in Canada and to offer a few notes regarding their distribution and especially their variation.

Many persons other than professional mycologists have expressed keen interest in the Nidulariaceae and amateur naturalists have been responsible for a number of large and valuable collections in my own herbarium. With the interests of amateurs in mind, every effort has been made to characterize the fungi by macroscopic features and by what can be observed using a 10X hand lens. With the aid of the photographs and referring to the chief macroscopic characteristics as given, it is possible to identify readily each fungus listed. One difficulty might arise regarding the separation of *Nidularia* from *Mycocalia;* here, although thickness of peridiole wall and colour are used in the key, the most reliable distinction does require the use of a microscope. Stiff spiny branched hyphae are present in *Nidularia* but absent in *Mycocalia*. Also, as is mentioned in the notes on *Cyathus stercoreus,* old weathered specimens of that fungus can be misidentified by the inexperienced unless spore size is determined microscopically.

TERMS AND MORPHOLOGY

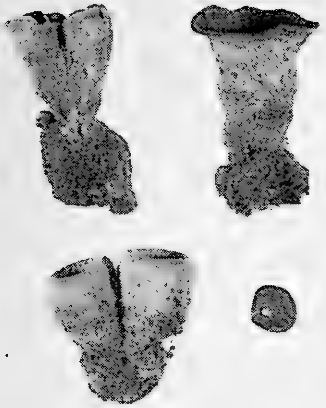
Much has been written concerning the structure of the carpophore. It is not necessary to review this literature in the present context. The reader may be referred to the monographic study by Tulasne (1844), to certain studies of my own (Brodie, 1948-1967), and to the taxonomic works listed in a previous paragraph.

Definitions of the terms used in the keys and elsewhere in this paper are however included for convenience and because some of the publications mentioned are no longer readily available.

Peridium.—Name applied to the carpophore or fruit body which may be globose, cup-shaped or vase-shaped. Fruit bodies of *Mycocalia* may be no wider than a coarse grain of sugar; those of some species of *Cyathus* may be ½ inch in width.

Tomentum.—Outer coat of hyphae (hairs) of peridium. The tomentum may consist of fine uniform hairs (Fig. 2). The hairs may also be aggregated into downward-pointing tufts (Fig. 6) or into tight globose curls.

Plication (or striation).—Both outer and inner surfaces of the peridium may be fluted or ribbed (Fig. 6, right). The ribs may be widely spaced or



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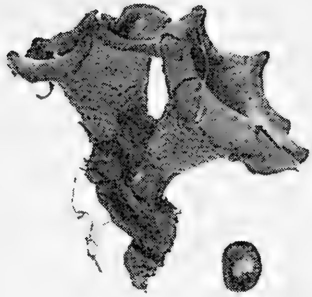

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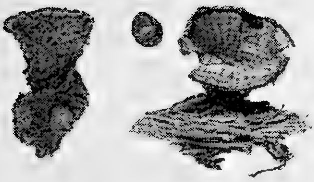

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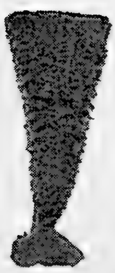

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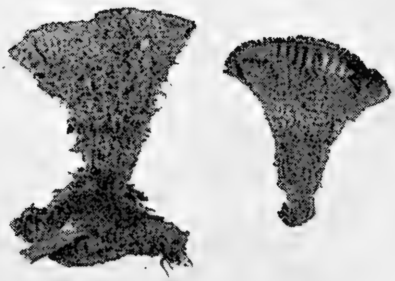

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FIG. 2. *Cyathus olla,* the form of commonest occurrence in Canada; note fine-textured tomentum and large irregular peridiole. FIG. 3. *Cyathus olla* forma *anglicus;* note very large cups with wavy mouth. FIG. 4. *Cyathus striatus,* a small common form; note internal striations or folds and woolly exterior. FIG. 5. *Cyathus striatus,* a tall dark form usually found in moist woods. FIG. 6. *Cyathus striatus,* very broad form common in the central provinces.

narrowly and they may be conspicuous or be absent (Fig. 3). In this connection, the term "smooth" has been used extensively to refer to the inner surface of the peridium. It does not mean smooth in an absolute sense but rather "not plicate or striate" (Fig. 3).

Setae.—Stiff (usually dark) hyphae surrounding the lip or mouth of the peridium (Fig. 6).

Epiphragm.—Thin membrane covering the mouth of the young peridium. Commonly the epiphragm consists of two layers, the inner a delicate and uniform web of hyphae, the outermost consisting of tufts of hyphae which become separated as the epiphragm expands. Rupture of the epiphragm ultimately exposes the contents of the peridium. The epiphragm is absent in some species, evanescent in others and persistent in still others.

Basal Emplacement.—A ball or mass of hyphae from which the peridium arises. It may be conspicuous and as wide as the peridium mouth (Fig. 13), or may be very small and inconspicuous.

Peridiole.—This is the lenticular capsule within which basidiospores are developed (Figs. 2-4). It may or may not be bounded by a *tunica*, usually a thin white or pale membrane composed of loosely interwoven hyphae. Within the tunica (or constituting the outer boundary in types lacking a tunica) is a *cortex*, a dark hard tissue made up of one layer or more of thick-walled densely-packed hyphae.

Tunica and cortex are both features of taxonomic value. They can best be studied in free-hand sections of whole peridioles that have been soaked in water for at least twelve hours.

Funiculus.—A stalk or cord attaching the peridiole to the inner wall of the peridium. There is no funiculus in *Mycocalia*, *Nidularia* and *Nidula* (Figs. 1, 10). In *Crucibulum*, the funiculus consists of a slender cord attached to small globose protuberance (Fig. 8) on the under side of the peridiole. The funiculus of *Cyathus*, under the hand lens, shows three component parts (Brodie, 1956).

Funicular Cord.—A long strand of elastic hyphae which is folded or coiled within the outer covering of the funiculus stalk.

A key to genera is given, followed by descriptions and notes about the species. The latter appear in order of their widest and most frequent distribution, regardless of taxonomic position.

KEY TO GENERA

1. Peridia (fruit bodies) containing peridioles which lack funiculi; peridioles, when moist, surrounded by mucilaginous material, adhesive

2. Peridia globose, epiphragm absent
   3. Peridia ¼ to ½ inch in diameter, wall of peridium thick, yellowish to brown; wall composed partly of stiff, branched, spiny aseptate hyphae *Nidularia*
   3. Peridia very small, about 1/16 inch in diameter, wall of peridium thin, white to pale buff; wall composed only of hyaline, branched hyphae bearing clamp-connections *Mycocalia*
2. Peridia cup-shaped, opening by means of an epiphragm *Nidula*

1. Peridia containing peridioles which are attached to inner wall of fruit body by funiculi
   4. Peridium wall composed of a single layer, massive; funiculus consisting of a simple cord attached to a conspicuous globose protuberance on the under side of the peridiole; tunica light coloured, thick *Crucibulum*
   4. Peridium wall composed of three layers; peridium usually vase-shaped, flaring; funiculus variable, resembling microscopic mushroom stem as seen under hand lens; when moist and pulled out, consisting of a long elastic cord *Cyathus*

NOTES ON SPECIES AND DISTRIBUTION

For brevity, complete descriptions of the species are not included in this article. Descriptions and illustrations are to be found in the taxonomic works mentioned previously. Distribution is given by province or province-area except where such designations are not appropriate.

The following abbreviations are employed herein: Nfld. (Newfoundland); N.S. (Nova Scotia); P.E.I. (Prince Edward Island); N.B. (New Brunswick); L. (Labrador); Q. (Quebec); O. (Ontario); M. (Manitoba); S. (Saskatchewan); A. (Alberta); B.C. (British Columbia); Y. (Yukon); N.W.T. (North West Territories).

Fig. 1 was made from living specimens. All other illustrations represent dry herbarium material because the assumption was made that most determinations would be undertaken using dry material. Some idea of the difference in appearance between living and dry specimens may be gained by comparing Fig. 1 with Fig. 10, both representing the same species.

1. *Cyathus olla* (Batsch) ex Pers. (Fig. 2)

This fungus might well be called the "Prairie Garden *Cyathus*," for it makes its appearance most commonly on the black prairie soils and in garden plots where it fruits upon old boards or upon dead stems of perennial plants *C. olla* is not a plant usually found in woodlands or in remote areas. It seems to be commoner in western Canada and United States than in the east and its range extends southward on the west coast at least as far as Perú. In Europe it is likewise commonly a "garden" fungus.

A great variety of forms of this fungus exist, the variation involving mainly size of the peridia and the degree of "sulcation" or crenulation of the peridia. In earlier publications, I have noted (Brodie, 1952 and 1967) the occurrence of the so-called forma *anglicus* in Oregon and in Alberta (Fig. 3).

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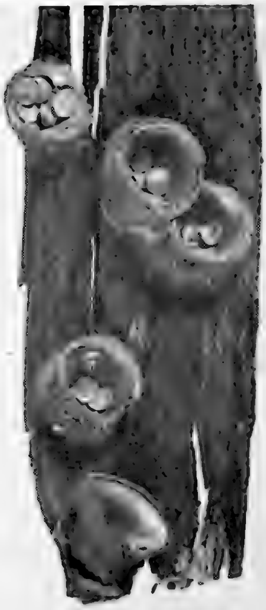

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FIG. 7. *Crucibulum laeve*, small pale thin-walled form found in dry areas and far north. FIG. 8. *Crucibulum laeve*, large, yellow, thick-walled form; note button-like attachment of funicular cord in second lowest specimen. FIG. 9. *Cyathus stercoreus* showing commonest forms; note dark shiny peridioles and the shaggy appearance of young specimens.

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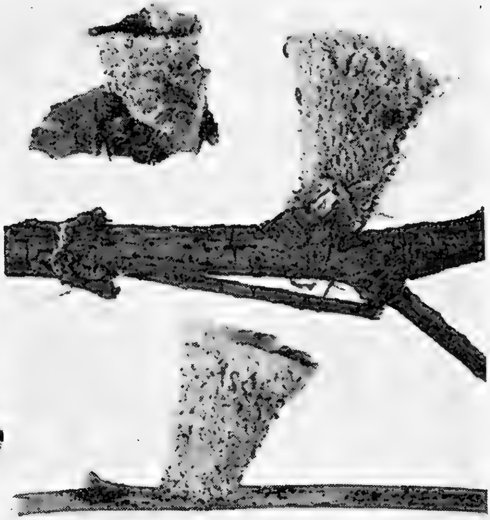

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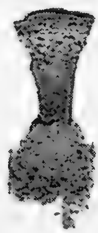

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FIG. 10. *Nidula niveo-tomentosa;* older specimens than those shown in Fig. 1; note that exterior may become smooth in age. FIG. 11. *Nidula candida;* note woolliness of cups and large peridioles as compared with Fig. 10. FIG. 12. *Nidularia pulvinata;* globose peridia breaking open irregularly and small peridioles. FIG. 13. *Cyathus helenae;* note small cup (*c.f.* Figs. 5, 6) and tufted tomentum in upper half.

Chief Macroscopic Characteristics: grey or grey-brown colour, bell shape and wide-flaring mouth, fine tomentum (not shaggy), smooth shiny interior, large peridioles.

Known Distribution: N.S., Q., O., M., S., A. Probably occurs in all provinces.

2. *Cyathus striatus* (Huds.) ex Pers. (Figs. 4-6)

This elegant fungus is probably the second most commonly encountered Bird's Nest Fungus in Canada. Moreover, it is the *most readily* identified by amateur as well as professional mycologists because of the conspicuous vertical fluting or plication of the peridia. Unlike *C. olla*, *C. striatus* is typically a 'wild' or woodland species, although it may occasionally be found in gardens and cultivated areas. Typically, it fruits upon rotting twigs and leaves in moist wooded areas.

C. striatus exists in many forms which intergrade to such an extent that name distinction is not practicable. In eastern Canada (and the U.S.A.) a rather small pale form is prevalent (Fig. 4). In the moist conifer forests of Alberta and British Columbia, a very tall dark-coloured form is prevalent (Fig. 5) which is similar to the prevalent form of Europe (Lloyd, 1906). In the prairie provinces of Canada and the central states of the United States, *C. striatus* occurs frequently as a large pale-coloured form (Fig. 6).

The recently described *C. helenae* Brodie (Fig. 13) is clearly closely related to *C. striatus;* the montane and boreal distribution of *C. helenae*, however, seems to separate it sharply from *C. striatus* — as do several distinctive morphological features (Brodie, 1966).

Chief Macroscopic Characteristics: colour fawn to dark brown; cups hairy, setose, narrow at base, flaring in upper third, strongly plicate externally and internally.

Known Distribution: N.B., Q., O., M., S., A., B.C.

3. *Crucibulum laeve* (Bull. ex DC.) Kambly (Figs. 7, 8).

This ubiquitous fungus should be known to and be studied by all ecologists and plant geographers, for it is of world-wide distribution in northern latitudes, but has never been found in the tropics. Most mycologists (and I concur) regard *Crucibulum* as a monotypic genus. No other member of the Nidulariaceae has such stout thick-walled peridia that enclose pale (at times almost white) peridioles provided with funicular cords of a type not found elsewhere among the Nidulariaceae (Brodie, 1956). Yet, *C. laeve* is so variable that at least a dozen species could be recognized by 'splitters,' especially if they had not seen that every conceivable intermediate exists between the pale "depauperate" forms of the far north (Fig. 7) and the deep yellow large forms of the mid south and east (Fig. 8).

One suspects that this is a geologically old fungus, partly because of its circumpolar distribution, and partly because of its apparent adaptability as to substratum: in my own collection there are specimens of *C. laeve* that fruited upon very old sleigh runners (in the Yukon), sawdust sidewalks (in the mid-west), upon the decaying shells of a variety of nuts, and upon boards of all sorts in gardens and other moist sites.

Chief Macroscopic Characteristics: cups low, broad, bowl-like; colour pale grey to deep buff or yellow; tomentum fine, not hairy; peridioles white or pale buff, attached to peridium wall by long funicular cord, the latter arising from small globose protuberance on lower surface of peridiole.

Known Distribution: Q., O., M., S., A., B.C., Y. I have seen no specimens from the Maritimes but, I do not doubt that it occurs there.

4. *Cyathus stercoreus* (Schw.) De Toni (Fig. 9)

It is difficult to understand why this Bird's Nest Fungus (Fig. 9) has been misidentified so frequently. True, the gross external features of the species are *extremely* variable, more so than for any other member of the Nidulariaceae known to me (Brodie, 1948); yet *no* other fungus of this group in our area has such large spores. North of central United States, no other *Cyathus* has basidiospores that measure close to 30 μ in diameter. One can only conclude that the very common misidentifications resulted from failure to examine spores.

C. stercoreus is a coprophilous species: in Canada and the United States it grows and fruits mainly upon cow dung and horse dung. It is also found commonly in gardens, especially where these have been enriched with the excrement of mammals.

Chief Macroscopic Characteristics: cups woolly (old specimens may be smooth), not plicate, internally dark, shiny; peridioles *black, shiny;* shape and size variable.

Known Distribution: Q., O., M., S., A.

5. *Nidula niveo-tomentosa* (Henn.) Lloyd (Figs. 1, 10)

In Canada and the United States, the genus *Nidula* is confined to the mountains of the west coast and the adjacent lands. Both species found in these areas also grow at sea level, but they are apparently more abundant in moist mountain regions at an altitude of about 5,000 ft.

Nidula is clearly distinguished from other cupulate members of the family by the lack of funiculus and the adhesive character of moist peridioles. Two species occur in Canada, known thus far only from British Columbia; however, their occurrence in adjacent areas of Alberta may be expected. Both species frequently occur together; although the two are readily distinguished (Brodie, 1951b), many collectors have confused them.

N. niveo-tomentosa is a small fungus, pale-cream or buff when young and usually becoming white in age. It fruits upon dead wood or dead fern rachis.

Chief Macroscopic Characteristics: cups broad, short, usually with wide-flaring mouth, pale buff-grey or whitish; inside brown, shiny; the flared mouth becoming almost snow white in age (Fig. 10); tomentum fine, weathering to smooth; peridioles small (1 mm.) reddish-brown, not attached by funiculi.

Known Distribution: B.C. only; to be expected in Alberta.

6. *Nidula candida* (Peck) White (Fig. 11)

This species is larger and darker in colour than the former.

Chief Macroscopic Characteristics: cup broad with rather straight sides, outer surface hairy, grey to light buff; mouth reflexed, becoming whitish; peridioles about 2 mm., light brown.

Known Distribution: B.C. only; to be expected in Alberta.

7. *Nidularia pulvinata* (Schw.) Fr. (Fig. 12)

This fungus occurs upon rotted wood, often among mosses. It has also occasionally been found on driftwood.

Chief Macroscopic Characteristics: peridium externally cinnamon brown to golden brown, flocculent when fresh, pale and smooth in age; peridium globose, breaking open to disclose numerous small brown peridioles which are mucilaginous when moist.

I have collected this species myself only on the Manitoba-Ontario boundary although I have collections from elsewhere in North America and from Europe. There is much variation in size and colour but it is not possible at present to decide whether or not Canadian material represents only one variable species, or several species.

Known Distribution: Q., O., M., B.C. (apparently not known from the central provinces).

8. *Cyathus helenae* Brodie (Fig. 13)

Although this recently-described species (Brodie, 1966) could be mistaken for a small form of *C. striatus*, it is distinctive in several important characters as well as in its unusual habitat.

Chief Macroscopic Characteristics: peridium small (7 mm. high or less), thick-textured, flaring out sharply in the upper third, pale brown to grey and covered externally with a nodular or tufted tomentum; inside of cup only faintly striate; basal emplacement at least as wide as mouth of cup.

Known Distribution: A. (Mountain Park, Jasper, Drumheller); M. (Gillam).

9. *Cyathus olla* (Batsch) ex Pers. forma *anglicus* Lloyd (Fig. 3)

Because this plant is so large and of such unusual shape, it is dealt with as a separate entity although I consider it a form and not a species (Brodie, 1952 and 1967).

The large wide-flaring irregular cups are well represented in Fig. 3.

Chief Macroscopic Characteristics: peridia grey to brownish, very wide (up to 14 mm.), wide-flaring and with irregular or sulcate mouth; peridioles large, usually of irregular outline.

Known Distribution: A. (Edmonton).

10. *Mycocalia denudata* (Fr.) J. T. Palmer

I have seen several collections of this very small fungus but I am aware of only two Canadian collections, both made by Dr. R. J. Bandoni in British

Columbia. The latter specimens grew on partly rotted alder wood. In Europe and elsewhere the fungus fruits on other substrates including birch and stems of rush.

Formerly this species was included in *Nidularia* but was transferred to a new genus *Mycocalia* by Palmer (1961). It is probably not rare but is likely to be overlooked because of its small size.

Because the fungus is minute, a detailed description is given based chiefly on the work of Palmer (1961, 1963).

The fruit bodies are irregularly globose, often confluent and *small* (up to 1.5 mm.). The outer surface is *white* or pale yellowish, smooth and thin; it may break up when fruit bodies are young and scarcely any bits may remain. The ochre-yellow peridioles are minute (of the order of 200-400μ in diameter) and gelatinous when moist. Basidiospores are ovate, about 7-10 x 5-7μ and may be intermingled with 'metamorphosed basidia,' (Palmer, 1963).

Known Distribution: B.C. (near Brackendale, along Squamish River.

SUMMARY

Nine species and one named variety of the fungus family Nidulariaceae are known to occur in Canada, some of these having been found in almost all areas visited by botanists. The four largest species *Cyathus olla*, *C. striatus*, *C. stercoreus* and *Crucibulum laeve* are wide-spread. The two species of *Nidula* are known at present only from British Columbia. *Nidularia* appears not to have been found in the Prairie Provinces. *Mycocalia* is known only from British Columbia but may have been overlooked because of its small size. *Cyathus helenae* appears to be a montane and boreal species. *C. olla* forma *anglicus* is a very large form, recognized so far only from Alberta.

The photographs, descriptions of species and a key to genera should enable amateur naturalists to identify the Canadian species.

ACKOWLEDGMENT

The present work was carried out in part during my tenure of a Senior Research Fellowship awarded by the National Research Council of Canada. I am grateful for this support. I wish also to express thanks to the Editors of Mycologia for granting permission to reproduce Fig. 1, originally published in Mycologia *43*: p. 334, 1951.

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NOTES ON FOOD AND FEEDING HABITS OF SOME WINTERING BIRDS

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FOOD AND FEEDING HABITS of seven bird species, the Hairy Woodpecker (*Dendrocopos villosus*), Downy Woodpecker (*Dendrocopos pubescens*), Gray Jay (*Perisoreus canadensis*), Blue Jay (*Cyanocitta cristata*), Black-billed Magpie (*Pica pica*), Common Raven (*Corvus corax*), and Black-capped Chickadee (*Parus atricapillus*), were observed in the Athabasca – Calling Lake area of Alberta during the winters of 1945 to 1949 inclusive. Observations were recorded from feeding stations, bush and farm roads, garbage dumps, logging camps, offal from butchered animals, and fish guts left from commercial fishing operations on frozen lakes.

Foods listed for each species are those supplied either directly or indirectly by man and his activities. Foods are listed in order of preference. These preferences were ascertained from observations at a feeding station where all listed foods were readily available. Methods of finding, handling, and storage of food were recorded.

Little is known regarding the effects of settlement on the seven bird species dealt with here. Gray Jays, a boreal species, seem to have decreased while Blue Jays have definitely increased. Blue Jays were absent from the area before settlement, and are still scarce in the more undeveloped northern part. Magpies are also said to be recent arrivals and like the Blue Jay are more abundant in the settled parts. Ravens decreased markedly during the frontier stage of settlement but now appear to be increasing.

The Athabasca – Calling Lake area of central Alberta is in the Boreal Forest, but fifty years of white-man's settlement have profoundly altered the character of the vegetation. Much land is now under cultivation. Only remnants of the original white spruce, aspen, jackpine forest remain. Predominant cover on uncultivated land is now second growth deciduous forest.

Winters are severe. Mean temperature November to March is 10.9 degrees fahrenheit. Extremes of 70 degrees F. and -61 degrees F. have been recorded. Ground is usually snow covered from early November to April.

Hairy Woodpeckers and Downy Woodpeckers ate fat, lean meat, rolled oats, and oats. Woodpeckers readily found food placed in closed wooden boxes. These boxes were always attacked at the bottom seam until a large hole was made. When holes, to allow entry of small birds, were made in sides and tops of boxes above the food level the woodpeckers, instead of using the available entrances, made holes near the bottoms of the containers. Woodpeckers were commonly seen feeding on frozen meat adhering to bones at garbage dumps and on the remains of butchered animals. They frequently chipped holes in granaries and outbuildings in order to get to frozen meat or oats stored within. Unshelled oats were eaten when fat and meat were not available. Oats were picked up singly and pressed, basal end first, into cracks in fence posts. The hull was then peeled back in much the same way a child skins a banana, and the "meat" eaten.

Gray Jays ate fat, meat, bread, and rolled oats. This species is said to eat most foods but my observations show that they definitely prefer animal food over vegetable. Bread and rolled oats were seldom touched when animal food was in good supply for a long period of time. Oats, corn, wheat, and sunflower seeds were never eaten.

The Gray Jay's weak bill is of little use in breaking off usable chunks of meat from frozen carcases in sub-zero weather but killed animals are important sources of food in milder weather. It is a common scavenger at bush camps.

The habit of storing food is well developed in the Gray Jay (Bent 1946). My observations seemed to show that this habit was strongest in autumn and winter; noticeably less so in spring. A definite slackening in the storage of food was noticed when it was abundant for some time.

The Gray Jay usually picks up small pieces of food or pecks off bits from larger chunks. These bits are mixed with saliva to form a bolus in the throat (Dow 1965). The bolus is then carried away and hidden for future use. Sometimes, however, larger pieces are picked up and stored without being so processed. Food was usually stuck in the rough bark of coniferous trees and thick spruce boughs well above the snow, but sometimes it was pushed under leaves in snow-free places and even into snow. Food was stored in places progressively closer to the source when supplies were ample for some time.

The carrying of food in the feet by Gray Jays, although seldom recorded (Allen 1965), is certainly of regular occurrence. The load is first picked up in the bill and transferred to the feet while the bird is in flight. Unless the observer saw the action at take-off it would be assumed that the bird lifted the load directly from the ground with its feet. If the load is heavy the bird "climbs" a tree by taking short upward flights from branch to branch while holding the food in the bill. Again the food is transferred to the feet when the bird launches itself from the top.

Carrying heavy pieces of food in the feet allows the jay to fly farther and more efficiently. Those that attempted to carry it in the bill across open areas usually "crashed" soon after setting forth and the food was lost in the loose snow. Landing with a load in the feet presented difficulties too and not infrequently it was knocked into the snow when the bird attempted to alight on a bare branch. Landing in dense spruce boughs seemed to be the preferred method.

Blue Jays ate sunflower seeds, nuts, wheat, suet, rolled oats, oats, and bread. This species, unlike the Gray Jay, prefers vegetable food. Frozen animal remains were seldom visited. They seem to depend for winter sustenance mainly on waste wheat and oats picked up on roadsides and at feed lots. They entered granaries wherever possible. Oats were a staple diet at the feeding station. Individual kernels were held between the feet against a twig. The kernel was then "hammered" until the husk was removed.

Surplus food was carried away in the throat. Blue Jays were never seen carrying food in the feet. They frequently pirated Gray Jays which were carrying food.

Black-billed Magpie: Animal food appeared to be preferred by this species but because of shyness it seldom visited the feeding station when the observer was present. They were often seen at cattle feeding lots where they appeared to be feeding on partly digested grain in manure. Remains of large animals and garbage dumps attracked numbers of magpies. Offal from freshly killed animals was quickly broken up and carried away particularly if the weather was mild enough to allow meat to remain soft. If magpies were kept away from offal or the feeding station by the presence of the observer they sallied out from a safe distance and successfully pirated the more confiding Gray Jays and Blue Jays when they were flying over open places.

Common Raven: This species was seldom seen in settled areas but was fairly common in wilder places and around lakes. An important source of food was guts of white fish, *Coregonus clupeaformis*, and whole "coarse" species such as sucker, *Catostomus* spp., and burbot, *Lota lota*, discarded by commercial fishermen. Most of this food was carried in the bill from the lake to the forest where it was cached to be eaten at leisure. Once a fisherman who shot at a raven flying overhead was nearly struck by a large lump of frozen fish guts which the bird dropped. Fishermen sometimes left their catch covered with snow on the ice. Fish piled in this manner did not freeze but remained "fresh" for several days. Ravens were observed to dig through two feet of packed snow with their powerful bills to get to the fish.

Geophysical crews offered another source of food. Ravens quickly learned that remains of lunches could be found on bush roads used by these crews.

Black-capped Chickadees ate sunflower seeds, fat, meat, rolled oats, oats, and bread. Sunflower seeds and oats were shelled by hammering and tearing off the husks in much the same manner as that of the Blue Jay. Chickadees visited cattle feeding lots and granaries for oats. Oats in horse manure on roads and farm yards were eaten. Food was seldom eaten on the ground but was usually carried to a tree branch where it could be torn into edible portions. Frozen meat hanging in outbuildings was frequently utilized.

Chickadees stored food when a new supply was made available. Storage was under bark and in cracks in dead trees or fence posts and always within a few yards of the supply. Sunflower seeds and oats were always shelled before storage. Storage stopped when food supplies were constant.

Although chickadees fed throughout the day they were most active in the early morning and late evening. In the evening they continued feeding until the degree of darkness was such that a bird leaving its perch was lost to view immediately. These feeding times might have been necessary because of the long winter nights and a small bird's energy requirements, or because the Gray Jays and Blue Jays that frequently harassed chickadees never fed at these times.

Several wintering bird species of the boreal forest have adapted their feeding habits to take advantage of food supplied by man. Food is more abundant now for some species and these new food sources may be important in the survival of these species. Food storage is an important survival habit with some boreal birds.

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NEW ALBERTA RECORDS OF THE SILVERY AND BRASSY MINNOWS, STONECAT AND SAUGER, WITH A PRELIMINARY LIST OF FISHES OF THE MILK RIVER IN ALBERTA

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THE MILK RIVER of southeastern Alberta is of particular zoogeographic interest as it is the only tributary of the Missouri drainage in the province. The author is studying the fish fauna of the Milk River in Alberta as part of his M.Sc. research under the supervision of Dr. D. A. Smith, Carleton University. Financial support for this project has been provided by the National Museum of Canada and the National Research Council and the specimens collected are housed in the National Museum of Canada. The author is grateful to Dr. D. E. McAllister, Curator of Fishes at this institution for his assistance during the preparation of this paper and to the Carleton University Museum of Zoology for the use of laboratory facilities and the excellent collection of freshwater fishes housed there.

Between May and August, 1966 the author made 135 collections containing over 10,000 specimens of fishes of 19 species in 10 families. The 19 species found in the Milk River system of Alberta are listed herein as Appendix 1.

The most noteworthy specimens obtained were three specimens of the silvery minnow, *Hybognathus nuchalis nuchalis* Agassiz. The first, NMC66-338 was collected 17 miles east and 3 miles south of the town of Milk River (S.8,Tp.2,R.13) on June 14, 1966. Two more, NMC66-431, were collected on September 4, 1966 from a location 8 miles north and 1 mile west of Aden, Alberta (S.20,Tp.2,R.10). Aside from a doubtful record for the Red River, Manitoba by Hubbs and Lagler (1958), this subspecies has apparently not been recorded previously from Canada. These records raise the known number of native fishes in Alberta to 40, based on the previous figure of 39 given by McAllister (1962).

The measurements of the three specimens are as follows: total length — 112.1 mm, 105.1 mm, 106.2 mm; standard length — 89.4 mm, 83.6 mm, 84.2 mm; preserved weight — 12.2 gms, 9.3 gms, 10.6 gms; eye diameter — 4.3 mm, 4.3 mm, 4.1 mm. They possess the following characters: preserved colour yellow-orange ventral to the lateral line and yellow-brown above, NMC66-431 specimens much more silvery than NMC66-338; dark middorsal and midlateral stripes, the latter diminishing somewhat in width and contrast anteriorly; dorsal origin only slightly anterior to pelvic base; mouth inferior and short, not reaching the eye which it closely approximates in length; dorsal rays 10; anal rays 8; 8 to 12 distinct scale radii; 13 scale rows across belly including the lateral line rows; 36 to 41 lateral line scales.

Because of the similarity of the silvery minnow to the plains minnow, *Hybognathus placitus* Girard, the difference between these species in the

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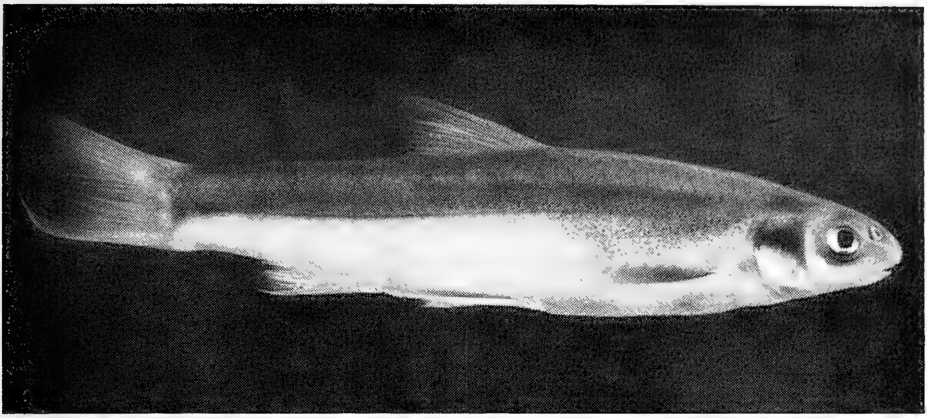

FIGURE 1. An Alberta Milk River specimen of the silvery minnow, *Hybognathus nuchalis nuchalis* (NMC66-338), 112.1 mm total length.

configuration of the posterior process of the basioccipital was utilized to positively identify the specimens. Bailey and Allum (1962) describe the process in *H. placitus* as "relatively slender and bladelike, without developed lateral expansions posteriorly" and in *H. nuchalis* "the process is expanded posteriorly and the posterior margin is either truncate (shovel-shaped) or emarginate". In the Milk River specimens this process is markedly expanded and the retractor muscles originating from the ventrally deflected lateral angles are well separated from one another.

H. nuchalis is easily distinguished from the other member of this genus in the Milk River drainage, the brassy minnow, *H. hankinsoni*, because of the smaller body size and the greater number of scale radii possessed by the latter. Close examination of the scales shows the circuli to be much more sharply angulate at the basal corner of the scale in *H. nuchalis* than in *H. hankinsoni*.

The presence of additional specimens of the silvery minnow in uncatalogued collections made during July, 1967, would indicate that this species is an established resident of Canadian waters. Trautman (1957) suggests that the ideal habitat of this species is one of quiet waters rich in phytoplankton and that spawning occurs only where the rate of siltation of the bottom is low. The loss of the silvery minnow from extensive areas in the U.S. is attributed to increased turbidity of the waters and the disappearance of aquatic vegetation and organic debris because of heavy silt deposition. Prior to 1900 the silvery minnow may have been well established in the upper reaches of the Milk River. However the greatly increased turbidity which accompanied the channelling of large quantities of irrigation water into the Milk River in the early 1900's to supply north-central Montana in all probability caused a rapid decline in the population numbers of this and other typically Missouri species over their Alberta range. Recovery of the stream channel and its vegetation from the original scouring has permitted repopulation by the species well into Canadian territory. However, the short grass prairie habitat through which

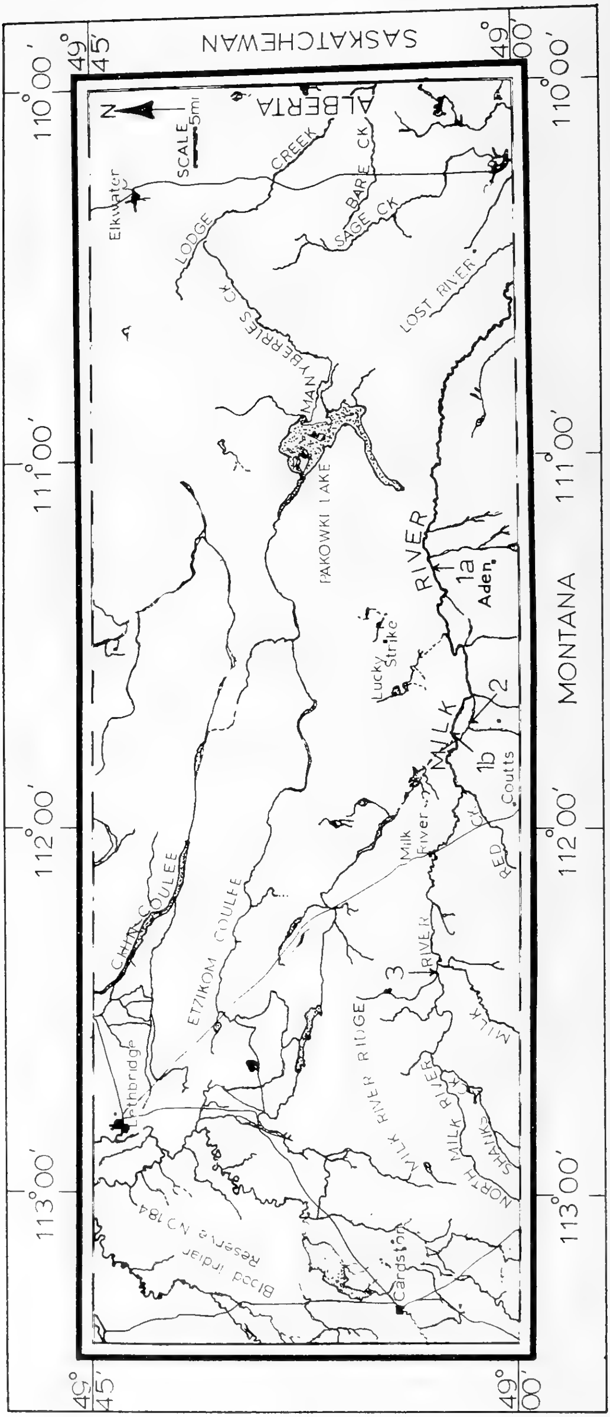

FIGURE 2. Map of Milk River drainage in Alberta showing sites of collections of the silvery minnow (1a: NMC66-431, 1b: NMC66-338) and the most westerly collection of the brassy minnow (2: NMC66-426) and the stonecat (3: NMC66-369).

FIGURE 3. Milk River Valley. Above: near the town of Milk River, West Butte of the Sweetgrass Hills in background. Below: near the river's entrance into Montana. Badlands illustrate the extreme susceptibility of the area to erosion.

the Milk River flows is one which is subject to extreme and continuous erosion. Any increase in the already high rate of silt deposition, whether it be due to rechannelling of the river by man or by erosion on overgrazed areas could very easily reduce this subspecies to extinction in Canadian waters.

Following the addition of the brassy minnow, *Hybognathus hankinsoni* (McAllister, 1962), the sauger, *Stizostedion canadense*, (Paetz, 1958, McAllister, 1962) and the stonecat, *Noturus flavus*, (Nursall and Lewin, 1964) to the list of Alberta fishes, further distributional records of these species are of interest in establishing their present status in the province.

Hybognathus hankinsoni Hubbs: NMC catalogue numbers NMC66-386, -426, -430. This species is found in isolated pockets in several of the numerous small tributaries flowing into the Milk River from both the north and the south. However it appears to be more common in soft-bottomed pools in the clear mountain-type streams flowing out of the three disjunct buttes of the Sweetgrass Hills located in Montana just south of the 49th parallel. A total of 13 specimens was collected, the eight bearing catalogue number NMC-66-426 being the most westerly. These were obtained from Black Coulee, 23 miles east and 4.5 miles north of Coutts, Alberta (S.31,Tp1,R.11), a location 54 miles west and 27 miles south of the location given by McAllister.

Stizostedion canadense (Smith): NMC catalogue numbers NMC66-330, -345, -354, -356, -359, -360, -396, -397, -403, -431. A total of 11 specimens were collected, all but three by means of baited set lines. The difficulty of distinguishing this species from the walleye, *S. vitreum*, has led to much confusion over the occurrence of the sauger in southern Alberta. However for local fishermen, the sauger (whether it be referred to as a walleye or as a pickerel) has long been recognized as the leading sport fish of the area. It is a common resident of rock-frequented pools in the Milk River throughout its entire length in Alberta. Collections of young saugers from tributaries near their junction with the Milk River near the rivers exit from the province and the absence of young saugers from similar tributaries farther west would indicate that the more eastern tributaries are the major spawning grounds for this species in the area.

Noturus flavus Rafinesque: NMC catalogue numbers NMC66-299, -302, -304, -323, -324, -325, -329, -336, -342, -344, -355, -356, -360, -362, -369, -395, -398, -401, -403, -415. Twenty-seven specimens were collected in all, the most westerly location (NMC66-369) being 13 miles west and 1 mile south of the town of Milk River, S.20,Tp.2,R.18, a station 96 miles west of the previous record (Lewin 1964). The total length of the single specimen obtained at this station was 55 mm. Only in the past few years have local fishermen added this small, easily caught catfish to their catches, an indication of the recent and highly successful invasion of the area by this species. As with the silvery minnow, the stonecat probably occupied the river prior to the introduction of irrigation water into the Milk River but has only become re-established in the turbid waters following the recovery of the aquatic vegetation and the associated bottom fauna.

Appendix 1. A preliminary list of fishes found in the Milk River drainage of Alberta, based on 135 collections made during the summer of 1966.

1. Salmonidae
   Salmo gairdnerii Richardson — rainbow trout
2. Coregonidae
   Prosopium williamsonii (Girard) — mountain whitefish
3. Esocidae
   Esox lucius Linnaeus — northern pike
4. Catostomidae
   Catostomus platyrhynchus (Cope) — mountain sucker
   Catostomus commersonii (Lacepede) — white sucker
   Catostomus catostomus (Forster) — longnose sucker
5. Cyprinidae
   Chrosomus eos Cope — northern redbelly dace
   Couesius plumbeus (Agassiz) — lake chub
   Platygobio gracilis (Richardson) — flathead chub
   Rhinichthys cataractae (Valenciennes) — longnose dace
   Hybognathus hankinsoni Hubbs — brassy minnow
   Hybognathus nuchalis Agassiz — silvery minnow
   Pimephales promelas Rafinesque — fathead minnow
6. Ictaluridae
   Noturus flavus Rafinesque — stonecat
7. Gadidae
   Lota lota (Linnaeus) — burbot
8. Percidae
   Stizostedion canadense (Smith) — sauger
   Etheostoma exile (Girard) — Iowa darter
9. Cottidae
   Cottus sp. — sculpin
10. Gasterosteidae
    Culaea inconstans (Kirtland) — brook stickleback

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DATES OF FIRST FLOWERS OF ALPINE PLANTS AT EAGLE CREEK, CENTRAL ALASKA

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INFORMATION ABOUT FLOWERING DATES of species in northern North America is still very sparse. For a number of years I have spent most of the spring and summer at Eagle Creek, east-central Alaska (65° 27′ N, 145° 22′ W), studying ptarmigan (*Lagopus* spp.). I had a good opportunity to record flowering dates of the conspicuous plants in the area, and I did so. This report summarizes the results.

The area of study, 15 square miles of hilly land in the drainages of Eagle and Ptarmigan Creeks, flanks the Steese Highway 104 to 107 miles northeast of Fairbanks. Elevations vary from 2600 to 4400 feet above sea level. The rounded ridges and hills are part of an eroded peneplain of Precambrian schist, interrupted by masses of granite, quartz diorite, and allied Mesozoic rocks. The area apparently was not glaciated in the Pleistocene.

The climate is continental subarctic. Total annual precipitation averages 10-15 inches, with snow cover usually present from mid-September to mid-May. Summer days tend to be cooler, breezier, and more showery than in the valleys of the Tanana and Yukon Rivers to the southwest and northeast. Days from mid-June to mid-August generally are frost-free, but snow flurries and light frosts sometimes occur within this period.

Small stands of spruce (*Picea glauca*) occur on a few south-facing slopes between 2600 an 3300 feet; wood-cutting during the first 50 years of the century removed most trees from some stands, and regeneration has been slow. Spruces also occur as scattered, stunted individuals on favorable sites up to 4000 feet, or even slightly higher. However, treeless alpine-arctic tundra is the dominant vegetation on all areas above 3000 feet. This tundra complex grades to shrubby communities at lower elevations on mesic sites, and to a tussocky *Carex*-heath type on moist, gentle, lower slopes. Narrow bands of tall willows (*Salix* spp.) and alders (*Alnus crispa*) line the banks of streams below 3400 feet. These shrubs undoubtedly have prospered because of the disturbances wrought by placer miners, whose activities destroyed many stands of riparian spruce.

Eagle Creek and Eagle Summit are easily reached by car in summer. For that reason, plant collections have been made here more often than in adjacent parts of the Yukon-Tanana highlands. Scamman (1940) published one of the earliest lists of plants from this area, and established its reputation as a place to look for new species and interesting range extensions. Hanson (1950) discussed vegetation and soils (especially as related to congeliturbation and solifluction) of the Eagle Summit area. Gjaerevoll (1958, 1963 and 1967) added a significant number of new plant distribution records as a result of his collections on and around Eagle Summit. An unusual, small *Saxifraga* of unknown taxonomy was described by Porsild (1965) on the basis of specimens

TABLE 1. — Dates of first flowers of 84 alpine plants at Eagle Creek, Alaska

Species (Years of Record)	First Flowers			
	Earliest	Latest	Mean	*s* (days)
Douglasia gormanii Const. (5)	5/19	5/31	5/23	4.7
Arctostaphylos alpina (L). Spreng. (5)	5/20	6/9	5/29	7.4
Syntheris borealis Pennell. (6)	5/22	6/9	5/29	7.5
*Pedicularis lanata** Willd. (5)	5/21	6/9	5/29	6.9
*Anemone parviflora** Michx. (5)	5/21	6/10	5/30	7.0
*Anemone narcissiflora** L. (5)	5/27	6/8	5/31	4.9
*Oxytropis nigrescens** (Pall.) Fisch. (5)	5/22	6/9	5/31	6.5
*Petasites frigidus** (L.) Fries. (5)	5/29	6/9	6/1	4.5
Anemone multiceps (Greene) Standl. (5)	5/26	6/11	6/2	6.2
*Ranunculus nivalis** L. (6)	5/29	6/9	6/3	4.9
*Lupinus arcticus** Wats. (5)	5/27	6/8	6/3	4.3
*Parrya nudicaulis** (L.) Regel. (5)	5/29	6/10	6/4	5.4
*Loiseleuria procumbens** (L.) Desv. (6)	5/28	6/9	6/5	4.6
*Dryas octopetala** L. (5)	5/31	6/12	6/6	4.6
*Diapensia lapponica** F. Schmidt (Hult.) (6)	5/31	6/9	6/6	3.8
*Cardamine purpurea** C. and S. (6)	5/30	6/11	6/7	4.2
*Rhododendron lapponicum** (L.) Wahl. (6)	5/28	6/11	6/7	5.1
Cassiope tetragona (L.) D. Don. (5)	5/30	6/11	6/7	4.6
Senecio atropurpureus (Ledeb.) B. Feditsch. (5)	6/5	6/11	6/8	2.3
*Silene acaulis** L. (6)	5/28	6/15	6/8	7.4
Arenaria obtusiloba (Rydb.) Fern. (5)	5/30	6/15	6/10	5.5
*Astragalus umbellatus** Bunge. (6)	6/10	6/23	6/17	5.3
*Arnica alpina** (L.) Olin. (5)	6/7	6/27	6/18	7.4
Papaver macounii Greene (6)	6/9	6/25	6/18	5.7
Saxifraga punctata L. (6)	6/12	6/20	6/18	3.1
Viola epipsila Ledeb. (4)	6/12	6/20	6/18	3.7
Mertensia paniculata (Ait.) Don. (4)	6/12	6/20	6/18	4.0
*Lagotis glauca** Gaertn. (6)	6/10	6/28	6/18	6.6
Pedicularis capitata Adams (6)	6/16	6/21	6/18	2.1
*Claytonia sarmentosa** C. A. Mey. (5)	6/13	6/23	6/19	3.9
Pedicularis sudetica Willd. (5)	6/17	6/28	6/20	1.7
Castilleja hyperborea Pennell (5)	6/17	6/28	6/20	4.7
Crepis nana Rich. (5)	6/18	6/28	6/21	4.2
Epilobium latifolium L. (4)	6/17	6/28	6/22	4.1
Valeriana capitata Pall. (5)	6/15	6/28	6/22	5.9
Tofieldia coccinea Richards. (3)	6/20	6/27	6/23	3.6
Saxifraga hieracifolia Wallst. and Kit. (5)	6/16	6/28	6/23	5.0
Saxifraga bronchialis L. (5)	6/19	6/28	6/23	3.9
Potentilla biflora Willd. (4)	6/10	7/2	6/23	11.3
Tofieldia pusilla (Michx.) Pers. (4)	6/20	6/28	6/24	4.2
Senecio fuscatus (Jord. and Fourr.) Hayck. (4)	6/20	6/30	6/25	5.0
Potentilla fruticosa L. (5)	6/21	6/28	6/25	2.8
Pedicularis labradorica Panzer. (4)	6/17	6/30	6/25	5.7
Senecio lugens Rich. (5)	6/22	7/3	6/27	5.1
Claytonia tuberosa Pall. (6)	6/15	7/5	6/27	7.7
Saxifraga reflexa Hook. (5)	6/8	6/16	6/10	3.2
Geum rossii (R. Br.) Ser. (6)	6/7	6/15	6/10	2.7
Rubus chamaemorus L. (6)	6/8	6/15	6/11	2.5
Cardamine bellidifolia L. (5)	6/8	6/20	6/12	6.4
Lloydia serotina (L.) Wats. (6)	6/8	6/15	6/12	2.9
*Anemone richardsonii** Hook. (6)	6/5	6/16	6/12	4.2

TABLE 1. — (*Continued*)

Species (Years of Record)	First Flowers			
	Earliest	Latest	Mean	*s* (days)
Corydalis pauciflora (Steph.) Pers. (6)	6/8	6/15	6/12	3.1
Sedum rosea (L.) Scop. (4)	6/8	6/15	6/12	3.7
Andromeda polifolia L. (5)	6/10	6/14	6/12	1.6
Vaccinium uliginosum L. (4)	6/10	6/14	6/12	1.7
*Dodecatheon frigidum** C. and S. (6)	6/8	6/20	6/14	4.3
Rubus arcticus L. (6)	6/8	6/21	6/15	4.8
Cornus canadensis L. (5)	6/7	6/21	6/15	5.6
Androsace chamaejasme (Spreng.) Hult. (6)	6/10	6/19	6/15	3.7
Eretrichium aretioides * (C. and S.) DC. (5)	6/11	6/23	6/15	4.7
Pyrola grandiflora Radius. (5)	6/13	6/19	6/16	2.5
Vaccinium vitis-idaea L. (3)	6/14	6/18	6/16	2.1
Polemonium acutiflorum Willd. (5)	6/12	6/22	6/16	3.6
Myosotis alpestris Schmidt. (6)	6/10	6/22	6/16	4.4
*Pedicularis oederi** Vahl. (6)	6/10	6/23	6/16	5.3
Erigeron purpuratus Greene (5)	6/15	6/19	6/17	1.5
Polygonum viviparum L. (6)	6/14	6/19	6/17	1.8
Lychnis apetala L. (5)	6/12	6/19	6/17	3.0
Parnassia kotzebuei C. and S. (5)	6/22	6/30	6/27	3.4
Pedicularis verticillata L. (6)	6/19	7/3	6/27	5.7
Saxifraga davurica Willd. (6)	6/23	7/3	6/28	3.3
Gentiana glauca Pall. (6)	6/25	7/1	6/28	2.2
Campanula uniflora L. (5)	6/20	7/3	6/30	5.6
Claytonia scammaniana Hult. (6)	6/27	7/6	7/1	3.3
Aconitum delphinifolium DC. (5)	6/18	7/9	7/1	9.6
Campanula lasiocarpa Cham. (5)	6/30	7/3	7/1	1.6
Spiraea beauverdiana Schneid. (4)	6/28	7/12	7/3	6.5
Senecio resedifolius Less. (5)	6/28	7/11	7/5	4.9
Saxifraga flagellaris Willd. (6)	7/3	7/18	7/8	5.9
Delphinium brachycentrum Ledeb. (6)	7/5	7/17	7/9	5.0
Saxifraga hirculus L. (5)	7/3	7/18	7/9	6.1
Zygadenus elegans Pursh (5)	6/28	7/25	7/16	10.8
Epilobium angustifolium L. (3)	7/10	7/24	7/18	7.1
Gentiana algida Pall. (4)	7/21	7/26	7/23	2.2

*Asterisks denote species used for phenological characerization of season (short method – see text).

collected at Eagle Summit. The efforts of several students and botanists from the University of Alaska have resulted in a representative collection of Eagle Creek plants in the herbarium of that institution.

METHODS

Each year from 1962 through 1967 I recorded the dates on which I saw the first fully-displayed flowers of many species at Eagle Creek. This report lists dates for 84 species, excluding plants with inconspicuous flowers (i.e. *Chrysosplenium tetrandrum*, *Empetrum nigrum*, *Ligusticum mutellinoides*); rare species such as *Saxifraga oppositifolia*, *Moneses uniflora*, *Viola biflora*, *Oxytropis mertensiana;* certain plants that were hard to tell from earlier-flowering species (*Pedicularis langsdorfii*); and species for which fewer than three years of flowering dates were obtained.

Voucher specimens of all but the commonest, most easily distinguished species were collected. Mr. John Crow, Department of Botany, Washington State University, Pullman, kindly verified my identifications in 1967. Plant names follow Anderson (1959).

RESULTS

Douglasia gormanii usually is the first flower to appear at Eagle Creek (Table 1). Found at elevations above 3500 feet, this low plant is restricted to slopes where wind and sun combine to expose the ground early in spring. Other early-blooming species (*Synthris borealis*, *Pedicularis lanata*, *Oxytropis nigrescens*) occur in this habitat also, but their mean first-flower dates are six to eight days later than *Douglasia* because of longer delays of development in late springs.

At the other extreme, *Gentiana algida* usually flowers after all others studied. This gentian grows in moist places at moderate to high elevations, and is most common in sedge meadows in saddles on ridges at 3900-4100 feet. Other plants in this habitat, like *Claytonia tuberosa*, *Senecio atropurpureus*, and *Saxifraga hirculis*, appear much earlier.

Some idea of annual variation in flowering dates can be obtained from standard deviations from mean first-flower dates listed for each species in Table 1. *Erigeron purpuratus*, *Andromeda polifolia*, *Campanula lasiocarpa*, *Pedicularis sudetica*, and *Polygonum viviparum* showed the smallest standard deviations (less than two days). *Potentilla biflora* and *Zygadenus elegans* had the largest deviations, with more than ten days on each side of the mean. There are ten species in Table 1 with standard deviations of two to three days, 15 with three to four days, 20 with four to five days, 15 with five to six days, eight with six to seven days, six with seven to eight days, and one species with a nine to ten-day standard deviation.

The number of species flowering in each five-day period from May 20 to July 23 is plotted in Figure 1. The curve is unimodal and quite symmetrical, except for an upsurge of flowering dates occurring June 14-18. One-fourth of all species studied had mean first-flower dates in that five-day period.

PHENOLOGICAL IMPLICATIONS

The flowering dates I recorded can be used to characterize seasons phenologically. One way is to sum deviations from mean first-flower dates, and to list the number of species blooming later and earlier than usual and the cumulative number of days earlier and later for all species. This is done in Table 2. The results suggest that there were two very "early" springs between 1962 and 1967, and four moderately or very "late" years. The phenological characteristic of each year, derived from these data, correlated well with at least one other event at Eagle Creek, the mid-point of hatching of rock ptarmigan (*Lagopus mutus*) eggs.

The method just described demands that data be gathered all summer. The season can be characterized only in retrospect. For convenience in other biological studies, it is desirable to limit the effort to a shorter span of time, preferably early in the summer. I attempted this by selecting a few common, conspicuous species that generally flower in June and show moderate variation in flowering dates from year to year (suggesting that their growth is fairly sensitive to short-run weather conditions). The species chosen are those with asterisks in Table 1. I expressed the flowering date of each species as the number of days after April 30 that first blossoms appeared in a given year. These were summed for all species, by year, and a mean was calculated. The mean was then converted to calendar date, starting with the April 30 base. The mean flowering dates are as follows: 1962, June 9 (22 species); 1963, June 6 (22 species); 1964, June 13 (22 species); 1965, June 9 (21 species); 1966, June 5 (22 species); 1967, June 13 (13 species). Like the method using all 84 species, this technique yields a consistent relationship between flowering dates and nesting of ptarmigan, except that 1967 flowering dates were as late as those in 1964, whereas ptarmigan nested much earlier in 1967. This could be a result of the small number of plants seen at the time of the first flowering, (due to a change in the pattern of my work at Eagle Creek) or it could reflect an imperfect correlation between the two phenologic events last year.

Discussion

It is clear that simply stating when first blossoms appear falls far short of fully describing the effect of environmental conditions on vernal plant development. The technique emphasizes individual plants, with all their inherent variabilities; it gives no clue about rates of development in populations. Furthermore, it hides the important variation within a species due to the plant's occurrence in a range of biotopes. For the biologist busy with other studies, however, first-flower dates offer a simple way of getting some insight into phenological progression.

Bliss (1956) emphasizes site variation in his paper on plant development in low arctic and alpine tundras. Although he gives no data on first-flower dates, he concluded from other criteria that " . . . the same species frequently reaches an equivalent level of phenological development on different dates at the various stations . . ." (p. 323). Later, (p. 324) he says "Most species at a given location appear to break dormancy, bloom, and fruit together. These

TABLE 2. — Phenological summations at Eagle Creek, Alaska, 1962-67.

Year	No. (percent) species earlier than average	No. (percent) species later than average	Cum. No. days earlier	Cum. No. days later	Seasonal character	Peak of hatch, *Lagopus*
1962 (78*)	24 (31)	45 (58)	83	143	mod. late	June 23
1963 (73)	51 (70)	20 (28)	269	82	very early	June 19
1964 (81)	8 (10)	65 (80)	29	288	very late	July 1
1965 (73)	30 (41)	40 (55)	83	131	mod. late	June 23
1966 (82)	64 (78)	10 (12)	242	21	very early	June 20
1967 (45)	19 (42)	24 (53)	66	85	mod. late	June 22

*Number of species for which records were available.

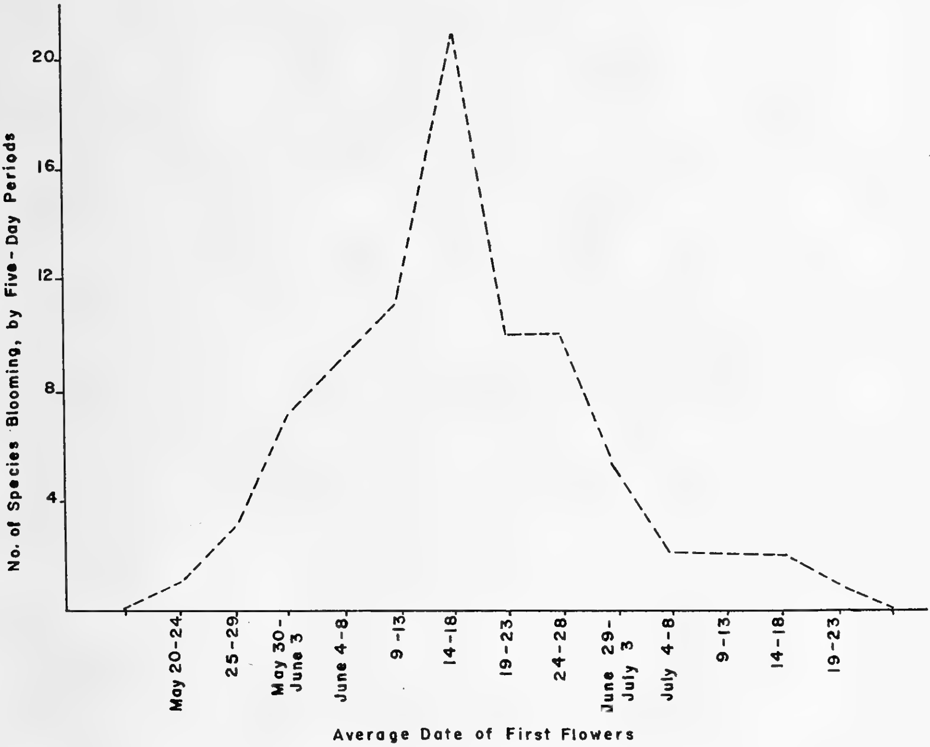

FIGURE 1. Number of species with average dates of first blossoms in five-day periods, May 20-July 23, Eagle Creek, Alaska.

same species show different phenological cycles in other microenvironments." Sorensen (1941) came to a similar conclusion in northeast-Greenland. He felt that the nearly simultaneous flowering of most species on a site could actually help ecologists to distinguish ecotopes. My experience at Eagle Creek suggests, nevertheless, that variation among species on the same site is considerable. For example, in openings in the shrub communities on south-facing slopes at timberline, different species achieve first anthesis as early as late May (*Arctostaphylos alpina*, *Anemone narcissiflora*) and as late as early July (*Spiraea beauverdiana*). The same is true of many other habitats at Eagle Creek, as was pointed out earlier in the discussion of *Gentiana algida*.

Some phenological studies have shown that early-flowering species vary more from year to year than do later flowering plants in the same area. There is not much information about this in the North, although Criddle (1927) obtained evidence for it in Manitoba, and Moss (1960) thought the phenomenon probably occurred at Edmonton, Alberta. If this were true, I would expect early-flowering species at Eagle Creek to have larger standard deviations than plants that develop later. This does not appear to be the case. Nineteen species with mean first-flower dates between May 20 and June 8 (Table 1), had an average standard deviation of 5.23 days. Forty-three species blooming between June 9 and June 23 showed an average standard deviation of 4.15 days, and 22 late species, blooming after June 23, had a mean standard deviation of 5.16 days. A more rigorous analysis, including more years of data, certainly would be advisable. Sorensen's (1941) data indicated that there was no general tendency for greater deviations among early species in years of different weather conditions; in fact, he noted that late-flowering species showed a slightly greater retardation than early-flowering ones, when a "normal" and an "early" year were compared.

There is a real temptation to compare flowering dates with those reported in other studies, especially when species are common to both areas. Sorensen (1941), for example, gave flowering dates in 1935 for 18 species in northeast Greenland that I studied at Eagle Creek. However, detailed comparisons are not meaningful unless an estimate of annual variation is available from both areas. Interpretation of the comparisons would have to be based on good meterological and soil temperature data, which I do not have.

Summary

Among 84 species of conspicuous flowering plants at Eagle Creek, east-central Alaska, the earliest (*Douglasia gormanii*) showed its first blossoms about May 23, on the average. The latest species to flower, *Gentiana algida*, began blooming July 23 most years. About 25 percent of the species studied achieved first anthesis between June 14-18. Site variation within species was not studied, but considerable variation in flowering dates among species on the same site was observed. The annual progression of flowering correlated well with hatching dates of rock ptarmigan. As far as the data allowed an examination of the subject, I found no evidence that year-to-year variations in flowering dates were greater among early than among late species.

Acknowledgments

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SOME ASPECTS OF COMMENSAL POPULATIONS OF *MUS MUSCULUS* IN SOUTHWESTERN ONTARIO

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Recently, studies of genetic polymorphisms in natural populations of the house mouse, *Mus musculus*, have suggested that these populations are subdivided into a large number of small, randomly breeding units or demes (Lewontin and Dunn, 1960; Petras, 1967a, 1967b). The existence of such units has also been indicated by the limited home range exhibited by mice (Southern and Laurie, 1946; Young, Strecker and Emlen, 1960; Brown, 1953) and the development of male territoriality (Crowcroft and Rowe, 1963; Anderson and Hill, 1965). Reimer and Petras (1967) described the formation and maintenance of small breeding units by mice housed in a population cage.

In an effort to determine whether the subdivision observed in the laboratory population was a reflection of the situation in commensal populations as is suggested by the genetic data, an extensive trapping program was undertaken on farms in southwestern Ontario. Data were collected on (1) the sex ratio in samples of mice from various localities and of various ages, (2) the movement of mice within single habitats and between dissimiliar habitats, and (3) the effect of farming practices on commensal mouse populations. The findings are consistent with the existence of small breeding units in such natural populations of *Mus*. Finally, the data are discussed in terms of a general concept of commensal populations of house mice.

Trapping Localities and Procedure

Trapping was carried out in and around a number of buildings on two farms in Essex County.

The mouse populations on Farm A (Fig. 1), located seven miles southeast of Windsor, Ontario, were sampled from May, 1964, through August, 1965, except for the cold-weather months, November through April. All buildings on this farm were badly in need of repair. Pigs, chickens, cows and dogs were found roaming about scattering considerable quantities of food within and between buildings.

Traps were set in the barn, the corn crib, the pig pen, the area between buildings and the adjacent fields. In the barn, which housed some livestock (cows and swine) and a granary at the lower level, trapping was concentrated in the granary during the spring and early summer since this appeared to be the major food source for mice in the building. By midsummer the supply of oats in the granary was depleted and the hayloft replenished. Traps were then moved to such convenient places in the loft as on and in the hay, along the walls, and on the beams. Traps in the corn crib, which contained corn throughout the year with the lowest level being reached just before harvest in October, were uniformly distributed (approximately two feet apart) along

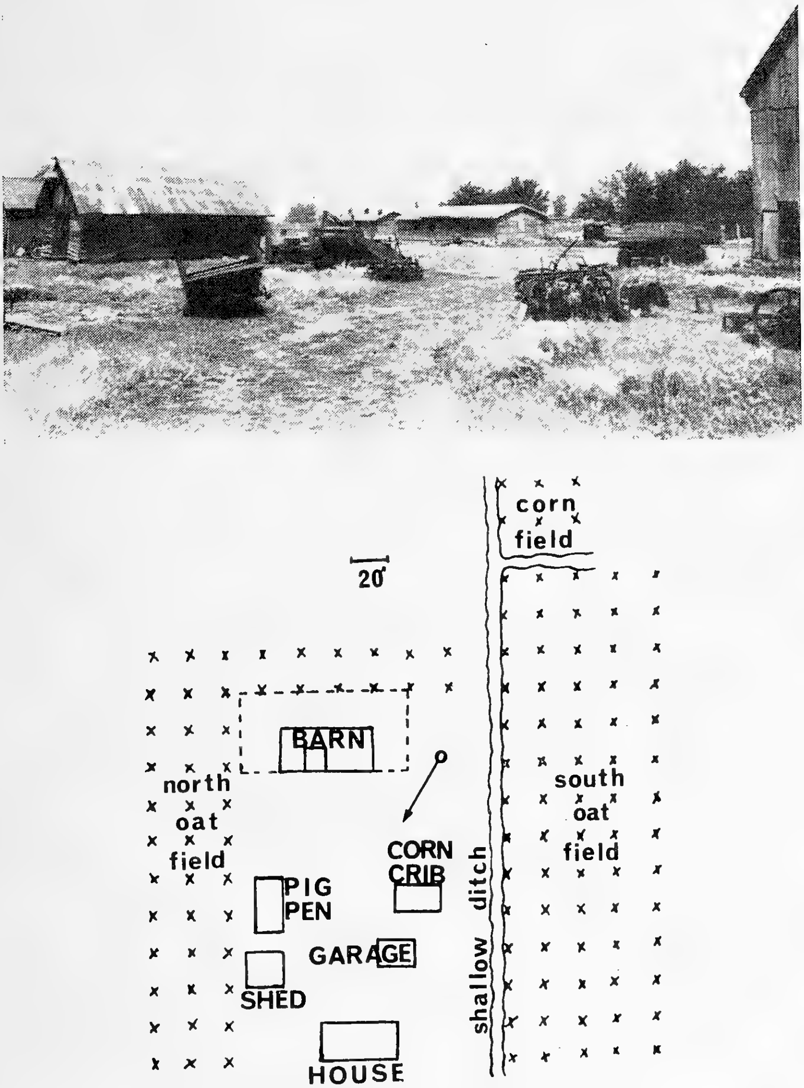

FIGURE 1. A chart and view of Farm A. The arrow indicates the direction in which the photograph was taken.

the outer walls and on the corn itself. The last building on this farm in which traps were set, the pig pen, housed a number of pigs throughout the trapping period. Pig meal, stored in barrels, was the only edible material available.

Ground cover between the buildings was sparse with numerous tracks, caused by farm machinery, traversing the area. As a consequence, traps were placed only in those spots where it appeared likely that they would not be disturbed. Considerable cover, however, was available both in an overgrown ditch running the length of the farm just 20 feet south of the corn crib and, during the summer in adjacent fields where oats (*Avena* sp.), corn (*Zea* sp.) and soybeans (*Soja* sp.) were grown. Traps in the field were set in a 20 foot grid which ran up to 100 feet from the buildings.

Farm B is located two miles south of Windsor and five miles southwest of Farm A (Fig. 2). This second farm was in much better repair than the first. Livestock on this farm was confined to the barnyard and only a few dogs and cats ran loose during the trapping period. Scattered around the periphery of the farm yard were nine rabbit hutches which housed a large number of animals.

Trapping, carried out during the early summer of 1965, was restricted to four structures: west corn crib, east corn crib, granary in the barn and a large rabbit hutch. Traps in the two cribs, which contained corn for nine months of the year, were placed at regular intervals along the periphery. In the granary, where oats were stored throughout the year, traps were set on the surface of the oats, the floor and beams supporting the walls. Lastly, traps were set in a large rabbit hutch which was well stocked with feed and water.

Single catch (2½ x 2 x 8 inch) masonite traps were used in the sampling. These were placed in appropriate places in the evening and were either picked up early in the morning after being checked or were permitted to stay open for the entire day. If the temperature dropped below 50°F during the night or rose above 80°F during the day, the former procedure was followed to reduce trap mortality. Bait, composed of rolled oats and peanut butter, was used in the early stages of the field trapping but eventually was discontinued without any noticeable decrease in catches or increase in trap mortality. No bait was used in the buildings. In both buildings and fields the exact distances between traps were recorded.

Animals trapped were sexed, ear-punched, toe-clipped and released at the spot of capture. A record was made of the exact position of the trap.

RESULTS

Sex Ratio of Captured Animals

Pooled samples from the buildings on the two farms consisted of 300 adult females and only 225 adult males (Table 1). The deviation from a 1:1 sex ratio is significant ($X^2 = 10.71$, $d.f. = 1$, $P < 0.01$). However, subadult males (obviously sexually immature individuals) outnumbered subadult females 105 to 80. This deviation from a 1:1 ratio is not significant ($X^2 = 3.38$, $d.f. = 1$, $P > 0.05$). The overall male to female ratio, also, does not differ significantly from a 1:1 sex ratio ($X^2 = 2.96$, $d.f. = 1$, $P > 0.10$).

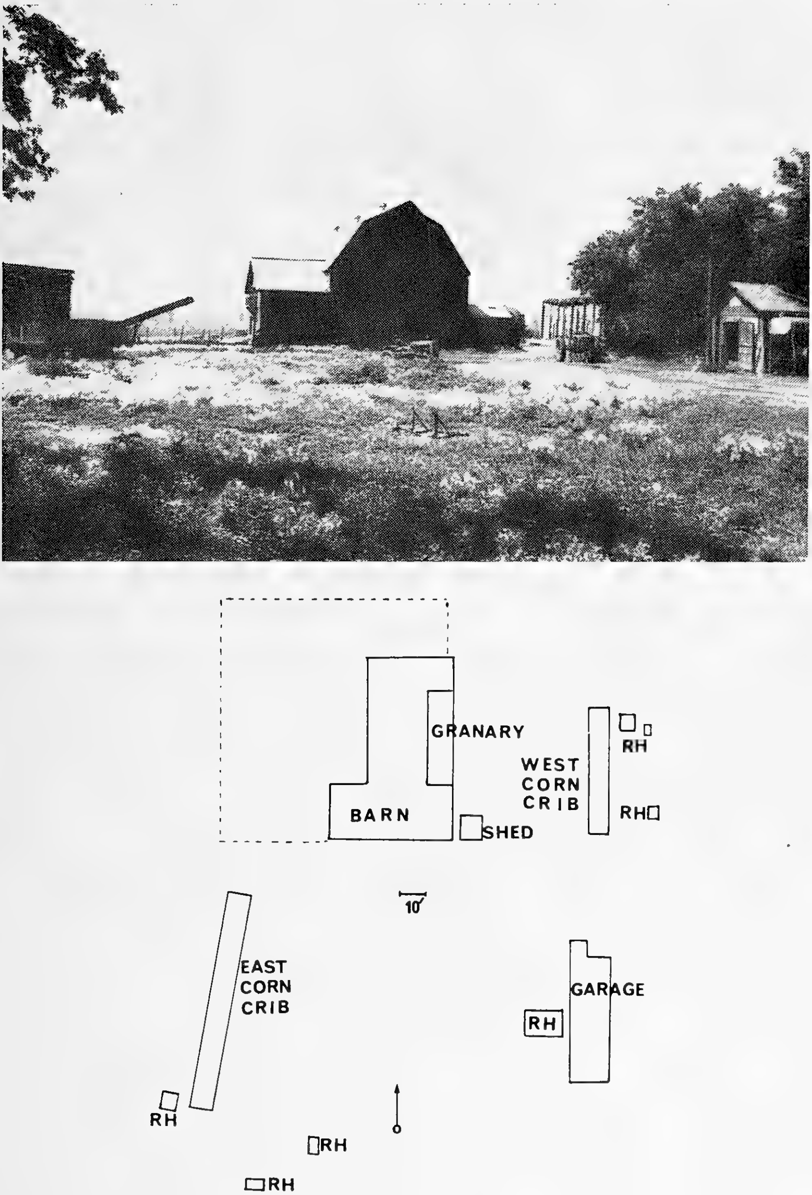

FIGURE 2. A chart and view of Farm B. The arrow indicates the direction in which photograph was taken. RH refers to rabbit hutch.

TABLE 1. — Sex ratio of animals captured in buildings and in fields

Collecting site	Adult males	Adult females	Per cent of adult males	Juvenile males	Juvenile females	Per cent of juvenile males
Samples from buildings:						
Farm A — barn	60	55	52	43	24	64
corn crib	92	138	40	38	34	53
pig pen	7	9	44	4	2	67
Pooled	159	202	44	85	60	59
Farm B — granary	14	28	33	4	7	36
rabbit hutch	7	17	29	10	8	56
west corn crib	22	16	58	5	5	50
east corn crib	21	30	41	1	0	–
Pooled	64	91	41	20	20	50
Summary of building data	223	293	43	105	80	57
Samples from fields around buildings of Farm A:	63	23	73	4	4	50

An examination of the sex ratio in adults from individual buildings indicates a significant difference in at least one comparison. For instance, the sex ratios in the samples from the rabbit hutch and the west corn crib on Farm B differ significantly ($X^2 = 4.83$, $d.f. = 1$, $P < 0.05$). However, unlike the situation in the juveniles, where there is a preponderance of males, only seven of ten samples from buildings favoured the male sex.

The sex ratio data from the rabbit hutch on Farm B are of particular interest because (1) the building was small (10 x 14 feet) and so supported a relatively small population, (2) the only food source was a basket filled with corn, and it was around this basket that all the mice were caught, and (3) in the first few days of trapping only adult mice were captured, and then only immature animals.

Most of the adults captured in the fields were adult males (Table 1). Deviation of the sex ratio from a 1:1 is significant ($X^2 = 18.6$, $d.f. = 1$, $P < 0.001$). Very few juveniles were captured.

Movement of Animals

The results of the capture-recapture studies of mice in the corn crib, summarized in Table 3, indicate very limited movement of mice. The range of females was found to be somewhat less than that of males.

Over a three month period a large number of animals were captured and marked in the granary of the barn on Farm A and a few mice were first caught in the hayloft. Subsequently many of the marked animals from the granary were recaptured in the hayloft and *vice versa*. Trapping was terminated when the frequency of catches dropped to nearly zero. This decrease was correlated with filling of the hayloft and depletion of oats in the granary. A summary of the distances travelled in the barn, between recaptures, is presented in Table 2.

TABLE 2. — Movements of mice on Farm A based on capture-recapture data

Collecting site	Sex and age	No. of mice captured	No. of mice recaptured	No. of recaptures	Ave. distance between recaptures in feet	Longest movement
Corn crib	Males – adult	23	10	18	4.2	10
	juvenile	4	2	2	5.0	6
	pooled	27	12	20	4.3	
	Females – adult	31	9	12	1.0	3
	juvenile	8	2	3	1.7	3
	pooled	39	11	15	1.1	
	Summary	66	23	35	2.9	
Barn	Males – adult	14	4	7	21.3	35
	juvenile	6	4	4	10.5	20
	pooled	20	8	11	17.4	
	Females – adult	11	4	4	25.8	45
	juvenile	4	2	2	12.5	15
	pooled	15	6	6	20.8	
	Summary	35	14	17	18.6	
Fields	Males – adult	63	17	24	54	220
	juvenile	4	1	1	400	400
	pooled	67	18	25	69	
	Females – adult	23	3	6	223	380
	juvenile	4	1	1	200	200
	pooled	27	4	7	218	
	Summary	94	22	32	98	

The results of the trapping program in the fields are also summarized in Table 2. Based on 32 recaptures, the average distance travelled by mice between captures was 98 feet, with males moving considerably less than females. The average number of days between recaptures was 21 and 8 for adult males and adult females, respectively. One adult female was captured 4 times over an 85 day span.

During the entire trapping period, a total of 237 mice were marked and of these 59 were recaptured a total of 74 times, with six animals moving either from a building into a field or *vice versa* (Table 3). One adult female moved from the corn crib into the oat field and was again recaptured in the corn crib the following summer, seven months later. All movements into buildings occurred after September 25th and before the onset of winter. No migration was detected between buildings.

Continuity of a Population

Shortly before a new crop of corn was added to the crib on Farm A in October 1964, a 30 inch high plastic barrier was placed around the crib and the remaining corn was removed. A few animals escaped but most were caught, examined, marked and then released into the corn which had been returned to the corn crib. Of the 42 mice captured during this procedure, three males and six females had been marked in June.

Additional trapping during 1965 resulted in another 3 males and 6 females being recaptured. Six of these animals had been marked in June or July of 1964 and 3 in the October raid.

Effects of Farming Practices

Farming practices differ from one geographic area to another depending on the climate. The Essex County growing season, that is frost-free days, extends from approximately the first day of May until the end of September. Between September and May, the temperature rarely falls below 0°F and snowfall is light. During this period the fields are undisturbed.

Trapping in the fields was begun shortly after they were ploughed in the spring and continued until the onset of winter.

No mice were captured in open fields lacking ground cover during the spring. All of the mice captured outside of buildings during this period were trapped in or near the shallow, overgrown ditch. In the oat field, as soon as the ground cover was about six inches high, several animals were trapped as far as 60 feet from the ditch. The density of mice appeared to increase until the oats were harvested. The population of *Mus* then appeared to decline in spite of considerable cover provided by straw and liberal new green growth from seeds scattered in harvesting. No mice were captured in the oat field after the first frost, which occurred on October 2nd in 1964. Similar results were obtained in the corn and soybeans fields (east of the barn).

DISCUSSION

The results of the sex ratio studies agree with those of other workers. Laurie (1946), for instance, found more females than males of all weights in samples taken from corn ricks, while Southwick (1958), in a study of complete rick populations of varying density, found a significant excess of females in mice above 12.5 gm but no significant excess below this weight. Similarly, Rowe, Taylor and Chudley (1963) found that adult females were significantly more numerous than adult males. However, as in the present study, Rowe, *et al* (1963) found that sub-adult males outnumbered sub-adult females.

A breakdown of the sex ratio data shows significant variations between populations. For instance, there is a significant difference between the frequencies of males in the rabbit hutch and in the west corn crib of Farm B. Although, the cause of this difference cannot be determined from the present information, such factors as habitat differences (food and cover abundance) and population densities should be considered.

The low frequency of adult males in buildings and storage structures (0.43) and the relatively high frequency in fields (0.73) suggest the following. House mice prefer a commensal habitat, where there is ample food and cover and no competition with *Peromyscus* and *Microtus*. Members of both genera were caught in the fields. This results in a density problem, and consequently,

TABLE 3. — Movement of mice between buildings and fields on farm A

Animals	Movement	Days between captures	Distance travelled (feet)
Adult male*	North oat field to pig pen	67	60
Juvenile male	Pig pen into corn field	22	380
Adult female	Corn crib into south oat field	83	30
Adult female	South oat field into corn crib	16	380
Adult female	Corn crib into south field and back into corn crib	235	40
Juvenile female	South oat field into corn crib	35	200

*Age of animal at time of first capture.

maturing males in buildings must compete with males already present (dominant males) for territory. The defeated males either become subordinate as in the population cage (Reimer and Petras, 1967) or more likely, since egress is possible, are driven out of the territory. These animals, then presumably seek an unoccupied area within the building and, if they fail to find one, move out of the building into the adjacent fields. The movements of these animals in the fields suggest an unstable home range, and the recapture data indicate that most of the mice do not survive long in this habitat but succumb to predators. Maturing females, on the contrary, generally remain in the territory of their father or his replacement. The presence of females in the fields may be the result of general over-crowding and associated lack of nesting space in some of the buildings.

Among the collections from the various buildings the one from the rabbit hutch of Farm B is of particular interest, because nesting space and food were limited, and, because the trapping results suggested that nearly all if not all of the mice in this habitat were caught. If all adults were captured, then approximately three adult females were present for each adult male. The juveniles were equally distributed between the two sexes. These observations and conclusions agree with the situation observed in the population cage.

Movement studies suggest that in structures with adequate cover and an abundance of food, such as the corn crib, the home range of a mouse is quite restricted (3 feet between recaptures). Such limited movement does not appear to be the result of physical barriers but rather behavioural. The latter is supported by the evidence which suggests the establishment of demes and associated territoriality in mice. In the corn crib, females were found to move shorter distances than males. If this difference is significant then perhaps it may be associated with nesting behaviour, or perhaps the distance moved by males is an overestimate resulting from the inclusion of males seeking new habitats.

In situations, as for example the barn, where suitable cover and adequate food are not as abundant as in the corn crib, mice of both sexes tend to move a considerable distance (18.6 feet). Similar values were found by Brown

(1953) and Young, *et al* (1950). The average distance is even greater in the fields (98 feet). Unfortunately, in both the barn and the fields, the low number of multiple recaptures did not permit a suitable determination of the home range of house mice. The field data do, however, indicate that the mice were not confined to a small area in this habitat. This together with the capture of only eight juveniles in the field suggest that the mice in the fields do not establish nests or stable breeding units. Competition with *Microtus* and/or *Peromyscus* could account for this (DeLong, 1966; Lidicker, 1966).

Simultaneous trapping both in and around farm structures revealed that 6 of 59 mice or 10% changed habitats. This value is consistent with the migration rate reported by other workers. Petrusewicz and Andrzejewski (1962) found a 5% rate (21/429), Evans (1949) a 2% (4/235) migration rate and Brown (1953) in frequent inspections and occasional trapping of a building adjacent to a hay barn found no movement of mice between them. One of the few instances of movement between buildings (2/12) was reported by Petras (1967a). The above values of physical migration may be underestimates by a considerable magnitude, if it is assumed that the populations in the fields are transient and are being continuously supplied by migrants from buildings, and that at least in some structures where cover and food are completely depleted, a new population must be begun by immigrants.

Unfortunately, no data are available to indicate the frequency with which new populations are begun by immigrants, but if this does occur, as it must in at least some instances, the occurrence need not be frequent. Perhaps more often than not, some animals survive even such catastrophic events as the complete depletion of food and cover, and give rise to the next generation. For instance, trapping over a 15 month period showed that some of the mice remained in the same area for the entire period in spite of radical changes in cover. Such a residual population, if composed of randomly selected individuals, may at the same time preserve genetic polymorphisms and permit a fluctuation of gene frequencies from generation to generation and from locality to locality (Reimer, unpublished thesis).

Even if the formation of new breeding units by immigrants is not common, here is a possible mechanism whereby mice from several demes may come together, in a vacant habitat, form a new breeding unit and bring about the reshuffling of genes of existing demes. This mechanism assumes significant evolutionary importance if the exchange of genetic material between established demes is highly restricted as is suggested by data obtained from population-cage studies.

Farm practices drastically effect mouse populations in the fields. Cover and food apparently must be present in order for a field to support even a transient *Mus* population. When ground cover was removed as in ploughing or harvesting, the density of mice declined, and with the onset of cold weather mice were no longer trapped in the fields. Presumably they either move back into buildings or succumb to predators. No information on this aspect was obtained in the current study.

No new litters were found in late fall or early spring so perhaps breeding is suspended during this period. It is not known whether territoriality is maintained during the nonbreeding period or if demes are disbanded and reformed in the spring.

Subdivision of a species into a large number of demes or small breeding units is not unexpected, since as Wright has pointed out on numerous occasions (see for example 1939) such division when accompanied by partial isolation provides optimal conditions for evolutionary progress.

SUMMARY

Commensal populations of the house mouse, *Mus musculus*, exhibit features that can best be explained by a subdivision of the population into a large number of small breeding units or demes. Extensive trapping over a 15 month period, on farms in southwestern Ontario, showed that: adult females are significantly more frequent than males in buildings, males are more frequent than females in field populations and the two sexes are equal in juveniles; a direct correlation exists between the distance covered by mice between captures and density of cover; the migration rate between habitats is 0.10; some mice remain in a specific locale in spite of drastic environmental changes; and mice survive in the fields only during the growing season and the period immediately after harvest. The data were discussed in terms of a general concept of a commensal house mouse population.

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ANOTHER RECORD OF WHITE WING-BARRING IN THE COMMON CROW

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AN IMMATURE COMMON CROW (*Corvus brachyrhynchos*) of undetermined sex obtained at Carman, Manitoba on August 2, 1949, and donated by A. H. Shortt, exhibits white wing markings similar to that shown in specimens reported in two recent publications. Spencer Sealy described a bird taken near Battleford, Saskatchewan on August 25, 1962; Lester L. Short, Jr. and Roxie C. Laybourne described one taken in Maryland on October 2, 1965 (Short and Laybourne 1967). The Manitoba specimen closely resembles both of these.

Fortunately, one wing of the specimen was removed and was preserved in a spread position (Figure 1). As in the previously reported specimens, a striking pattern of white, resulting from failure or inhibition of deposition of melanin (black pigment) in the developing feathers, occurs across the wing. Primaries and secondaries show an unpigmented, white area extending from the base to within a few inches of the tip, with the broadest area of white on the broader inner vane. As was the case in Sealy's specimen, the affected feathers also show an unpigmented rachis; this is especially noticeable in the primaries. In this specimen, too, the pattern is apparently symmetrical on both wings, as far as can be judged from the folded, dried wing on the specimen. The second primary on the latter wing, however, has a slight unpigmented area at its tip, a feature not matched on the figured wing.

As in Sealy's specimen, the greater primary wing coverts are all affected, an unpigmented area running from the base to one-quarter or one-third of

PHOTO BY ROBERT R. TAYLOR

FIGURE 1. Dorsal surface of right wing of Common Crow.

the length. These white areas are largely covered by the alular feathers. In addition, two greater secondary coverts are slightly affected close to the feather base.

In contrast to the Saskatchewan and Maryland specimens, in the present one all of the tail feathers (rectrices) are affected in a manner similar to that of the wing feathers. An unpigmented area occurs on each feather, from the base to about half the length. As in the other feathers, the unpigmented area is greatest on the inner or median vane; it is also longest on the central feathers. This pattern is surprisingly similar to a condition described as "white tail-base" in the Red-winged Blackbird. About all that is known about this trait, which is common in the Redwing, is that there seemed to be no correlation with age, and individual birds showed a similar amount of white at the base of the tail feathers through successive molts.

The Manitoba specimen also has a small clump of six white feathers above the left eye. Judging by this specimen, white wing-barring in the Common Crow is one aspect of a more general albinotic abnormality affecting chiefly rectrices and remiges.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. VI. *B. PAPYRIFERA* FROM THE ROCKY MOUNTAINS

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THE FOLLOWING RECORDS morphological observations carried out on white birch (*B. papyrifera* Marsh.) collections made in August, 1961, in the Rocky Mountains, and includes chromosome numbers which have been determined from their seedling progeny. All the specimens were collected in Alberta except those from one stand in British Columbia. The specimens are of interest as they clearly indicate that the morphological variability exhibited by this species is in agreement with our studies of this species from other areas (Brittain and Grant, 1965, 1966, 1967).

OBSERVATIONS AND DISCUSSION

The localities, together with the chromosome numbers, stomatal guard cell measurements and remarks on the different specimens, are listed in Table 1. The fruiting and folial characters of representative specimens are shown in Plate 1. These have been selected to show the range of variation which exists.

When mature, the white birches in the Rocky Mountains are large trees which differ from the very large birches of the Pacific Coast. The latter are usually referred to as *B. papyrifera* var *commutata*. The Rocky Mountain birches lack the characteristic compact rounded crown with its slender branches and the very dark brown bark of many of the coastal specimens. The most noticeable characteristic of a large proportion of the montane trees is the bronzy, generally close, bark. In some individuals, however, the bark is decidedly loose, freely exfoliating and pinkish white or greyish in color.

While individual characteristics for each of the different collections are given in Table 1, comments on a few of the outstanding morphological variants are presented here.

Standing apart from all the other specimens is number 168, collected in the Waterton Lakes National Park. The difference between the long narrow leaves of this specimen and other accessions in this collection is striking, though number 145 from Jasper National Park resembles it more closely than the others (Plate 1). In contrast to number 168 is number 64 from Jasper National Park which is distinctive in having large coarse leaves, large catkins and very loose white bark (Plate 1). Other specimens with marked individual characteristics are numbers 159 with its very large leaves which are rounded at the base and sides, and number 48 with circular or subcircular leaves and abruptly narrowed tips (Plate 1).

Somatic chromosome numbers of 70 and 84 were determined from seedling progeny, agreeing with numbers for the majority of accessions from British Columbia (Brittain and Grant, 1966) and eastern Canada (Brittain and

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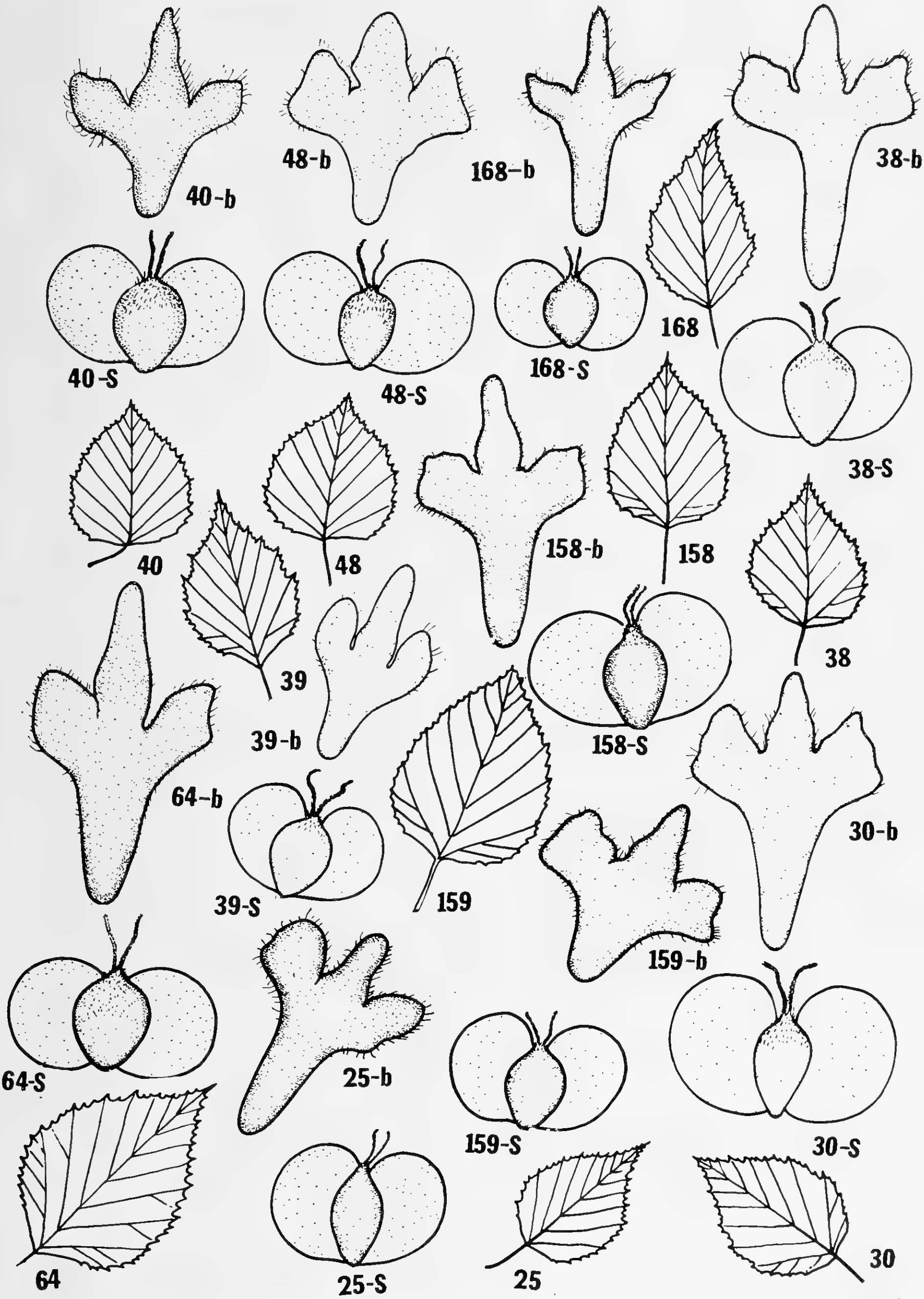

PLATE 1. Bracts and samaras (× ca. 6) and leaves (reduced ca. 3/5) of representative specimens. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara.

TABLE 1. — Observations on collections of *B. papyrifera* from the Rocky Mountains[1]

Acc. No.	Locality	Somatic chromosome no.	Stomatal size (μ)[2]	Special characteristics
25	Near Kananaskis, at base of Pigeon Mountain	70[3]		Leaf almost circular with abruptly attenuated tip, resembling No. 48, otherwise except for minor differences, No. 36 and No. 158; dead white or greyish bark; d.b.h. 7.62 cm.[6]
26	No. 1 Highway, between Kananaskis and Banff.	70:84[4]		Resembles Nos. 39 and 40, except for fertile bract with short peduncle; subequal in length to broad median lobe; d.b.h. 10.16 cm, bark dark brown, close.
30	Banff National Park.		35.44	Most like Nos. 36 and 145; buds sticky; tree with 3 trunks; d.b.h. 7.62, 10.16, 15.24 cm; bark grey with bronzy tint.
36	Banff National Park, 10 mi. E. on Highway No. 1.		41.86	Differs only in minor detail from No. 30 and 158; d.b.h. 10.16 cm; bark bronzy-brown close.
38	Banff — Radium Highway 17 mi. W. of pass; alt. 1464 m., British Columbia.	70		Similar to No. 30, but fertile bract very long and narrow with short median lobe; close, brownish bark with bronzy tint.
39	Yoho National Park.	84	39.19	Similar to No. 40, but lobes rounded and lack very long fine hairs; d.b.h. 11.43 cm; bark dark grey, with bronzy tint.
40	Lower Waterfowl Lake.	70	38.81	Very long fine marginal hairs on fertile bract; closely resembles Nos. 39 and 49; d.b.h. 12.70 cm; bark grey or dirty white.
48	Jasper National Park, 14 mi. E. of Jasper; alt. 1022 m.	84	40.88	Leaf form closely resembles No. 25; but fertile bract with shorter peduncle, subequal in length and median lobe; d.b.h. 15.75 cm; bark greyish, feebly exfoliating.
49	Jasper Nat. Park.	84	38.12	Most closely resembles Nos. 36 and 145; d.b.h. 28.45 cm; dark cream to bronze bark, exfoliating.
56	Jasper Nat. Park, 2 mi. E. Miette Junct.; alt. 1037 m.	84		Most closely resembles Nos. 30, 36, 158 and 145 except for minor characters; d.b.h. 24.13 cm; bark pinkish, feebly exfoliating.
64	Jasper Nat. Park, Edith Cavell Junct.	84[5]	37.13	Differs from others in larger coarsely serrate leaves, bracts and achenes large, approx. as broad as long; d.b.h. 15.24 cm; dull white bark, very freely exfoliating.

TABLE 1. — (*Continued*)

Acc. No.	Locality	Somatic chromosome no.	Stomatal size (μ)[2]	Special characteristics
145	Jasper Nat. Park, Edith Cavell Jct., alt. 1220 m.	84	37.13	Resembles No. 30 and 36, d.b.h. 20.32 cm; dull white bark.
158	Banff Nat. Park, 2.2 mi.S. Eisenhower Jct., alt. 1591 m.			Resembles No. 30, 36, 145, except in bark character; d.b.h. 10.16 cm; bark creamy-white or pinkish; strongly exfoliating.
159	28 miles W. of Calgary.	70		Differs from all others in very large broadly ovate leaves with rounded base; fertile bract with short peduncle; sub-equal in length to median lobe; d.b.h. 27.94 cm; bark creamy-white, slightly exfoliating.
168	Waterton Lakes Nat. Park, W. side of Lake; alt. 1297 m.	84[3]	38.91	Differs from all others in very long narrow leaves; most closely resembles No. 145.

[1]All collections are from Alberta with the exception of No. 38 from British Columbia.
[2]Average of 20 measurements.
[3]Determination from two seedlings.
[4]Two seedlings with different chromosome numbers.
[5]Determination from five seedlings.
[6]d.b.h. = diameter at breast height.

Grant, 1965, 1967). However, no plants were found with a chromosome number of $2n = 56$, although a few plants had been found with this number in collections from the other areas. Guard cell measurements are consistent with those determined for *B. papyrifera* from other areas. No hybrids were detected although *B. fontinalis* Sarg. was of frequent occurrence in this area and hybridization between these species is well documented (Dugle, 1966).

The illustrations (Plate 1) will make it evident that the type of variation shown in these specimens is similar to that found in other regions of Canada (Brittain and Grant, 1965, 1966, 1967). We have been unable to discern any consistent pattern either in tree form, foliage, the finer characters of the seed, or in chromosome number to warrant the segregation of these specimens into subtaxa. The lateral lobes of the fertile bract were remarkably consistent in all specimens: they were invariably of the ascending type.

There has been nothing in the development of these *B. papyrifera* seedlings to differentiate them from those from other areas. The stem of the young seedling is glandular at first, but this character is lost in later development. The growth rate of the seedlings while less than the average of those from the lower mainland of British Columbia differed little from that of seedlings from other areas, varying from 76 to 101 centimeters per three years of growth.

Summary

A morphological and cytological study has been carried out on a collection of *Betula papyrifera* Marsh. from the Rocky Mountains of Alberta and British Columbia. As in eastern Canada and in western and south central British Columbia, *B. papyrifera* showed considerable variation in minor characters. One character found in common for all specimens was the ascending lateral lobes of the fertile bract. The mature trees differ somewhat from those of the Pacific Coast in crown shape and bark color but not sufficiently to warrant their separation into subtaxa. Somatic chromosome numbers of 70 and 84 were determined for seedling progeny. No hybrids were detected.

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Dr. W. Ogilvie was of the utmost assistance in the collecting trip and contributed the specimens from the Waterton Lakes National Park.

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NOTES

Red-throated Loon Nesting in Northern Ontario

DURING THE SUMMERS OF 1962, 1964, AND 1966 I had the opportunity to travel along the coast of Hudson Bay between Winisk and Cape Henrietta Maria, either on foot or by canoe. As a matter of interest, I usually kept a list of birds observed in my travels. On several occasions breeding Red-throated Loons (*Gavia stellata*) were observed on nests, giving distraction displays or attending flightless young. Not until the publication of W. E. Godfrey's "The Birds of Canada" (National Museum of Canada Bulletin No. 203, 428 p.) was I aware that the Red-throated Loon had not been recorded as a nesting species in northern Ontario. Otherwise, I would have collected specimens. However, on July 29, 1966 I took photographs of two adults with two downy young on a pond located about 1 mile from the Hudson Bay coast at 55°7′N and 82°43′W. One of these photographs was submitted to Mr. J. L. Baillie, Assistant Curator of Birds, at the Royal Ontario Museum. He confirmed the identification of the birds and now has the photograph in the Museum files.

The only other nesting observation I have recorded in my field notes was made at 55°15′N and 84°W on August 3, 1962. On that occasion I flushed an adult from a nest containing two eggs after I had approached to within 15 feet. Upon examination I found that the eggs were cold. When I returned to try to photograph the adult and nest the next day there was no sign of the adult and the eggs were quite cold. I assumed that the eggs were infertile since they had not yet hatched at that time of year.

This species is a relatively common nester in the coastal area covered on foot between the mouth of Burntpoint Creek (55°17′N and 84°10′W) and Cape Henrietta Maria. Nesting locations which I observed were located on small ponds ½ to 2 acres in size and 2 to 5 feet deep. The ponds are characterized by being deeper than the average for this area and by having a luxuriant growth of sedges around the edges.

This type of habitat is fairly continuous westward along the coast to the Manitoba border and I presume that nesting Red-throated Loons will be found when ground studies are made there.

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Cattle Egret In The District Of Algoma

THE AREA, WHERE the following observations were made, is about three miles NNW of a point on the map with the reading of 84°W and 46°30′N; or, just East of the Echo River, where it meets the boundary line between Kehoe Township and MacDonald Township, on the farm of Mr. & Mrs. Clifford Trotter.

On August 18, 1967, Mrs. Trotter reported seeing four (to her unknown) white birds flying past her window. She noticed that one of these birds remained with her cattle, from August 18 to August 30.

On August 24, Mr. Garry Rahn and Mr. Russ Dennison visited the farm to identify the bird. Mr. Rahn returned Aug. 25 with a 450 MM. lens and secured more than 25 pictures of the egret. I personally visited the Trotter Farm and talked to Mrs. Trotter. One readily identifiable photograph of the bird, a Cattle Egret, *Bubulcus ibis*, is deposited in the National Museum of Canada.

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Accepted November 24, 1967

Notes on Manitoba Plants. II.

Psoralea esculenta Pursh (Breadroot or Indian Turnips).

ON JUNE 24, 1967, I found several plants of this species about 25 miles northwest of Dauphin (T26, R21, W1). This locality is in Halliday's (1937) Boreal Forest Region, near the boundary between the Mixed Woods and the Manitoba Lowlands sections. The species does not appear to have been reported this far north before. Scoggan (1957) lists its habitat as "Dry prairie of southern Manitoba. Northernmost collection: Millwood . . ." The Breadroot was used as a food plant by the early travelers on the prairies. John Pritchard, who was lost in the Souris River area for over a month in the summer of 1905, gives, in a letter to his brother, one of the earliest descriptions of its use as food:

> "I this day found a plant, whose root the Canadians call the turnip of the plains. But not having a knife or axe to make a stick, I had no hope of digging them up; the root being at least a foot in the earth, and the ground extremely hard. The root is from two to three and one-half inches long and one and one-half in girth, by no means unpleasant to the palate. I thought upon the sticks I had taken from the wolf-trap, one of which I still retained. It, having been pointed for its former use was in every respect fitted for my purpose. I therefore set to work, which was very great labour for me in my weak state. Having eaten a few raw, I returned to my encampment with about half a dozen, roasted them for supper, and found myself greatly refreshed next morning."

Petalostemum candidum (Willd.) Michx. (White Prairie Clover).

On July 9th of the same year, and on the same site I found one plant of this species. This too, appears to be a first report from the Boreal Forest as defined by Halliday (1937). Scoggan (1957) gives its habitat as "Dry prairie of Southern Manitoba. Northernmost collection: St. Lazare . . ." Specimens of both the above mentioned plants were sent to the National Museum of Canada, Ottawa. Both species were found growing on the Upper Campbell glacial beach, just east of Brokenpipe Lake, between the lake and No. 10 highway. The Campbell is in two major strands, and is believed to co-date the Valders Advance of the Wisconsin glaciation. The upper strand, east of Brokenpipe, is typical prairie, with *Anemone patens*, *Viola pedatifida*, *Geum triflorum*, *Heuchera richardsonii*, *Penstemon gracilis*, *Chrysopsis villosa*, *Liatris punctata*, and *Gaillardia aristata*. Trees along the lakeshore include *Fraxinus pennsylvanica*, *Ulmus americana*, *Quercus macrocarpa*, and at least one specimen of *Populus deltoides*, none of which is typical of the Boreal Forest.

Along the west side of the upper strand lies a line of reedy meadows and swamps, with Brokenpipe acquiring the status of a lake, although it often freezes to the bottom in winter and is occasionally completely dry. The west side of the Lower Campbell, about half a mile east of the Upper, is marked by a band of coniferous forest, in contrast to the prairie flora of the beaches proper. Much of the area adjacent to the beach could be reasonably classified as Aspen Parkland rather than as Boreal Forest.

It is not clear whether the prairie flora here is pioneer or relict. The coniferous forest in the Duck Mountain is in retreat, a fact which would support a pioneer supposition. Blood, (1966) however, regards the fescue prairie in the Riding Mountain as relict.

Lotus corniculatus L.

Several plants of Bird's-foot Trefoil, *Lotus corniculatus* L. were noted in 1965 and 1966 just north of Gilbert Plains village, apparently as escapes from the

Collegiate lawn. In 1967 a quite massive escape was seen about seven miles north of Grandview town. This plant is not listed by Scoggan, or by Budd and Best, but it is becoming quite firmly established and probably should be added to the Manitoba Flora.

Asparagus officinalis L.

One plant of this species was found in September 1967, on the bank of the Valley River, about half a mile west of, and upstream from, the Village of Gilbert Plains.

Asparagus is quite often found established in the wild in the United States and adjacent to Canada, but the Gilbert Plains specimen may be the most northerly escape noted to date.

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Accepted January 18, 1968

A Possible Fieldfare Observation near Ottawa, Ontario

ON JANUARY 8, 1967, I was birding in Rockcliffe Park near Ottawa, Ontario. At the "Rockeries" I observed a robin-sized thrush-like bird that was strange to me. My field notes follow: Robin-sized, thrush-like with fairly large bill. Black tail which it bobs (or wags) fairly frequently when perched. Pearl gray head and rump. Dark mask-like mark at eye (similar to Myrtle Warbler). Brown wings and shoulders. Orange throat and breast with dark specks in breast. Clear centre gives effect of cutaway coat. White belly and spots in under-side of tail. Occasionally shows white mark at shoulder.

My review of reference material at home led me to suspect the possibility (fantastic though it seemed) of the bird being a European thrush named the Fieldfare (*Turdus pilaris* Linnaeus). I contacted S. D. MacDonald, Assistant Curator of Ornithology, National Museum of Canada, who agreed that the possibility existed. I also contacted Dr. John Woolley who was familiar with these birds through his observations in England.

On January 9, a party composed of Messrs. MacDonald, Woolley, Mr. Frank Cosenzo of the National Museum staff and I returned to Rockcliffe but were unsuccessful in locating the bird though Mr. MacDonald found thrush-like tracks and droppings indicating the presence of a fruit-eating bird.

Reference to Peterson's "Field Guide to the Birds of Britain and Europe" and to specimens in the collection of the National Museum, confirm my opinion that the bird was a Fieldfare. Godfrey's "The Birds of Canada" (National Museum Bulletin No. 203) notes that only one record exists for this bird in Canada (a skin found in the possession of an Eskimo off Baffin Island in 1939). It is also noted that a breeding colony became established in southwestern Greenland in 1937. The birds also breed in Eurasia from Norway to Siberia and winter south to the Mediterranean Sea and Northern India.

H. N. (HUE) MACKENZIE

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Accepted October 25, 1967

Studies of the Byron Bog in Southwestern Ontario. XXIX. The Virginia Chain Fern, an Addition to the Flora of the Bog.

IN THE REPORT BY JUDD (1967) an account is given of three species of club-mosses and eight species of ferns found in the Byron Bog. In that report it is recounted that on September 6, 1966 Mr. Eli Davis and the writer went through the bog looking for the Bog Club-moss, *Lycopodium inundatum*, but found no specimens. At the same time we were looking also for the Virginia Chain Fern, *Woodwardia virginica* (L.) Smith. Mr. Davis said that some time in about the last twenty-five years, on one of his frequent trips to the Muskoka area of Ontario, he had located the Chain Fern in a *Sphagnum* bog, possibly near Parry Sound, and had transplanted two or three plants to the Byron Bog, thinking that they would likely grow well in their new habitat and would make an interesting addition to the bog flora. He recalled that he put the plants in the soggy *Shagnum* moss south of Redmond's Pond in Zone A of the bog (see Fig. 1, Judd, 1967). It was for evidence of this planting that we were searching on September 6, 1966 but we failed to find any.

On September 9, 1967 I went into the bog and, on passing through the area south of Redmond's Pond, located a patch of Virginia Chain Fern growing in the wet moss in the general area where Mr. Davis had said his plants were put. The fern was identified as *Woodwardia virginica* with keys and descriptions in Cobb (1963), Cody (1956) and Fernald (1950). There were about ten plants occupying an area which was roughly square and of dimensions 5 yds. x 5 yds. The growth included sterile fronds and fronds in full spore-production. Three fronds were collected and put in the writer's herbarium with the following Accession Numbers: No. 735 – a sterile frond; No. 736 – a fertile frond on which the chain-like arrangement of sori was evident; No. 737 – a fertile frond on which the chain-like arrangement was obliterated by the great proliferation of rusty-brown sori.

Cody (1963), in discussing the distribution of *W. virginica* in Canada, gives a record for Middlesex County based upon a specimen in the Herbarium of the University of Toronto with the following data: TRT25631, R. T. Anderson, Sept. 10, 1898, London, Ont., wet swamps. There is no indication that the "wet swamps" included the Byron Bog but this record of 1898 does indicate that *W. virginica* is native to the vicinity of London. The collection made by the writer in 1967 in the Byron Bog may thus be either from plants native to the bog or from a growth originating from the few plants transplanted by Mr. Davis.

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Accepted November 15, 1967

Eight Erythristic *Plethodon cinereus cinereus* (Green) from Poison Lake Area, Cumberland County, Nova Scotia

THREE COLLECTIONS OF erythristic *Plethodon cinereus cinereus* (Green) were made in Cumberland County, Nova Scotia, approximately 15 miles west of Oxford in the summer of 1967. These collections constitute the third recorded occurrence of the phase in Canada. This phase was unknown to Canadian populations until August 16, 1957, when Francis R. Cook collected two adult specimens at Sandy Lake on North Mountain, north of Paradise, Annapolis County, Nova Scotia. (Bleakney and Cook, 1957, Copeia 1957 (2): 143).

The second occurrence of the phase was discovered on June 4, 1958. Francis R. Cook and J. Sherman Bleakney collected seven erythristic specimens in a series of nineteen *Plethodon c. cinereus* two miles west of the headquarters building, Fundy National Park, in southeastern New Brunswick. (Cook and Bleakney, 1961, The Canadian Field Naturalist 75 (1): 53).

The third Canadian occurrence was discovered by the writer in the Poison Lake area on June 3, 1967. Twenty adult *P. c. cinereus* were collected under rocks on two woods roads in maple birch forest at about 750′ above sea level.

On two of the specimens the dorsal surface was bright orange, with the exception of the tip of the tail and black fleck marks on the trunk and head. These specimens lacked lateral bands. The orange lateral surface of the trunk occurred in streaks and patches interrupted by the same cream color of the ventral surface. The lateral surface of the last three quarters of the tail had scattered black markings. The ventral surface was a cream color with orange fleck marks and was brighter on the chin becoming gray on the tail.

On the morning of July 24, 1967, a total of twenty-eight adult *P. c. cinereus* were collected under rocks, and under bark of large decaying, moist stumps and logs. Orange and cream colored mushrooms were abundant in the area. Three of the twenty-eight specimens were erythristic.

In the early afternoon of September 3, 1967, fifteen adult *P. c. cinereus* were collected under rocks. Eleven were of the common red-backed phase. One red-backed salamander was guarding six young, which were of the same color phase. Three other adults were erythristic. Another adult, guarding seven young salamanders, was different in color. The dorsal and lateral surfaces were mostly black with orange mottled patches. Black was the predominant color. The ventral surface was a steel gray color with black markings. The entire body had a peppered effect of minute steel gray spots. All of the seven young salamanders were of the common red-backed phase.

3 collections			
77 specimens			
	64 adults =	55	common red-backed phase
		8	erythristic
		1	mottled pattern
	13 young =		all of the common red-backed phase

There were no lead-backed *P. c. cinereus* collected in this area.

Reed (1955, Copeia 1955 (3): 253-254) presents a good review of the United States distribution of the phase with especial reference to its occurrence in western Connecticut. Richard Highton, in his *Revision of North American Salamanders of the genus Plethodon* (1962, Bulletin of the Florida State Museum, Biological Sciences 6 (3): 235-367), notes (on p. 303) specimens from western North Carolina and points out that the pigment fades in preservatives so that the geographic range of this phase can not be determined from museum specimens.

The three erythristic specimens collected on July 24 have been deposited in the National Museum of Canada where they are catalogued as NMC 10173. The remaining specimens are in the collection of the Nova Scotia Museum.

JOHN GILHEN

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Halifax, Nova Scotia
Accepted November 20, 1967

Summer Occurrence of the Fox Sparrow in New Brunswick

AS THE LATEST SPRING MIGRANT Fox Sparrows *Passerella iliaca* in New Brunswick are normally seen in the first week of May, the writer was somewhat surprised to find a singing bird of this species at Summit Depot, Restigouche County, on May 27, 1964. Others were discovered from then until August 5 when the species was last heard. Total for the summer was at least eleven singing birds in an area of approximately sixty square miles, extending from the Right and Left Hand Branches of Belone Brook in northern Madawaska County to Wild Goose Lake and Twenty-seven Mile Brook in western Restigouche County. They were observed in the following habitats: young balsam fir stands regenerating after clearcut, five birds; mature balsam fir stands, severely damaged by spruce budworm attack, two; mature balsam fir stands with pond and stream edge, two; young pin cherry — white birch — balsam fir fire stand, one; black spruce bog, one.

Additionally, a Fox Sparrow was captured, banded, and released at Summit Depot on July 14. Viewed through the skin, the skull appeared pink, that is, non-ossified, and the body feathers were very loosely webbed, both characteristics indicating that the bird was an immature.

In the same area the writer observed three singing birds between May 19 and 30, 1965, while on June 23, 1966, Dr. L. J. Mook recorded four Fox Sparrows on the fifty-stop Green River Breeding Bird Survey route.

The regular occurrence of Fox Sparrows singing on territory and the presence of an immature in mid-July suggest that the species must be an uncommon to fairly common breeding bird in this region. There is no evidence of its regular occurrence in summer elsewhere in New Brunswick. Also confined to this part of the province, in summer, is the Gray-cheeked Thrush *Hylocichla minima*. (The writer recorded individual Gray-cheeks singing near Left Hand Branch Belone Brook, June 9, 1964, and at Wild Goose Lake, June 22, 1964.)

The area of all these observations lies within the Green River District of the Gaspé — Cape Breton Ecoregion of Loucks (1962, Proceedings, Nova Scotian Institute of Science 25:85-167), a high, hilly region having a cool, moist climate. Thus the occurrence of Fox Sparrow and Gray-cheeked Thrush in this portion of northwestern New Brunswick is probably related to the same conditions influencing their occurrence in summer in parts of the Gaspé and Cape Breton.

DAVID S. CHRISTIE

Fundy National Park
Alma, N.B.
April 11, 1967
Accepted December 20, 1967

NEWS AND COMMENT

Canadian Botanical Association Newsletter

The Canadian Botanical Association which was founded in 1965, has started the publication of a regular newsletter to be known as the *Canadian Botanical Association Bulletin* and to be issued quarterly. The first issue (of seven 8 x 11 inch pages) includes a message from the president, Dr. R. L. Taylor, a program outline for the C.B.A. meetings to be held at Lakehead University June 11-14, highlights of the Executive Committee Meeting, reports of the various sections and news notes on the following subjects:

1. The Biological Council of Canada
2. Canadian Participation in the International Biological Program
3. Conference on Plant Gene Resources
4. Flora North America Project.

The Bulletin concludes with personal notes on the activities of its various members. Dr. J. H. Soper, National Museum of Canada, Ottawa is the treasurer of the Association.

The Okanagan Similkameen Parks Society Reports Progress

In May, 1966 a citizens group was started in British Columbia which has aroused wide interest among conservationists. The new organization was called the Okanagan Similkameen Parks Society. By mid-September the society announced the opening of a fund to purchase 576 acres of winter rangeland for a band of California bighorn sheep near Vaseux Lake. Four months later this land purchase was completed and the society was wondering what to do with the money still coming in.

This part of the story may be fairly well known but perhaps more information on the society's aims and progress to date might be of interest.

The original objective of the organization was to promote the idea of an integrated park plan for the Okanagan and Similkameen Valleys. The society evolved from a council formed by representatives from several local groups interested in parks and conservation. Some of these groups had tried to interest the provincial government in particular park projects without much success. After several months of discussion and planning, a public meeting was called to hear the plans and decide on a form of organization.

Public reaction to the movement was enthusiastic and the meeting decided to form a new society rather than continue as a council. Representatives attended from a wide variety of organizations such as naturalists, sportsmen, garden and geology clubs, historical societies, a Boy Scouts Council and chambers of commerce. When formal organization was completed at a later meeting the new board of directors represented many of these participating groups from communities throughout the plan area.

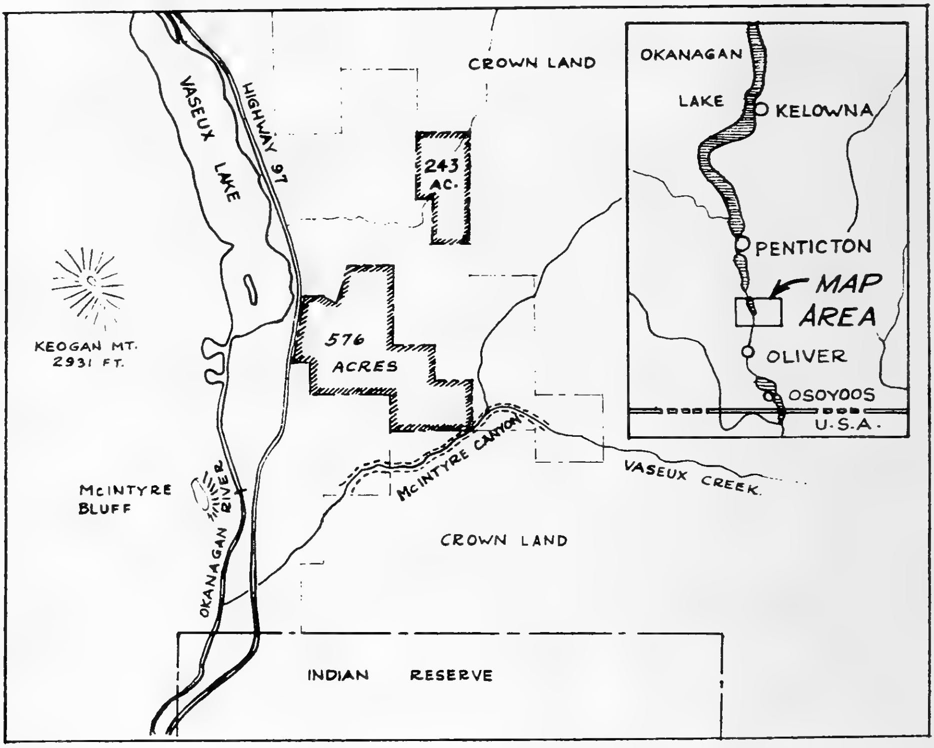

FIGURE 1. The area near Vaseux Lake, B.C. showing two blocks of land purchased by the Okanagan Similkameen Parks Society as part of a proposed park and winter range for California Bighorn Sheep.

Committees were appointed to develop briefs on six parks in the overall proposal for the district. A preliminary brief covering the integrated plan was forwarded to the appropriate ministers in Ottawa and Victoria. This was followed by the more detailed briefs prepared for each of the proposed parks in the plan.

In the meantime the 576 acre property at Vaseux Lake became available for purchase and the new society acted quickly in a move which may have changed the fate of a band of bighorn sheep and certainly provided the spark needed to kindle the public imagination. Reaction from Ottawa and Victoria has been encouraging and no doubt the initiative shown by the society and the clear demonstration of public support has made its impression. Useful contacts have been made with both federal and provincial leaders up to cabinet level and many meetings have been held with government officials. As a result studies are now underway in several of the park proposal areas.

One of the most encouraging aspects of this conservation effort is the prospect of scientific and educational use of areas such as Vaseux, Osoyoos and Cathedral Lakes. Government and university workers have already carried out scientific studies in these unique areas and recent enquiries suggest that

Photo by S. R. Cannings, 20 West Bench Drive, RR 1, Penticton, B.C.

FIGURE 2. Vaseux Lake, B.C. showing part of areas purchased by the Okanagan Similkameen Parks Society for nature reserve and California Bighorn Sheep range. The low mountain just across the lake and to the right includes nearly all of the 576 acres.

this type of use may provide a strong argument for acquisition of nature reserves.

The Okanagan Similkameen Parks Society have now made two installments on a second block of land east of Vaseux Lake. $2800 remains to be paid on this 243 acre property. When this purchase is completed the society feels it will be in a better position to deal with either the provincial or federal government on a final settlement of the Vaseux park proposal.

The society would like to see more of the private land in the area added to the park together with a generous amount of the adjacent crown land. As the federal government controls the waters of Vaseux Lake as a migratory bird sanctuary, it has been suggested that a co-operative project involving the federal and provincial governments and the O.S.P.S. might be the best approach. However, the society is ready to donate its property to any government authority that will incorporate it into a worthwhile park or nature reserve with a secure future.

Donations to the Vaseux Bighorn Fund would be very welcome and are income tax deductible. Please address to Okanagan Similkameen Parks Society, Box 787, Summerland, B.C.

KEJIMKUJIK, NOVA SCOTIA — GAME SANCTUARY

KEJIMKUJIK NATIONAL PARK has been declared a game sanctuary as a result of co-operative action by the Province of Nova Scotia and the Department of Indian Affairs and Northern Development, the federal department responsible for the National Park system.

An Order in Council passed by the Province makes effective in the Park the game regulations of the Lands and Forests Act with respect to sanctuaries.

Kejimkujik, the newest addition to the park system, is an area of about 140 square miles located in Annapolis, Digby and Queens Counties with entrance at Maitland Bridge, Annapolis County.

The long-term effect in the areas surrounding the park will be better hunting resulting from increased game population build-up and subsequent migration across the park boundaries.

The application of provincial game sanctuary regulations within the Park is an interim action pending final legislation placing the area in the National Parks schedule. At that time protection of the wildlife in the Park will be covered by the provisions of the National Parks Act.

Press Release,
Department of Indian Affairs
and Northern Development,
Ottawa.

REVIEWS

The Shell Bird Book

By James Fisher. Ebury Press and Michael Joseph, 1966. 344 pp., numerous illus. In Canada available from Thomas Nelson and Sons (Canada) Ltd., Toronto. $5.75.

The author, James Fisher, amply lives up to his reputation for producing a fact-packed yet informal and highly readable publication. This is a book about British birds and birdwatchers, not the usual guide to bird recognition. It might well have been entitled "Birds and Man" for it is concerned mainly with bird to man associations and especially with how birds are studied in Britain and by whom. The author's occasional remarks show him to be a discerning observer of man as well as birds. For example, "Birds, the most observable of the animals, are a litmus paper of a country's state of native culture."

Twelve chapters make up the book. The first two deal with the fossil record and history of British birds. Then follows a thorough account of the zoogeography of the British avifauna. Next an oddly-titled chapter "The Migrants" which, however, is concerned with methods of studying migration, not with accounts of the migrants themselves. An interesting history of bird protection in Britain is followed by a chapter called "Bird Gardening" with instructions on attracting birds with food, water, and nesting boxes, including interesting accounts of hard winters with high bird mortality going back at least to the year 671, and emphasizing how feeding may save many birds in such times. Perhaps a list of shrubs and trees that could be planted to attract birds would have been a useful adjunct.

A short chapter on bird song is followed by a 40-page one on birds in literature, music, and art. Then comes a "Guide to the Birds' Provinces" which must have required much careful compilation for there are lists of clubs, organizations, sanctuaries, reserves, zoos, a selected bibliography of British birds, and an impressive list of regional publications arranged by vice-counties (which are clearly mapped on the book's end papers). There is a six-page index to the birds mentioned, but not to the numerous other subjects dealt with.

The book is attractively and variously illustrated with 48 small but pleasing bird paintings in color by E. A. R. Ennion; 150 black and white drawings, maps, photographs, and diagrams; and twelve pictures in color of British bird reserves and sanctuaries.

The extent of the Shell Oil Company's connection with the book is not made clear. However both they and the author deserve great credit for producing such a useful book at a very modest price.

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The Sparrow's Fall

By Fred Bodsworth. Doubleday and Company, Garden City, N.Y. and Toronto, Ontario. 1967. 255 pp. $4.95.

Fred Bodsworth has written a love story against the harsh background of the Hudson Bay lowlands in winter. The hero and heroine – Jacob Atook and Niska, and the other man, Taka Cheechoo, are Caribou Indians who must use all their primitive knowledge and skills to wrest a living from the bleak forests of Northern Ontario. Jacob's problem is that he has been listening to Father Webber's explanation of God's great love that caused Him sorrow even when a tiny sparrow fell. To a hunter, the disturbing thought that God did not want him to kill, could have disastrous effects. To make things worse, Jacob and Niska eloped on the eve of her family's planned marriage to Taka. And now they are starving in their small tent hidden in the vast northern woods.

Into this basic pattern of a love story, Fred Bodsworth has woven the ecology of the forest – caribou and wolves and the raven. Skillfully the author guides Jacob and the reader to a deeper understanding of the significance of nature's harsh law – the survival of the fittest.

This is an exciting story, skillfully written. The cold bleakness of the Arctic tundra is numbing. Fred Bodsworth shows a deep understanding of the relationships between the northern animals and their environment. I have only one plaintive query – a caribou fawn born in March?

A. W. F. BANFIELD

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Radar Ornithology

By ERIC EASTWOOD. Methuen & Co. Ltd., London. 1967. xii + 278 pp. Liberally illustrated. 75 shillings. (Distributed in the United States by Barnes & Noble, Inc.)

Since 1964, the National Research Council of Canada's Associate Committee on Bird Hazards to Aircraft has taken films of radar displays at civil and military radar stations from coast to coast across Canada. The enormous quantities of film taken constitute an unique source of information on bird movements over the northern half of this continent. Members of the Canadian Wildlife Service, the Royal Canadian Air Force and the Meteorological Branch of the Department of Transport are engaged in the primary analysis of the film record – the relating of bird movements to weather conditions. Smaller scale analyses, e.g. of particular movements of such species as geese and Whistling Swans, have been carried out by faculty members of the University of Calgary and University of Toronto, and students at McMaster University.

The interpretation of bird movements on radar films, and their identification with particular species populations, requires considerable ornithological skill. Few North American ornithologists have watched migration actually in progress "live" on a console at a radar station. Dr. Eastwood's *Radar Ornithology* has, therefore, been published at a very opportune moment, and it should do much to encourage additional students to take part in the full utilization of the wealth of ornithological information available in the films taken in Canada.

Dr. Eastwood is a radar engineer at the Marconi Company in England, who became involved with birds when these were identified as being responsible for much of the "clutter" found on the plan position indicators of the increasingly powerful defence radars developed during the last ten years. Because of his technical background, Dr. Eastwood's book will be of particular value to ornithologists whose knowledge of physics is slight.

Of the fourteen chapters, two are devoted to the principles of radar and the electronics involved; two are devoted to why birds produce radar echoes, and how (bird-produced) "angels" are identified; two are devoted to study of the echo by electronic means (signature analysis) in order to determine what species of bird is causing an echo, how many birds compose an echo, and the number of birds involved in a roosting or migratory movement; two are devoted to the patterns of spring and fall migration which have been observed with radar in Europe and North America; and the remaining chapters discuss such topics as reversed migration, migratory orientation, drift by the wind and the altitude at which migrants fly – the recorded ceiling is 21,000 feet.

There are numerous line-drawings in the text – essential in any account of bird movements observed by radar. There are 24 pages of photographs which, among other things, illustrate aerials, consoles, "angels" on p.p.i's, "wing-beat patterns" and radar signatures, the different appearances of migratory movements of warblers, thrushes and shorebirds, and "ring-angels" produced by starlings leaving their roosts. It is unfortunate that the photographs have a flat grey quality (the publishers could surely have done better) and I do not like their cardboard-cutout appearance. There are five pages of references but it is unfortunate that many bird-radar studies have not been listed e.g. only one paper by Bellrose is included. I found more than a few inaccurate and incomplete citations.

This book is an indispensible introduction to radar-migration studies. It will be useful to anyone wishing really to understand the background of regional or species studies, based on radar observations, that have appeared in *Ibis*, *British Birds*, *Bird-banding* and other journals in recent years. It will be essential first reading for anyone preparing to conduct a radar study. By providing them with an explanation of the physical basis of radar as it applies to studies of birds with such sophisticated machinery, Dr. Eastwood has done ornithologists a great service, and he has done a good job also of making a bird-radar literature that is often excessively tedious, interesting for the general reader. Thank you Dr. Eastwood!

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Rocky Mountain Flora

By WILLIAM A. WEBER. University of Colorado Press, Boulder. 1967. viii + 437 pp. $9.40 U.S.

This is an excellent book, which I recommend with only one reservation. The scope is not as wide as the title suggests, for, as explained on the title page, it covers the southern Rocky Mountains from Pike's Peak to Rocky Mountain National Park and from the plains to the continental divide. Nevertheless it will simplify field identification in most of Colorado and will be a useful supplement in adjoining areas.

In order to include the 1500 species of vascular plants of the Front Range it was necessary to omit full descriptions. Instead the final division of the key often gives supplementary information, allowing the user to confirm his identification. The book is essentially what in Europe is generally termed an excursion flora. Many of the widespread species are illustrated with excellent line drawings by C. F. Yokum.

The keys are frankly artificial, but are based on abundant experience and seem to be thoroughly practical. (I was impressed by the warning in a preliminary key that poison ivy occurs in the group in question.) In strongly represented families there may be separate keys to each genus; but, where few species occur, space is saved by treating the whole family in a single key.

All too often condensed floras, aimed principally at the amateur naturalist, are of very little use to more serious workers. In contrast, Weber's book shows how well a skillful author can combine simplicity with completeness and accuracy. There are no species citations and only minimal synonyms; but, to judge from examination of sample genera the taxonomy and nomenclature is extremely up to date. In fact one species is included that was published in December 1966. Thus, for those requiring modern nomenclature and species concepts for the region, this book will be extremely valuable.

D. B. O. SAVILE

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Modes of Reproduction in Fishes

By CHARLES M. BREDER, JR. and DONN ERIC ROSEN. Published for the American Museum of Natural History by the Natural History Press, Garden City, New York. 1966. 940 pp., 56 illustrated charts. $20.00.

Impelled by annual grants to publish quickly and by promotion based on output of papers to publish often, scientists are publishing more and shorter articles in the scientific "weeklies." Few scientists are able to resist these pressures and progressively fewer large and maturely considered monographs are appearing. It therefore gives me satisfaction to review Breder and Rosen's 900 page treatise, collected and written over a period of 33 years, covering the Amphioxi, Agnatha, Placodermi, Chondrichthyes and the Osteichthyes.

The body of the monograph, following a brief introduction, consists of descriptions of reproduction in the various species, which are grouped in families and arranged phylogenetically. Summaries are given at the beginning of each major taxon.

The sizes of the species accounts vary considerably according to what is known – they may be only a line or two, or as much as five pages. According to the introduction the following features are treated: breeding season, breeding site, migration, secondary sex characters, sex discrimination, competition for mates, courtship, mating and parental care. But frequently egg form, adhesiveness and buoyancy, hatching time and age at sexual maturity are also included. Accounts follow the sources closely, a method which often gives something of the flavour of the original and makes for interesting as well as accurate accounts. The sources are always cited. The reader is referred to Dean's *Bibliography of fishes* for the full citation of earlier references. Later references, over 2,000 of them, are given in a bibliography at the end of the book. The cut-off date for references is 1962.

These accounts reveal the rich variety of reproductive methods in fishes, from oviparity to viviparity, from nest builders to mouth breeders, and from demersal to pelagic eggs. Described, for example are the habits of a characin, *Copeina arnoldi*, a pair of which leaps together out of the water to deposit and fertilize their eggs on vegetation or on a stone, and a Kamchatkan *Careproctus* which lays its eggs in the gill chamber of a crab.

Following the species accounts which comprise the body of the text, is a summary. This section succinctly surveys the diversity in certain aspects of reproduction – mating associations; mating habits, breeding sites and migration; and secondary sexual characters and mating patterns.

After the summary is a 56 page illustrated chart which outlines for each family what is known of secondary sex characteristics, mating, breeding sites, sex products, parental care and migration. A line drawing of a typical member of each family is provided. A bibliography and an index to taxa completes the volume.

The most disappointing aspect of the book, to this reviewer, is the lack of analysis. There is no discussion of reproductive phenomena cutting across evolutionary lines. No generalizations are made about, for example, viviparity, cavernicolous, and deep-sea reproduction, or sexual dimorphism. Why, for example, are eggs often placed on the ceilings of the nests? Does this avoid the settling out of sediment on eggs? Definitions to terms are not provided, nor are illustrations (aside from chart figures) included.

When covering such a wide field it is difficult not to miss references. The following references (some of which are after the cut-off date) cover taxa for which little or no information was recorded and are intended as an addenda rather than a criticism. Brodal and Fänge (1963) in *Biology of Myxine* give a comprehensive survey of the biology of the hagfish. Spermatophores, an unusual feature, are known in the basking shark, *Cetorhinus maximus* (Maxwell, 1955, *Harpoon at a aventure*). Millot and Anthony (1960, C. R. Acad. Sci. Paris 251: 442) describe reproductive organs of the coelacanth, *Latimeria chalumnae*. Okada (1959-60, Journal of the Faculty of Fisheries, Prefectoral University of Mie) gives considerable new information on the reproduction of Japanese freshwater fishes, including the Salangidae, and Andriashev (1954) in his *Fishes of the northern seas of the U.S.S.R.* presents material on Arctic fishes, especially the Stichaiedae and Zoarcidae. Blacket (1962, Copeia (1): 128) and Krejsa (1964, Copeia (2): 448) give data on reproduction of *Dallia* and *Synchirus*, respectively. Taliev's (1955) monograph *The sculpins of Lake Baikal* is omitted and the Baikal Comephoridae are erroneously ascribed to the marine waters of northern Europe. *Lapsus calami* include the placement of *Lestidium* in the Alepisauridae instead of Paralepididae, and *Ernogrammus* is the Hexagrammidae instead of Stichaeidae.

Much is unknown about fish reproduction. The breeding habits of only 300 of the 20,000 species are well known. Most of our knowledge is based on 9 families. The author's provision of lists of families whose reproduction is unknown will be a valuable stimulus to research. It is certain that this monograph will remain for many years a source book and guide to those interested in aspects of fish reproduction, be they ichthyologist, ethologist, fishery biologist or aquarist.

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OTHER NEW TITLES

The following titles are offered as a service to readers. Their listing does not preclude them from possible review in a future issue of the Canadian Field-Naturalist.

The Apes. The Gorilla, Chimpanzee, Orangutan and Gibbon, Their History and Their World. Vernon Reynolds. Dutton, 1967. 296 p. 110 plates. Drawings. Maps $10.00 (US).

In the Service of Man. Technology and the Future of Human Values. J. V. Langmead Casserley. Regnery, 1967. 204 p. $4.95 (US).

The Mammals. Young Readers Edition. Adapted from text by Richard Carrington, Eds. of Time-Life Bks. Time Inc., 1967. 128 p. Illus. $3.95 (US).

River Plains and Sea Coasts. Richard J. Russell. Foreword by Carl O. Sauer. Univ. of Calif. Press, 1967. 173 p. Photographs. Maps. $8.75 (US).

Seawatchers. Oceanographers in Action. William Bixby. McKay, 1967. 215 p. Illus. by John Flynn. $4.25 (US).

They Dared the Deep. A History of Diving. Robert F. Marx. World Pub. Co., 1967. 160 p. Illus. $3.95 (US).

Hummingbirds. Walter Scheithauer, transl. from German by Gwynne Vevers. Crowell, 1967. 176 p. 76 color photographs by author. Drawings. $10.00 (US).

The World of the Frog and the Toad. George Porter. Lippincott, 1967. 153 p. Photographs by author. $4.95 (US).

World of the Great White Heron. A Saga of the Florida Keyes. Marjory Bartlett Sanger. Devin-Adair, 1967. 146 p. Illus. by John Henry Dick. Map. $10.00 (US).

Animals of the North. William O. Pruitt, Jr. Harper and Row, New York, 1967. 183 p. Illus. $5.95 (US).

Trap-Nesting Wasps and Bees. Life Histories, Nests, and Associates. Karl V. Krombein. Smithsonian Press, Washington, D.C. 1967. 576 p. Illus. $12.50 (US).

The Larousse Encyclopedia of Animal Life. McGraw-Hill, New York, 1967. 640 p. Illus. $25.00 (US).

Album of North American Birds. Vera Dugdale. Illustrated by Clark Bronson. Rand McNally, Chicago, 1967. 112 p. $3.95 (US).

The Life of Prairies and Plains. Durward L. Allen. Published in cooperation with World Book Encyclopedia. Our Living World of Nature Series. McGraw-Hill, New York, 1967. 232 p. Illus. $4.95 (US).

A Naturalist in Russia. Letters from Peter Simon Pallas to Thomas Pennant. Carol Urness (Ed.). University of Minnesota Press, Minneapolis, 1967. 189 p. Illus. $7.50 (US).

Science and the Mass Media. Hillier Krieghbaum. New York University Press, New York, 1967. 242 p. $6.95 (US).

Scientific Principles and Moral Conduct. James B. Conant. Cambridge University Press, New York, 1967. 48 p. $1.95 (US). Arthur Stanley Eddington Memorial Lecture, Princeton University, 1966.

Structure and Habit in Vertebrate Evolution. G. S. Carter. University of Washington Press, Seattle, 1967. 520 p. Illus. $9.50 (US).

The Structure of Life. Royston Clowes. Penguin, Baltimore, 1967. 312 p. Illus. Paperback. $1.95 (US).

Technology in Western Civilization. Melvin Kranzberg and Carroll W. Pursell, Jr. (Eds.). Two volumes, boxed. Volume 1, The Emergence of Modern Industrial Society: Earliest Times to 1900 (802 p. Illus.). Volume 2, Technology in the Twentieth Century (822 p. Illus.). Oxford University Press, New York, 1967. $27.50 (US).

Wilderness and the American Mind. Roderick Nash. Yale University Press, New Haven, Conn. 1967. 256 p. $6.50 (US).

The Biology of Aquatic Vascular Plants. C. D. Sculthorpe, St. Martin's Press, New York, August 1967, 610 p. Illus. $23.00 (US).

The Lichen Symbiosis. Vernon Ahmadjian, Blaisdell Publishing Co., A Division of Ginn & Co., Waltham, Mass. 1967, 152 p. Illus. $5.75.

The Monocotyledoneae: Cat-Tails to Orchids. E. Lucy Braun, with Gramineae by Clara G. Weishaupt, original drawings by Elizabeth Dalve and Elizabeth King, The Vascular Flora of Ohio, Vol. 1, The Ohio State University Press, Columbus, Ohio, 1967, 464 p. Illus. $10.00 (US).

Olduvai Gorge. L. S. B. Leakey (Ed.). Vol. 2, The Cranium and Maxillary Dentition of *Australopithecus* (*Zinjanthropus*) Boisei, P. V. Tobias. With a foreword by W. E. Le Gros Clark, Cambridge University Press, New York, 1967, 264 p. Illus. $17.50 (US).

The Wolves of Isle Royale. L. David Mech, Fauna of the National Parks of the United States, Fauna Series 7, 1966, United States Government Printing Office, Washington, D.C., 210 p. Illus. $1.00 (paper).

Play, Exploration and Territory in Mammals. Proceedings of a symposium, London, Nov. 1965. P. A. Jewell and Caroline Loizos (Eds.). Published for the Zoological Society of London by Academic Press, New York, 1966. 294 p. Illus. $11.50 (US).

Taxonomy, A Text and Reference Book. R. E. Blackwelder. John Wiley and Sons, New York and London. 1967. 698 p. 150 s.

Molecular Mechanisms of Temperature Adaptation. Publication No. 84 of the

American Association for the Advancement of Science. Washington, D.C. Horn-Shafer Co., Baltimore, Maryland. 390 p. Contains the proceedings of a symposium held at Berkeley, California in 1965. 24 contributors.

Life, Land and Water. William J. Mayer-Oakes (Ed.). University of Manitoba Press. 1966. Proceedings of the 1966 Conference on Environmental Studies of the Glacial Lake Agassiz Region. Contributions by 19 specialists. Illus. About 400 p. Paperbound $4.00. Clothbound $6.00 (Canadian or US Funds).

Parable of the Beast. John N. Bleibtreu. Macmillan, 1968. A study of man as an animal and his relations to the rest of the animal world. $6.95 (US).

Audubon Book of True Nature Stories. John K. Terres. Crowell 1968. Selected true stories from the "Audubon" Magazine, of man's experiences with the animal world. $6.95 (US).

Adaptations for Locomotion and Feeding in the Anhinga and the Double-Crested Cormorant. Oscar T. Owre. Ornithological Monographs No. 6. American Ornithologists Union 1967. Illus. 138 p. $3.50 (US).

Canadian Society of Wildlife and Fisheries Biologists, Occasional Papers No. 2. M. T. Myres (Ed.). Published by the CSWFB in 1967. 50 p. $0.50.

Articles on the following topics are included:

1. Resource Administration and Development in the Northwest Territories — a proposal by the CSWFB.
2. A Role for Wildlife in Canada Today — by W. A. Benson.
3. The Biologists' Role in Fisheries Management — by C. P. Ruggles.
4. Canada's Water Resources — How Adequate Are They? — by C. R. Stanton.
5. The Evaluation of Two Aspects of Hatchery Stocking in British Columbia.
6. Implications of ARDA to Wildlife and Fisheries Management — by W. J. D. Stephen.
7. Operational Research and its Potential Application to Biological Research and Management — by C. E. Law.

Available only from Dr. M. T. Myres, Dept. of Biology, The University of Calgary, Calgary, Alberta.

The Breeding Bird Survey, 1966. C. S. Robbins and W. T. Van Velzen. U.S. Dept. of The Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. Special Scientific Report — Wildlife No. 102. February 1967. Washington, D.C. Illus. 43 p.

Birds and Aircraft on Midway Islands, 1959 — 63 Investigations, Special Scientific Report — Wildlife No. 85. C. S. Robbins, U.S. Dept. of The Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. October 1966. Illustrated. 63 p. $0.45 (US).

Functional Design in Fishes. R. McN. Alexander. Hutchinson University Library, Hutchinson & Co. Ltd. 1967. 160 p. 10 s. 6 d. in paperback.

Estuaries. George H. Lauff (Ed.). AAAS, 1967. 525 illustrations. 776 p. 7¾" x 10½". $27.00 (US). Contributions to a symposium by outstanding scholars.

Taxonomic Literature. F. A. Stafleu. A selective guide to botinical publications with dates, commentaries and types. Ragnum Vegetabile Vol. 52. 556 p. Published in co-operation with Inter-Documentation Company, Zug. $18.00 (US).

Cellular Injury and Resistance in Freezing Organisms. Proceedings of an international conference on low temperature science sponsored by the Institute of Low Temperature Science, Hokaido University. Volume 2. Conference on Cryobiology. Bunyeido Printing Co., Sapporo, Japan. 257 p., 15 contributions.

Formulation of Research Policies. Collected Papers from an International Symposium. AAAS, 1967. L. W. Bass and B. S. Old (Eds.). Illus. 218 p. $7.75 (US).

Ground Level Climatology. Robert H. Shaw (Ed.). AAAS, 1967. Illus. 408 p. $12.50 (US).

Agriculture and the Quality of the Environment. N. C. Brady (Ed.). AAAS, 1967. 476 p. $13.50 (US). Contributions of 36 scientists considering specific aspects of (1) Agriculture and Air Quality, (2) Agriculture and Water Quality, (3) Soil Pollution in Agriculture and (4) Human and Animal Wastes.

Handbook on Orchids. Carl Withner with Sarah and Phillips Jesup, Eds. Brooklyn Botanic Garden, 1967. 81 p. color plates, photographs, paper, $1.25 direct to publisher, Brooklyn, N.Y. 11225. There are 30,000 recorded orchid species in the world, growing both at sea level and at 14,000 feet above. This manual contains a wealth of information for the amateur greenhouse gardner.

The Life of the Pond. William H. Amos. McGraw-Hill, 1967. 232 p., color photographs, drawings, $4.95. Describes the complex communities of plants and animals that thrive in natural and man-made ponds.

Transactions of the Thirty-First Federal-Provincial Wildlife Conference. Canadian Wildlife Service, Department of Indian Affairs and Northern Development. 1967. 97 p.

Contents:

Vermont Life Book of Nature. Ronald Rood and others. The Stephen Press, 1967. 188 p. $6.95 (US).

Patterns in the Balance of Nature, and related problems in Quantitative Ecology. C. B. Williams. Academic Press 1964. 324 p. $9.50 (US). For the professional ecologist and taxonomist.

Genetics of Fungi. Karl Esser and Rudolph Kuenen, translated from German by Eric Steiner. Springer-Verlag New York Inc., New York. 1968 (originally published in 1965). 500 p. Illus. $18.50 (US).

The Komarov Botanical Institute: 250 Years of Russian Research. Stanwyn G. Shetler. Smithsonian Institution Press, Washington, D.C. 1967. Illus. 240 p. $5.95 (US).

The Wild Gardener in the Wild Landscape. H. Hamilton. Hafner Publishing Co., Inc., 31 East 10th Street, New York 10003. 1967. 232 p. Illus. $7.50 (US). A book that favors the natural look — for lawns it proposes stabilized, unmowed grasslands.

Scanning the Sky. Birds on Radar; Weather and Migration. I. C. T. Nisbet and W. H. Drury. Reprint from *Massachusetts Audubon*, Summer and Autumn, 1967. 16 p. A non-technical report on radar investigation of migrating birds in New England. Available from Massachusetts Audubon Society. South Great Road, Lincoln Massachusetts, 01773.

The Prairies and the Ducks. David A. Munro. Reprint from the Canadian Geographical Journal, July, 1967. Illus. 12 p. Available from the Canadian Wildlife Service, Ottawa. A non-technical publication of general interest.

The Fresh-Water Fishes of British Columbia. G. C. Carl, W. A. Clemens and C. C. Lindsey. B.C. Provincial Museum Handbook (5): 1-192. Illus. Color. Fourth Edition (reprinted with corrections). December, 1967. $0.75.

Forest Wildlife Management. Bryant A. Batemen (Ed.). Louisiana State University Press, 1968, 108 p. Maps. $5. Papers for 1967 Forestry Symposium primarily concerned with the forest as a habitat for game species, both mammals and birds, in the South.

Scientific Progress and Human Values. Edward and Elizabeth Hutchings (Eds.). Preface by Lee A. Durbridge. Am. Elsevier Pub. Co. 219 p. Diagrams. $7.50. Proceedings of conference celebrating the 75th anniversary of the California Institute of Technology, 1966. Papers range from discussion of the elementary particles of matter of the role of the educator in a scientific world.

Snakes of India. P. J. Beoras. NBT, India (Amcorp Ltd., N.Y.), 1965. 148 p. Color plates. Photographs. Drawing. $3.00. Written by specialist for the layman. The book tells of the importance of snakes in Indian culture, describes the main species, their identification, anatomy, habits, venoms and treatment.

Tracks. E. A. Ennion and N. Tinbergen. Oxford University Press. 1968. 63 p. Photographs. Drawing. $4.25. Shows how to identify and interpret the tracks and traces of small wild animals, including birds.

Waste Water Renovation and Conservation. Penn State Study No. 23 – R. R. Parizek and others – Pennsylvania State Univ., 1967. 71 p. Illus. Folded may. Paper. $2.00. Investigates the feasibility of a system for spraying sewage effluent on croplands and forested areas to establish a cycle of renovation and return most of the waste water to the underground reservoir.

Water is Everybody's Business. The Chemistry of Water Purication – A. S. Behrman – Doubleday, 1968. 229 p. Illus. $4.50. Paper, $1.45. Treatment stresses modern chemical technology's contributions to deal with water impurities and describes processes for their removal.

REPORT OF COUNCIL TO THE EIGHTY-NINTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 18, 1967

DURING the past year, eight meetings of Council were held at the National Museum of Canada: January 5, 23, March 30, April 10, June 6, August 31, October 12 and December 8, 1966. The average attendance was eleven members. The Club's business was conducted in the usual orderly manner.

Appointments for 1967 were made as follows:

Editor, THE CANADIAN FIELD-NATURALIST	– T. MOSQUIN
Business Manager, THE CANADIAN FIELD-NATURALIST	– W. J. CODY
Chairman, Publications Committee	– J. M. GILLETT
Chairman, Excursions and Lectures Committee	– MRS. H. A. THOMSON
Chairman, Reserve Funds Committee	– H. LLOYD
Chairman, Membership Committee	– I. BRODO
Chairman, Bird Census Committee	– G. H. MCGEE
Chairman, Macoun Field Club Committee	– I BRODO
Chairman, F.O.N. Affairs Committee	–
Chairman, Public Relations Committee	– A. NEWMAN
Chairman, Sites Committee	– W. K. W. BALDWIN
O.F.N.C. Representative to A.A.A.S. Council	– V. E. F. SOLMAN
Chairman, Constitutional Committee	– T. MOSQUIN
Chairman, Natural Areas Committee	– T. MOSQUIN

REPORT OF THE PUBLICATIONS COMMITTEE

Since the last report of Council, five numbers of THE CANADIAN FIELD-NATURALIST have been published. These include Volume 80, Number 3, July-September 1966, containing 63 pages and Number 4, October-December, containing 87 pages; Volume 81, Number 1, January-March 1967, containing 78 pages; Number 2, April-June, containing 83 pages and Number 3, July-September, containing 77 pages. The breakdown of items by subject for the five numbers is as follows:

	ARTICLES	NOTES	REVIEWS
Botany	16	2	8
Herpetology	3	1	1
Icthyology	4	2	4
Mammology	8	3	4
Ornithology	9	25	7
Miscellaneous	2	3	14
	42	36	38

In addition to the above summary there were 18 other items such as Editorials, News and Comment, and Special Notices.

Expenditures for the year were as follows:

Volume 80 (Nos. 3 and 4) and Volume 81 (Nos. 1, 2 and 3)	$5,561.21
Reprints for Volume 80	1,640.05
Total	$7,201.26

The publication of THE CANADIAN FIELD-NATURALIST was again supported this year by a grant of $500 from the Conservation Committee of the Canadian National Sportsmen's Show. This assistance is gratefully acknowledged.

This year a new periodical entitled "Trail and Landscape" was begun by the Club. The objective of this periodical is to publish articles of a non-technical nature for naturalists residing in the Ottawa Valley. To date all five numbers of Volume 1, containing a total of 128 pages, have been published. This new venture has been received with considerable enthusiasm by the local membership.

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

The Excursions and Lectures Committee met six times during the year to arrange a total of thirty-nine natural history activities for the local membership.

The annual spring banquet, held this year at the Eastview Hotel on April 11, was enjoyed by over a hundred members, with James Woodford, Executive Director of the Federation of Ontario Naturalists, as guest speaker.

Five lectures were held: Courtship Behaviour of Blue Grouse by S. D. MacDonald, Orchids and Bog Plants by E. Greenwood, Primitive Spore Plants by W. Illman, Our National Parks by A. Helmsley and D. Muir, and Astronomy for Beginners by D. Brunton. In addition, three study group meetings were held on bird identification, bird calls and warbler songs.

There were eighteen bird outings, featuring winter birds, early spring migrants, marsh birds, May migration, dawn chorus, breeding birds, shore birds and migrating waterfowl. Other outings featured animal tracks, salamanders, a general excursion to Gatineau Park, Flynn Creek heronry, Woodcock territorial flight, early spring flowers, orchids, insects, spore plants, botany and geology.

The Committee wishes to thank all those who made this program possible by leading field trips and conducting lectures and study groups.

REPORT OF THE RESERVE FUNDS COMMITTEE

A total of $1,700.00 was invested in Canada Savings Bonds Series 1967-68 on November 15, 1967.

The sale of a $1,000 Hydro-Electric Power Commission 3% Bond due January 16, 1958 for $996.52 plus $703.48 cash from Reserve Account deposits provided the funds for this purchase.

Funds remaining in Reserve Fund accounts amount to $120.14 and consideration should be given to further investment as soon as the sum available exceeds $500.00.

Report of the Sites Committee

Members of the Committee have been active with several projects, notably: the Mer Bleue and the Rideau River Conservation Authority; continued consultation on developments in Gatineau Park (following Mrs. Thompson's initiative); the survey of localities of orchids (Mr. Edward Greenwood's enterprise); and the proposals for purchasing sites placed before Council.

Report of the Constitutional Committee

A study of the Articles of Incorporation, the Constitution and the By-Laws of the club was started in June 1967 and is continuing. A considerable number of amendments and additions are planned. These will be presented for consideration to Council before March 31, 1968.

Report of the Natural Areas Committeee

The Natural Areas Committee held two meetings in 1967. The topic of discussion was "The role of the Ottawa Field-Naturalists Club in the preservation of Natural Areas". A letter was written to the Ontario Department of the Provincial Secretary and Citizenship in order to find out whether our club can purchase and own property in Ontario. A reply was received from the solicitor stating that the powers and privileges of our club (which was originally incoporated in Ontario on February 29, 1884) are presently defined in Section 288 of the Ontario Corporations Act which reads as follows: "A corporation has power:

(a) to construct, maintain and alter any building or works necessary or convenient for its objects;

(b) to acquire by purchase, lease or otherwise and to hold land or interest therein necessary for its actual use and occupation or for carrying on its undertaking, and when no longer so necessary, to sell, alienate and convey the same." – Revised Statutes of Ontario, 1960, Chapter 71.

It is clear, therefore, that the Ottawa Field-Naturalists' Club can purchase and own property in Ontario. Members of the committee are now making a survey of lands west and south of Ottawa in an attempt to discover areas that may be suitable for our purposes.

Report of the Bird Census Committee

The forty-eighth consecutive Annual Christmas Bird Count was held on Sunday, January 1, 1967.

A total of 9,404 birds of 49 species was reported, compared with 8,367 birds of 52 species last year. The number of individuals is a new record. The number of species is well above the 10 year average of 44.

One new species, the Savannah Sparrow, was added to our all time list which now totals 95 species.

A total 44 observers in 13 parties participated in the count. The details of the count were reported to the National Audubon Society and were published in the Audubon Field Notes. The count data was also published in

(a) The January 1967 Newsletter and

(b) The "All Ontario Tabulation", compiled by the Kitchener-Waterloo Field-Naturalist Club.

REPORT OF THE MEMBERSHIP COMMITTEE

1. One official committee meeting was held, but informal discussions between the chairman and committee members were frequent.
2. A promotional membership letter and application forms were enclosed in the first issue of Trail and Landscape.
3. A suggestion for membership cards (which did not originate from this committee) was voted down in council, mainly because of the necessity of replacing them each year for all members. In its place, a letter of Club acceptance and official welcome was agreed upon. Such a letter was drafted, duplicated, and sent out to all members who joined, August through November. All new individual (non-institutional) members will receive this letter in the future.
4. A letter to parents of Macoun Field Club members, inviting them to become members of the O.F.N.C., was drafted and duplicated and will be sent out as soon as envelopes have been addressed.
5. At the suggestion of Ted Mosquin, an invitation for gift memberships was drafted and sent out to all local members.
6. A brochure describing the club and containing a membership form is being printed (by Love Printers, Ltd.). Illustrations were done by Mrs. Brenda Hass. The brochure is meant to be used in 1968 only (or until a new constitution is approved).
7. Finances: See Treasurer's Report.
8. Membership totals (communicated by the Treasurer from her records):

Active: Local (Ottawa area)	245
Nonlocal	647
Total	892
Associate (only local)	86
Honorary	5
Life	7
Total	990

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

The Macoun Club "year" actually begins with the school year in September. This report will therefore cover part of last year's program, and part of this year's.

1. *Membership.* Membership fluctuates quite a bit particularly in the Senior (or high school) Group, and therefore, the numbers given below are averages. A complete turnover occurs in September. The maximum for each group is 35.

Group	*1966-1967*	*1967-1968*
Junior (Grades 4-6)	35	35
Intermediate (Grades 7-8)	21	30
Senior (Grades 9-13)	21	21

2. Activities.

A. Field Trips: *Senior Group*

Winter birds — Aylmer area
Animal tracks — Meach Lake area
Peat bogs — Mer Bleue
Autumn skies — Ottawa Observatory
Autumn birds — Shirley Bay
Caving — Lusk Caves

Intermediate and Junior Groups

Mounted bird collection — Mr. A. Bourguignon
Winter tree identification — Rideau Canal area
Spring natural history — Meach Lake area
Autmun birds — Shirley Bay

Joint trip with all Groups

Hilton Iron Mines, Shawville, Que.

B. Speakers: Invited speakers were part of the Senior Group program. We had 12 speakers this year all of whom were excellent. Their names will be published in the Little Bear in May.

C. "Observation periods" with member participation, microscope work (of elementary and advanced types), films, slide showings, games, and informal talks and discussions were also conducted.

3. *Assistance*: The Macoun Field Club could not possibly be run without the valuable help of Mr. Michael Shchepanek. He took charge of all library affairs, the point-award system, the procurement of films, and many other day-to-day jobs that keep things running smoothly. He also attends all the Saturday morning meetings to help out there. Mr. Pat Wohler of the Museum Education Section is a valuable aide in administrational affairs.

4. *Macoun Room facilities*: Room 359 of the National Museum, although now in use as a general conference room for Museum meetings, still is assigned for prime use by the Macoun Field Club. It was completely cleaned up at the beginning of the year. A new window shelf was installed which will be used for display material and terraria and aquaria. A magazine rack-cupboard was "appropriated" (having fallen out of use in another Museum office and now being put to good use in the Macoun Room to display new book and magazine acquisitions. A valuable egg collection was put into a special display case by two former Macoun Club members last year, but a cover for the case still has not been made.

5. *Library*: The library continues to expand, mainly through contributions, although a number of books were purchased as well. Approximately 40 to 45 books were added this year bringing the total to 318 books available for loan. In addition, a number of encyclopedias, large reference volumes, and magazines are available for use by the members within the Club room.

For a full financial report, see the Treasurer's Report.

6. *Miscellany*:

A. The field trip contribution, requested (but not required) from each member attending a trip, has been raised from 25c to 50c. This was done to ease our budget and permit more purchases of books and equiment.

B. The meeting time of the Junior Group was changed from 11:00-12:00 to 11:15-12:45 to permit a 15 minute period between Intermediate and Junior meetings for library use.

C. The annual party was held in late May (instead of in the fall as had been the practice in recent years) and was combined with award presentation.

D. A new award "The Badge Winner's Honour Circle" was instituted for members who qualify for a Macoun Club Badge (due to active participation in Club affairs) but who already have the badge from a previous year.

E. Membership cards for all members were introduced.

STATEMENT OF FINANCIAL STANDING
THE OTTAWA FIELD-NATURALISTS' CLUB, NOVEMBER 30, 1967

CURRENT ACCOUNT

Assets		Liabilities	
Balance in Bank Nov. 30/67	$ 7,217.02	Cheques Outstanding	$ 2.62
Bills Receivable	271.24	Balance	7,485.64
	$ 7,488.26		$ 7,488.26

Receipts			Expenditures		
Balance, Nov. 30, 1966		$ 7,254.74	Can. Field Nat. (4 nos.)		$ 5,561.21
Fees:			Separates & Illustrations		1,640.05
Current	$3,643.11		Editor's Honorarium		200.00
Arrears	94.85		Bus. Manager's Honorarium		100.00
Advance	310.00		Trail & Landscape		514.25
Associate	276.15		Macoun Field Club		111.48
		4,324.11	Bird Books, E. Godfrey		937.50
Separates & Illustrations		2,836.61	Postage & Stationery		356.20
Back Numbers		236.10	Exc. & Lectures Committee		94.64
Advertising		79.10	Roneo Machine		274.58
Geologies		473.25	Miscellaneous		126.72
Donation, Sportsmen's Show		500.00	*Bank Bal. Nov. 30/67	*$7,217.02	
Bird Books, E. Godfrey		1,175.15	Less o/s Cheques	2.62	
Macoun Club Collections		91.00			7,214.40
Trail & Landscape Copies		37.75			
Miscellaneous		123.32			
		$17,131.03			$17,131.03

RESERVE FUND

Assets		Liabilities
Can. Savings Bonds, S22	$ 1,500.00	
$2,000 H.E.P.C. 3% bonds market value	1,880.00	
30 shares Bell Telephone market value	1,297.50	NIL
Bank Bal. Nov. 30, 1967	58.56	
	$ 4,736.06	

Receipts		Expenditures	
Bank Bal. Nov. 30/66	$ 388.85	Safety Deposit Box Rental	5.00
Bank Interest	13.19	Purchase Can. Savings Bonds S22	1,500.00
H.E.P.C. Bond Interest	90.00	Bank Bal. Nov. 30/67	58.56
Bell Telephone Dividends	75.00		
Sale of $1,000 H.E.P.C. Bond maturing Jan. 1968	996.52		
	$ 1,563.56		$ 1,563.56

PUBLICATIONS FUND

Assets		Liabilities
Can. Savings Bonds, S22	$ 200.00	
$1,500 H.E.P.C. 3% Bonds market value	1,410.00	
5 Shares Bell Telephone market value	216.00	NIL
Bank Bal. Nov. 30, 1967	61.58	
	$ 1,887.58	

Receipts		Expenditures	
Bank Bal. Nov. 30/66	$ 197.81	Bank Bal. Nov. 30/67	$ 61.58
Bank Interest	6.27	Purchase Can. Savings Bonds S22	200.00
H.E.P.C. Bond Interest	45.00		
Bell Telephone Dividends	12.50		
	$ 261.58		$ 261.58

Audited and found correct (Signed)
J. M. Gillett and D. E. McAllister, Auditors

(Signed) L. G. Howden, Treasurer

*Since audit of accounts, and at the direction of Council, $5,000 fully registered Canada Savings Bonds S22 were purchased from the Current Account balance.

The CANADIAN FIELD-NATURALIST

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

Can. Field Nat.	Vol. 82	No. 2	p. 75-168	Ottawa, April-June, 1968

The objectives 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 is published quarterly with the assistance of affiliated societies and of a contribution from the Canadian National Sportsmen's Show. Manuscripts representing observations or the results of original research in any branch of natural history are invited. Contributions to the Letters and to the News and Comment sections are welcome. All material intended for publication should be addressed to the editor. Opinions and views expressed in this journal are private and do not necessarily reflect those of The Ottawa Field-Naturalists' Club or of any other agency.

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The Canadian Field-Naturalist

Volume 82 APRIL-JUNE 1968 Number 2

EDITORIAL

Chlorinated Hydrocarbons

Despite overwhelming evidence of the damage to resources caused by the widespread use of persistent chemical pesticides, the use of such pesticides, although outlawed in many places, continues unchecked in others. The chlorinated hydrocarbons (DDT, dieldrin, aldrin, heptachlor, endrin, lindane, chlordane, and others) have been outlawed by the United States Forest Service on national forest land, and by the United States Department of the Interior on national parks, Indian and other lands. Many local and state agencies in the United States have also put stringent restrictions on the use of such chemicals. In Michigan for example, the Department of Conservation has halted all uses of these chemicals in Department programs, and has issued orders that they not be used for any future projects.

Since the publication of the modern classic, Silent Spring, by Rachel Carson, much more information on the effects of persistent pesticides has become available and, with this information in hand, it is now possible to predict quite accurately what the continued use of these chemicals will mean to us in the future.

In New Brunswick, where the spraying of the forest from the air has now taken place every year for about a decade, chemicals such as DDT have been discontinued for the present, probably because DDT was more effective in controlling the natural enemies of the bud worm, than in controlling the bud worm itself. New chemicals are now being used on a large scale but the entire forest resource which the spray had been intended to protect, is now in jeopardy. At the same time, the salmon runs in New Brunswick rivers have suffered wide-spread destruction, and there have been a great many other unintended "side effects" (See article by Elson, Journal of the Fisheries Research Board of Canada 1967, No. 4, 130 pages).

Many birds that live at the end of food chains, now carry large flows of persistent pesticides in their body fats and more and more of the eggs of these birds contain lethal doses of these chemicals. Within the last decade, the Peregrine Falcon has become almost extinct North America and elsewhere. Bald eagle populations are in continual decline, with the percentage of immature birds in the United States eagle population falling from 26.2% in 1963, to 23.7% in 1964, and to 21.6% in 1965. Migratory populations are on the decline, with fewer birds being seen in recent years. If the contamination of the environment by persistent pesticides is allowed to contine for long, other birds such as gulls, terns, bitterns, and herons which also live at the end of food chains will soon embark on the road to extinction.

Fortunately, non persistent chemical substitutes are becoming available, but some of these are inconvienent to use and cost more for effective application. Chemicals such as malathion and methoxychlor, and biologicals such as the various natural enemies of insects, can often be used in place of chlorinated hydrocarbons.

The use of pesticides alone for the control of insects is seldom satisfactory because insects do develop resistance. Evidence of effective control is often subtle and certainly does not require dead insects in the hand. There are many examples available where natural or introduced predators are keeping insect pests at a low level and therefore in check. What is particularly needed now is more research into the biology of natural checks and balances so as to prevent situations such as the New Brunswick disaster from occurring elsewhere. What also seems to be a matter of utmost priority is to outlaw the manufacture and sale of persistent pesticides so as to prevent the gradual extinction of many forms of life which we have with us today. Theodore Mosquin

Mailing date of this number: 15th August, 1968.

PROGRESS OF THE EUROPEAN FROG-BIT IN CANADA

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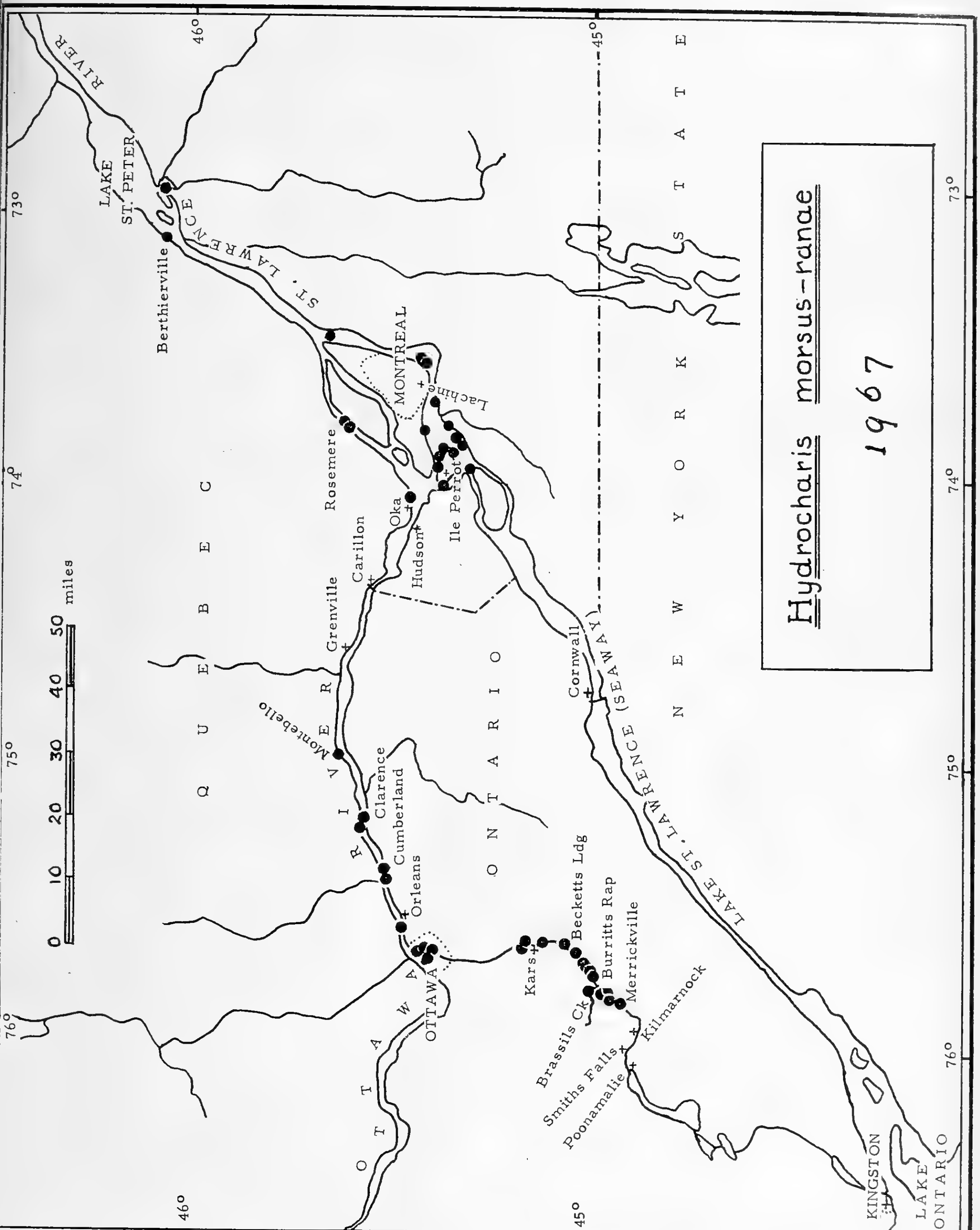
In the 28 years since *Hydrocharis morsus-ranae* was first noticed in the Rideau Canal at Ottawa, this Old World aquatic plant has spread downstream into the Ottawa and St. Lawrence Rivers as far as Lake St. Peter and upstream in the Rideau as far as Merrickville. In its course it has encompassed about 200 miles of natural and artificial waterways and gives every indication of becoming more widespread and abundant.

Frog-bit is not known to be naturalized in any other part of the New World. It has been mentioned only in updated revisions of three of our floristic manuals (Ogden 1957; Louis-Marie 1959; Rouleau 1964) and these state its range simply as Eastern Canada. Particular notices of its local occurrence have appeared from time to time (Minshall 1940; Dore 1964; Lévesque & Pageau 1967; Louis-Marie 1958, 1960, 1961, 1962; Pageau & Levesque 1967) but there are many other observations by workers in fresh-water biology which have not been published. The time seems appropriate to bring these records together into a continuous story and to make some sort of assessment of the progress of this alien element in our permanent flora.

Frog-bit, although possessing a well-developed root system, must still be classified as a free-floating aquatic. The roots, usually 4 to 8 inches long, do not seem to be able to penetrate the bottom mud and anchor the plant in place. They do, however, impede ready drifting and cause the plants to clog in masses on submerged obstructions or become tangled among cat-tails and stems of other shoreline plants. A spongy thickening (aerenchyma) on the underside of the leaves causes the leaves to float flat on the surface and buoy up the rest of the plant, the stems and their long stolons being suspended an inch or so beneath the water. The stolons which rapidly increase the diameter of a plant are both flexible and tough and tend to bind masses of plants together into a tangled and tenacious network. The roots of frog-bit are 'bushy' with abundant and remarkably long root-hairs. This feature, almost unique among water plants, can best be observed when the plant is placed in a glass jar or aquarium. The large, clear, unicellular hairs have proven useful in certain physiological experiments (Minshall 1959).

The white flowers, supported on relatively long stalks but exposed just above the surface of the water, are unisexual. The sexes are on separate plants, a point often difficult to decide in nature and on which reference works are usually ambiguous. At one place near Ottawa where plants of both sexes grew inter-tangled, abundant fruits were noticed to be forming in mid-August and, presumably, by the end of the season good seed ripened. In many places and in certain seasons, however, no flowers are produced. Seed formation for dispersal and persistence, of course, is not necessary since these

[1]Contribution No. 653.


Hydrocharis morsus-ranae
1967
0 10 20 30 40 50 miles
QUEBEC
ONTARIO
NEW YORK STATE
RIVER
LAKE ST. PETER
ST. LAWRENCE
Berthierville
MONTREAL
Lachine
Rosemere
Oka
Hudson
Ile Perrot
Carillon
Grenville
Montebello
Clarence
Cumberland
Orleans
OTTAWA
OTTAWA RIVER
Cornwall
LAKE ST. LAWRENCE (SEAWAY)
Kars
Becketts Ldg
Burritts Rap
Merrickville
Brassils Ck
Smiths Falls
Poonamalie
Kilmarnock
KINGSTON
LAKE ONTARIO
46°
45°
73°
74°
75°
76°

processes can be accomplished, quite effectively, by numerous plump winter-buds (or turions). These buds develop individually at the tips of short stalks arising from stolon nodes and in the autumn loosen and sink to the bottom where they lie dormant over winter. In the spring they rise to the surface (by some mechanism not too clearly understood) and drift along with the current as vegetative growth is resumed.

Story of invasion of the lower Ottawa and St. Lawrence River

The escape and free establishment of frog-bit in the Rideau Canal at Ottawa, as mentioned above, was first noticed in 1939 by Harold Minshall (1940). The particular site of escape was adjacent to aquatic beds of the botanic garden in the Lower Arboretum, Central Experimental Farm, where plants had already been growing for seven years, originally introduced from the Zürich garden, Switzerland, presumably in the form of seeds. The subsequent appearance of frog-bit in nearby sections of the Rideau Canal and in Brown's Inlet, an artificial pond filled each spring with water from the Canal through underground sluices, was perhaps to be expected, but when frog-bit was found along the shore of the main channel of the Ottawa River, some 13 miles below the city and exit of the Canal in 1953, the prediction of Minshall was fulfilled (Dore 1954).

In this same year, 1953, Marcel Raymond of the Montreal Botanic Garden identified, as *Hydrocharis morsus-ranae*, an unknown specimen gathered by Miss A. H. Pattison the previous summer at Rosemere, Quebec, from that branch of the Ottawa River (Rivière des Milles Iles) which flows on the north side of Montreal Island. It was first thought that this Rosemere establishment, localized some 100 miles away from Ottawa, might be of independent origin. Subsequent collections made at the mouth of Rivière-aux-Serpents where it enters the Ottawa at Oka in 1957 and 1958 by Father Louis-Marie and his students, however, clearly indicated that the plant must have floated down the Ottawa to the Rosemere site. Immediate search for frog-bit at Hudson, Grenville and Hawkesbury, intermediate points between Oka and Ottawa, failed to detect it and it must be supposed that propagules simply by-passed these points on the way down, or if they lodged, they must have succumbed to desiccation during the summer low-water stage. A suggestion that the population at Rosemere and at other places around Montreal could have originated from plants discarded from the Montreal Botanic Garden pools (Raymond and Kucyniak 1947), or from aquaria at McGill University (Minshall & Scarth 1952) cannot be substantiated.

In 1958, frog-bit made its appearance in the channel of the Ottawa flowing on the south side of Montreal Island as detected by G. Pageau at Ile Madore, adjacent to Ile Perrot at the head of Lake St. Louis (Pageau & Lévesque, 1967). In 1960, it was independently discovered at two other places along Ile Perrot: on the side facing Ste Anne de Bellevue by Dr. Newton-Swales, and at Ile des Pins in the rapids on the Vaudreuil side by Father Louis-Marie *et al.* The same summer it was also found on the far side of Lake St. Louis and among small islands at the foot of Lachine Rapids,

FIGURE 1. The Lower Arboretum at the Experimental Farm, Ottawa, the site of the former aquatic garden where frog-bit was introduced in 1932. The outlines of the water beds connected to the Rideau Canal and long filled in are still visible in lawn today.

FIGURE 2. A non-flowering clone of frog-bit which has developed from a single turion into a crowded mat 5 feet across during the course of the summer. Side-channel of Rideau Canal, 13 August 1965 (specimen 21736).

FIGURE 3. Strong cord-like stolons hold the plant mass firmly together. (Same site as Fig. 4.)

FIGURE 4. A sluggish inlet of the Rideau River near Kars, Ontario, becoming clogged with frog-bit. The rest of the aquatic vegetation consists of all native species; 5 August 1965.

respectively 7 and 20 miles beyond Ile Perrot. These occurrences were duly reported by Louis-Marie (1960, 1961) in short releases.

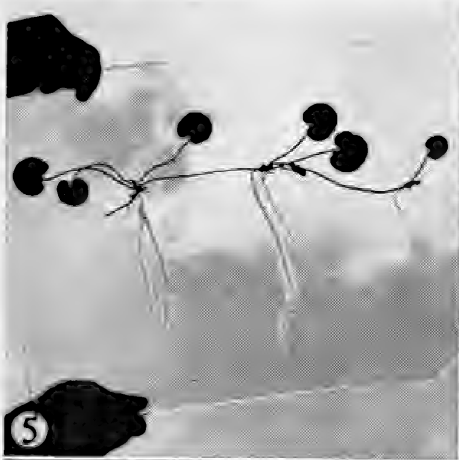
However, at the time of these exciting discoveries, it was not realized that the plant had already been collected — but under the mistaken identity of *Nymphoides cordata*, a rare native species — in Lake St. Peter, some 50 miles below Montreal. The specimen had been taken there in 1958 by Desmarais and Moisan in Lavallière Bay, on the south side of Lake St. Peter between the mouths of the Yamaska and St. Francis rivers. Dr. Yves Desmarais (in correspondence, 1965) returned in 1961 to search elsewhere in the lake for frog-bit but did not find it.

During the early years of detection, 1953 to 1960, the reports from the Montreal area indicate that the colonies were meagre in extent and very 'spotty'. Soon there was to be no doubt that sparse plants at local foci are capable of persistence and further progress. From surveys in Lake St. Louis in 1964, Pageau and Lévesque (1967) were able to state, "nous l'avons observée à une dizaine d'endroits differents où elle était abondante et semblait être définitivement établie." In ecological surveys between 1965 and 1967, J. P. Lamoureux (in correspondence) recorded *Hydrocharis* in as many as 37 out of 41 aquatic quadrats studied in Lavallière Bay of Lake St. Peter. In 1967 it was also found on the other side of Lake St. Peter, in a flood-lagoon on the first alluvial island next to Berthierville by Dore and Marchant but not noticed by them in any of the four main channels between the islands that can be inspected from the highway. Lévesque (in correspondence, 1967) summarizes the situation by saying, "frog-bit is now very common in small shallow bays along the Saint Lawrence River, from Lake Saint-Louis to Lake Saint-Pierre, where it has been collected or observed at over 60 stations."

On the Ottawa, it is important to note that in 1963 a dam, newly constructed at Carillon, started to hold back the waters and inundated the shores to a point a little above Orleans. Frog-bit was seen that year in large masses accumulated at the ferry docks at Clarence and at Cumberland, where it had not been noted earlier. In 1965, certain dead-water lagoons near Orleans were found to be clogged solid with luxuriant growth. Here the frog-bit as well as certain native species of hydrophytes, which usually do not flower, bloomed profusely perhaps as the result of the unbalanced and rich conditions created in the habitat. In 1967, J. E. Charlebois wrote about the *Hydrocharis* at Montebello: "cette espèce a envahi densément toutes les petites baies d'eau peu profonde formées recemment par l'élèvation du niveau de l'eau."

Story of invasion of Rideau River and Canal System

In 1954, frog-bit was noticed in a flood-plain lagoon of the Rideau River about a half-mile over fields from the original Arboretum site at Ottawa. Presumably the plant had been carried overland by some person, intentionally or unintentionally. Three years later the plant had escaped this lagoon and appeared in the main stream of the Rideau. Currently it can be seen all along the shores below this point in the three mile stretch of the Rideau that traverses the city of Ottawa.



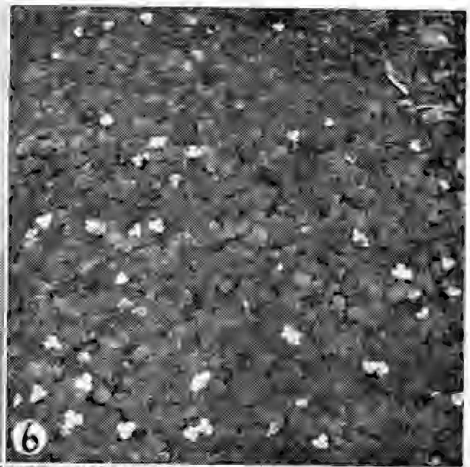


FIGURE 5. Unusually long hair-cells characterize the roots of frog-bit and show up well when floated onto a sheet of glass and viewed against the light.

FIGURE 6. The white, fragile flowers are held slightly above the surface on slender stalks. The flowers are 3-petaled and unisexual. Plants of both sex are intermingled in the Rideau inlet near Kars, Ontario; 5 August 1965 (specimen 21717).

FIGURE 7. A lagoon near Orleans, Ontario, formed by the damming of the Ottawa River at Carillon has rapidly become overgrown by frog-bit; 30 July 1965 (Specimen 21711).

FIGURE 8. One of the two small colonies recently established in Brassils Creek at the crossing of a bush-road. (The planks of the bridge protrude into the lower corner of the picture.) The site is not far from the infested Rideau, but is separated from it by a series of cascades on the creek. (19 August 1965, specimen 21747.)

The establishment of the plant upstream in the Rideau and at considerably greater distances away from the Arboretum is more difficult to explain. In 1960, a solid stand of frog-bit was discovered covering the surface of a small pond at Becketts Landing some 30 miles above Ottawa. The pond was an artificial one, made when the bridge was reconstructed, and had an overflow into the Rideau. The plant was found to be similarly abundant in one inlet on the same side of the Rideau about 4 miles below the Becketts Landing pool, but at several other likely places farther down, no trace of plants could be found. It seems that propagules must have been carried up to Becketts Landing or beyond by human agency, perhaps adhering to boat gear or in a fisherman's pail, or perhaps transported carefully by some aquarist or aquatic-garden fancier. In 1962, a plant was encountered at the new bridge below Kars, about 9 miles below Becketts Landing, where it seemed to be a new arrival. In 1965, frog-bit was so extensive up a nearby inlet that had been partly excavated for a marina for the Carleton Golf and Yacht Club, that one is lead to believe that it might have been a separate introduction.

Accordingly, on August 19 and 24, in 1965, a more organized attempt was made to find out if the plant occurred at points upstream from Becketts Landing. Frog-bit was found in abundance at a point about 10 miles above Becketts Landing at "The Catch-all", a shallow stretch between marshy alluvial islands where debris of all sorts tends to accumulate. It was also present but in lesser amounts at scattered points as far up the river as Merrickville.

At Merrickville the last colony was found behind the backwater, *above* the series of locks there. From its unit size, this small colony was adjudged to have started from a single propagule carried up during the previous year. Immediately below the Merrickville locks, there were numerous patches, especially in a marshy bay there. Increasing pleasure-boat traffic through the lock-system will undoubtedly account for the gradual spread of the plant up the Rideau. Above Merrickville the river enters a long stretch of quiet water between broad shores. Examination of the shores at several accessible points: around Kilmarnock, at Smith Falls, and as far as Poonamalie Locks, revealed that the plant had not yet reached these points in 1965. The Rideau, being a series of still-water stretches held by locked canals all the way to Kingston on Lake Ontario, presents a system very susceptible to the rapid spread of aquatic plants. It receives drainage from the fertile soils of the surrounding farmland, becomes quite warm in summer, and naturally supports an abundant aquatic vegetation. "Weed-dredges" are required to keep the navigation channel open. It can be expected that frog-bit will add to the troublesome growth of water weeds in the years ahead.

Story of invasion of Brassils Creek

Brassils Creek is a small stream about 10 miles long, usually dry in mid-summer. It enters the Rideau at the village of Burritts Rapids, Carleton County, Ontario, down a series of cascades. At a point in its course 1.4 miles above its mouth, and about 75 feet higher in elevation, two small clones of *Hydrocharis* were found on August 19, 1965. Propagules must have been carried there sometime during the past year, but how?

The plants in Brassils Creek grew in a shallow but permanent pool just at an old wood-plank bridge where a bush road crosses. It is said that fishermen come to this secluded spot to trap minnows for bait. At two other points more accessible to the public and respectively 2 and 2.5 miles further upstream no frog-bit was seen; no other alien aquatic species was detected in the system. The stream itself is not navigable, not even by canoe, and it is difficult to see why some person would deliberately introduce the plant to this place for ornamental or conservation purposes. Other possible agencies which might transfer the small resting buds up from the infested Rideau below are the beavers which inhabit the creek and have built dams in its upper reaches. Deer and stray cattle in wading parts of the creek might drag living fragments along a short distance, but these chances are slight.

The two plants of frog-bit present in Brassils Creek in 1965 did not flower but are estimated to have produced about 300 turions. It will be of interest to watch how the frog-bit prospers in this wilderness habitat.

Herbarium specimens, many with photographs and full field-notes attached, to support the information summarized above, are preserved at the Plant Research Institute, Ottawa. A mimeographed listing of all the localities where the plant has been observed, as well as the places where it has not been seen, is available should further surveys be contemplated. At the moment, it seems that *Hydrocharis morsus-ranae* is starting to spell out a long and notorious history of spread as a water pest in America. Many another shy aquatic has developed a similar course when loosed in an alien land; for example, *Eichhornia crassipes*, *Elodea canadensis*, *Trapa natans*, *Potamogeton crispus*, *Butomus umbellatus*, *Lasarosiphon major* and *Pistia stratiotes*. We wish we knew more of their early history of population explosion.

The intention of the above article is therefore partly to fulfil that general need expressed so well by Hiram Wild in the preface to his *Harmful Aquatic Plants of Africa and Madagascar* (Kirkia 2: 1-66. 1962): "One of the major problems in the fight against harmful aquatic plants in Africa, as in other parts of the world, is that infestations of particular species have often spread alarmingly before their danger is realized. This may be because the botanical identity is not known early enough, or alternatively because it is not recognized that the plant constitutes a potential danger as a harmful plant."

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A COMPARISON OF CAPTURE SUCCESS BETWEEN SHERMAN AND LONGWORTH LIVE TRAPS

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THE TWO MOST widely used live traps in small mammal capture-recapture studies are the Longworth and Sherman traps. The experiments presented here were designed to evaluate the relative capture efficiency of these traps. The construction details of the Longworth trap have been described by Chitty and Kempson (1949). The Sherman trap used was the aluminum folding model, 3 x 3.5 x 9 inches in size.

The study area, located in the aspen parkland transition zone of Saskatchewan, two miles south of Saskatoon, included both open prairie grassland and low brush areas similar to those described by Bird (1961). Six parallel lines, 60 ft apart with eight traps, 60 ft apart on each line, formed a trapping grid with an internal area of 2.89 acres. The trapping was done between 10 May and 30 July 1967. All traps were one year old and all had been used the previous summer. Trigger mechanisms were cleaned and checked prior to the experiment. Traps were dry-baited with oats one evening prior to each trap period, then set at 7:30 PM and checked at 7:30 AM except where otherwise noted. Captured animals were toe-clipped and released immediately at the station of capture.

The initial experiment was designed to register trap preference only; since no attempt was made to estimate species densities, trap periods varied in length from two to five days. One Sherman and one Longworth trap were placed side by side within five ft of each station at a likely capture site. The open ends faced in the same direction so that an approaching animal would be

TABLE 1. — Capture records of Sherman and Longworth live traps. Per cent of subtotals are in parenthesis.

Trap type	Total number trap nights	Total number of captures			Totals
		Microtus	Peromyscus	Clethrionomys	
Sherman	688	75 (55.6)	29*(67.4)	18 (62.0)	122**(58.9)
Longworth	688	60 (44.4)	14*(32.6)	11 (38.0)	85**(41.1)
Subtotals		135	43	29	207

*P ⩽ .05 (chi square).
**P ⩽ .01 (chi square).

forced to choose between traps. The performance record of each trap type indicates a preference for the Sherman trap under these conditions (Table 1).

Having established this preference for Sherman traps, the second experiment was to determine efficiency of each trap type in sampling the same animal population when used alone. The study area was trapped for four days using both Sherman and Longworth traps as described, then four days with Longworth traps only, and four days with Sherman traps only. Observed species density/acre were calculated from these data (Table 2).

Thirteen lined ground squirrels (*Citellus tridecemlineatus*) were present on the grassland portion of the study area but were seldom captured during the nocturnal trap periods. As this species had been previously captured in both Sherman traps and Longworth traps the previous summer, capture preference was tested during a diurnal trap period from 9 May to 11 May 1967. Ten individuals were captured a total of 25 times, with 23 or 92% captured in Sherman traps, indicating a strong preference for the Sherman trap.

TABLE 2. — Species density. Total numbers in each sample are in parenthesis.

Trap type	Period date	Species density per acre			Total density per acre
		Microtus	Peromyscus	Clethrionomys	
Sherman and Longworth	19 July-22 July	5.88(17)*	2.42(7)	2.42(7)	10.73(31)
Longworth	23 July-26 July	4.49(13)	2.08(6)	2.77(8)	9.34(27)
Sherman	27 July-30 July	3.12(9)	2.77(8)	2.42(7)	8.3(24)

*Chi square tests computed among total numbers of each period for each species were not significant at the 95% level.

TABLE 3. — Additional species captured during the test period 19 July- 30 July 1967.

Species	Trap type		
	Sherman and Longworth	Longworth	Sherman
Zapus hudsonius	4	5	4
Citellus franklinii	3*	0	3
Citellus tridecemlineatus	4*	0	3
Mustela rixosa	0	2	2
Onychomys leucogaster	1*	0	0
Perognathus fasciatus	3*	0	0
Totals	13	7	12

*All captures in Sherman traps.

Sixty-eight individuals of *Microtus pennsylvanicus*, *Peromyscus maniculatus* and *Clethrionomys gapperi* were live-trapped a total of 207 times during this study. Forty-four *M. pennsylvanicus* were captured a total of 135 times, 14 *P. maniculatus* were captured 43 times and 10 *C. gapperi* were captured 29 times. When offered a choice of trap type, all three species preferred the Sherman trap. The total capture difference between Sherman and Longworth traps was significant (P < .01 chi square, Table 1). This preference may result from the difference in the size of the entrance. Sherman openings measure 3 x 3.5 inches. The smaller Longworth openings measure 1.25 x 1.75 inches. In addition, an animal must pass through a 'tunnel' before entering the nest box of the Longworth. Quast and Howard (1953) have shown a preference of *Peromyscus* sp to enter a large Sherman trap (opening 3 x 3 in) compared with a smaller Sherman trap (opening 2 x 2.5 in). My observations show a significant preference of *P. maniculatus* for the Sherman trap (P < .05 chi square). *Microtus* and *Clethrionomys* also appear to prefer the Sherman trap although the difference in capture records are not significant at the 95% level.

Recorded species densities appear very similar with the exception of *Microtus* (Table 2). As double captures were common during the first trap period, the larger number of *Microtus* captures may reflect a higher actual density of this species than that recorded duing the latter two periods. *Microtus* density variation between the second and third periods, probably is a function of the short trap periods and not of the trap type considering the trap preference results presented earlier.

Throughout the study a number of both trap types were closed without capture. In nocturnal trap periods, 27 Sherman and 14 Longworth were closed without capture. In the three day diurnal trap period, 55 Sherman and 28 Longworth were closed without capture. When properly triggered, both trap types (particularly Sherman) will close if touched. Disturbance by ground squirrels was probably responsible for the large number of traps found closed duing the diurnal period as closed traps were frequently moved from the original set position.

In addition to the three major species, a number of other animals were captured during the nocturnal trap periods (Table 3). The data are too few for valid conclusions but show that when given a choice between trap types, four of the five species were captured exclusively in the Sherman traps.

In summary, the following conclusions can be stated. (i) When offered a choice, Sherman traps were preferred over Longworth traps by the majority of species tested. This preference may be related to the size of the entrance. (ii) Considering the small sample size and short trap periods, both types, when used separately, yield approximately similar species density values. (iii) Both trap types are probably unsuitable for animals larger than mice and voles, although ground squirrels were captured.

This study was conducted during the course of other research being performed with the assistance of a grant from the Canadian Wildlife Service. I wish to thank Dr. W. J. Maher, Department of Biology, University of Saskatchewan, for helpful suggestions concerning the manuscript.

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SEA BIRDS IN NEWFOUNDLAND AND GREENLAND WATERS, APRIL-MAY 1966

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Introduction

Sea birds spend much of their lives at sea, and yet we know very little about them once they are out of sight of land. For the northwest Atlantic, Tuck (1961) and Rees (1963, 1965, and unpublished) have made important contributions to sea bird ecology in the waters around Newfoundland; and Wynne-Edwards (1935) and Rankin and Duffey (1948) have published detailed surveys of the birds of the north Atlantic shipping lanes, but there has been very little more. This is, of course, mainly due to the practical difficulties in collecting data. But it is also unfortunate that birds at sea fall between two disciplines: ornithologists pay too little attention to the water under their birds, and oceanographers largely ignore the birds that fly over their sea.

In a stimulating review, Bourne (1963) shows the advantages of combining these two approaches. He points out that birds at sea occupy ecological niches that can be defined as precisely as those on land; their numbers depend on the numbers and species of available food organisms, which in turn depend on physical and chemical characteristics such as sea water temperature, composition and so on. So it is particularly important to try to correlate sea bird numbers with oceanographic data; ideally, there ought to be an ornithologist on every oceanographic cruise. Bailey (1966) has applied this combined approach to birds in the Indian Ocean; I was interested in work of this kind in the northwest Atlantic.

I was therefore fortunate in being able to sail as ornithologist on the CSS HUDSON in the spring of 1966, for part of the Bedford Institute of Oceanography cruise BIO-0266. The HUDSON was working in the waters south and west of Greenland – the area known to oceanographers as the Southern Labrador Sea. This part of the Atlantic is little frequented by shipping, particularly at this time of year, and I can find no published records of its sea birds. So if nothing else, my observations fill in the gap between what is already well known from Newfoundland waters to the west, and from the Atlantic shipping lanes to the south. However, I have tried to go beyond a simple list of birds seen, and wherever possible discuss aspects of their pelagic ecology.

Figure 1 shows the area covered by the cruise. We left St. John's, Newfoundland, on April 23, and reached the first oceanographic station (51°24′N, 39°30′W) early on April 25. We then took a line of stations coming in towards Cape Farewell, reaching 59°20′N, 43°10′W on the evening of April 29, went out again to reach 53°52′N, 37° 30′W on May 3, and then back to 60°10′N, 41°58′W on the morning of May 7. From there we sailed for home, and were off Cape St. Francis, Newfoundland, on the morning of May 10.

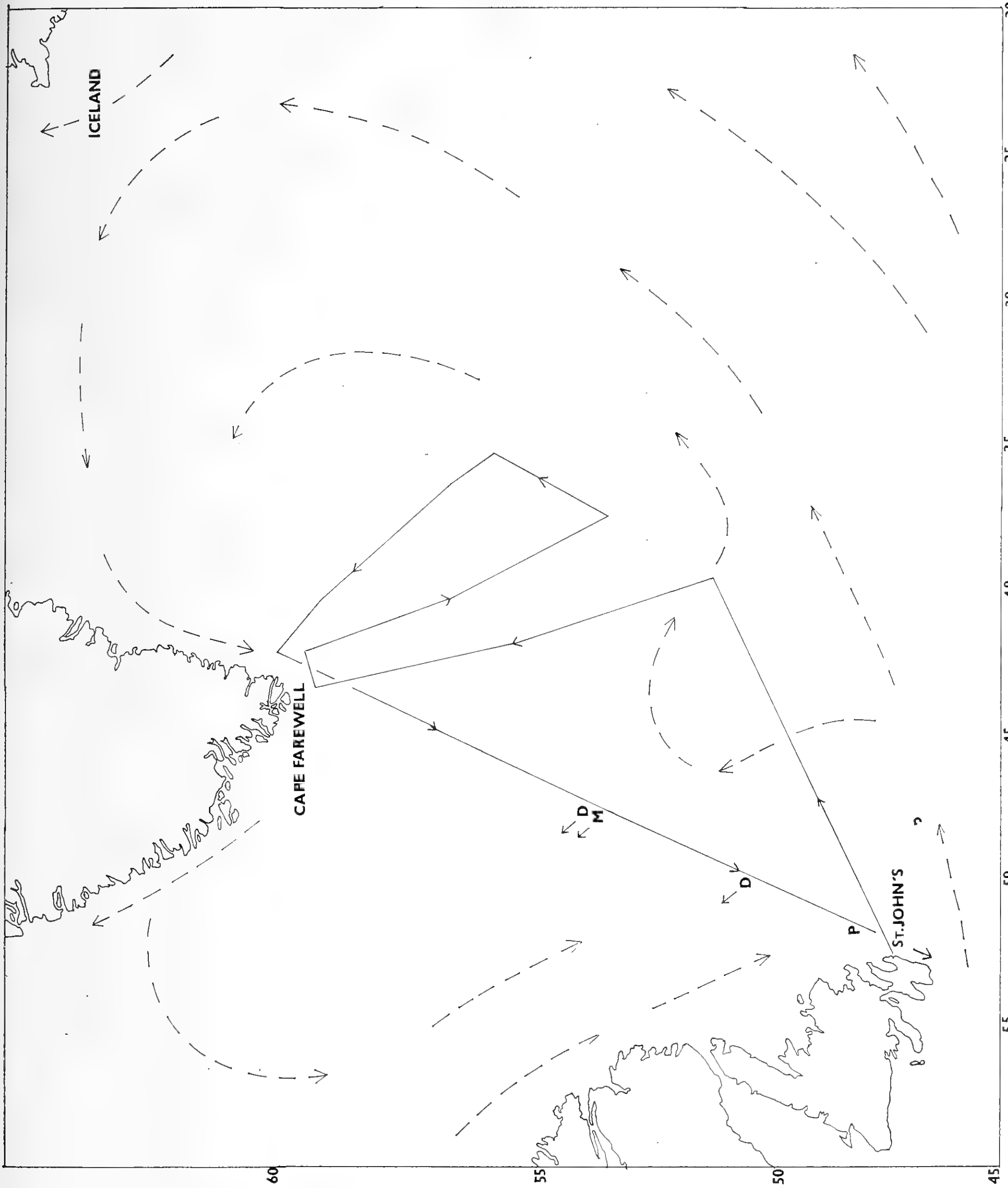

Figure 1. The area covered by the CSS HUDSON cruise showing the ship's track (unbroken line) in relation to the main water current systems (arrowed broken lines). The map also shows concentrations of Murres (M), Dovekies (D) and Small Petrels (P); short arrows beside these letters show directions of movement.

My observations therefore fall into three groups – those in the survey area, and those made on the outward and return voyages. The former are naturally the most detailed, but the others are just as important because they make it possible to compare the birds of the survey area with the better known waters off the Newfoundland coast.

In addition, J. R. Lazier has allowed me to use some notes he made on birds to the west of the survey area, just before I joined the ship.

STATISTICAL METHODS

My basic unit was the number of birds of a given species which I could count during a half-hour watch. I made these counts both from the stationary and the moving ship; since many birds are attracted to stationary ships, the differences between these two measures can be startling. However, I shall only quote the moving-ship transects. I wanted to compare numbers in the survey area with those off Newfoundland, and the ship did not stop off Newfoundland; in any case, moving-ship counts are more universally applicable, since most ships do not stop regularly on the high seas.

This system provides a relative measure of a species' abundance. Ideally, it would be useful to convert this into some absolute measure of density, but this is difficult. The HUDSON averaged 12 knots, and so each half-hour count takes in the birds I saw along a 6 mile line. But in fact I was searching, not a line but a "box", whose width depended on the relative visibility of the birds, and of visibility conditions in general. I find it hard to give any reliable estimate of this width. Kuroda (1963) found that, under favourable conditions, he could distinguish between two closely related gulls in flight at over 1 km., using x8 binoculars. My identifications were mostly of Fulmars and Kittiwakes; these are conspicuous birds, easily identified by their method of flight, and I think that, with the help of x9 binoculars, I was picking them up at least a mile away under good conditions. I suggest that a half-hour count of these species very roughly represents the number present in an area of the order of 12 sq. miles. This would not, of course, be true for inconspicuous species such as murres and small petrels, for which a quarter-mile range would be a more realistic estimate.

OCEANOGRAPHIC DATA

Members of the HUDSON's scientific staff were sampling, among other things, water temperatures, oxygen contents and salinities at various depths; these data are on file at the Bedford Institute of Oceanography, Dartmouth, N.S. I have only quoted the surface temperature data here because they are available for the outward and return voyages, as well as the survey area.

From the point of view of the birds, it is important to see how measures such as these reflect plankton densities. No plankton samples were made. However, D. C. Gordon (in preparation) sampled the organic matter at various points in the survey area; as part of his study, he estimated the number of cells/ml. in his samples – mostly silicoflagellate *Distiphanus* sp. – and these counts thus give an indirect index of plankton densities. His 11 samples

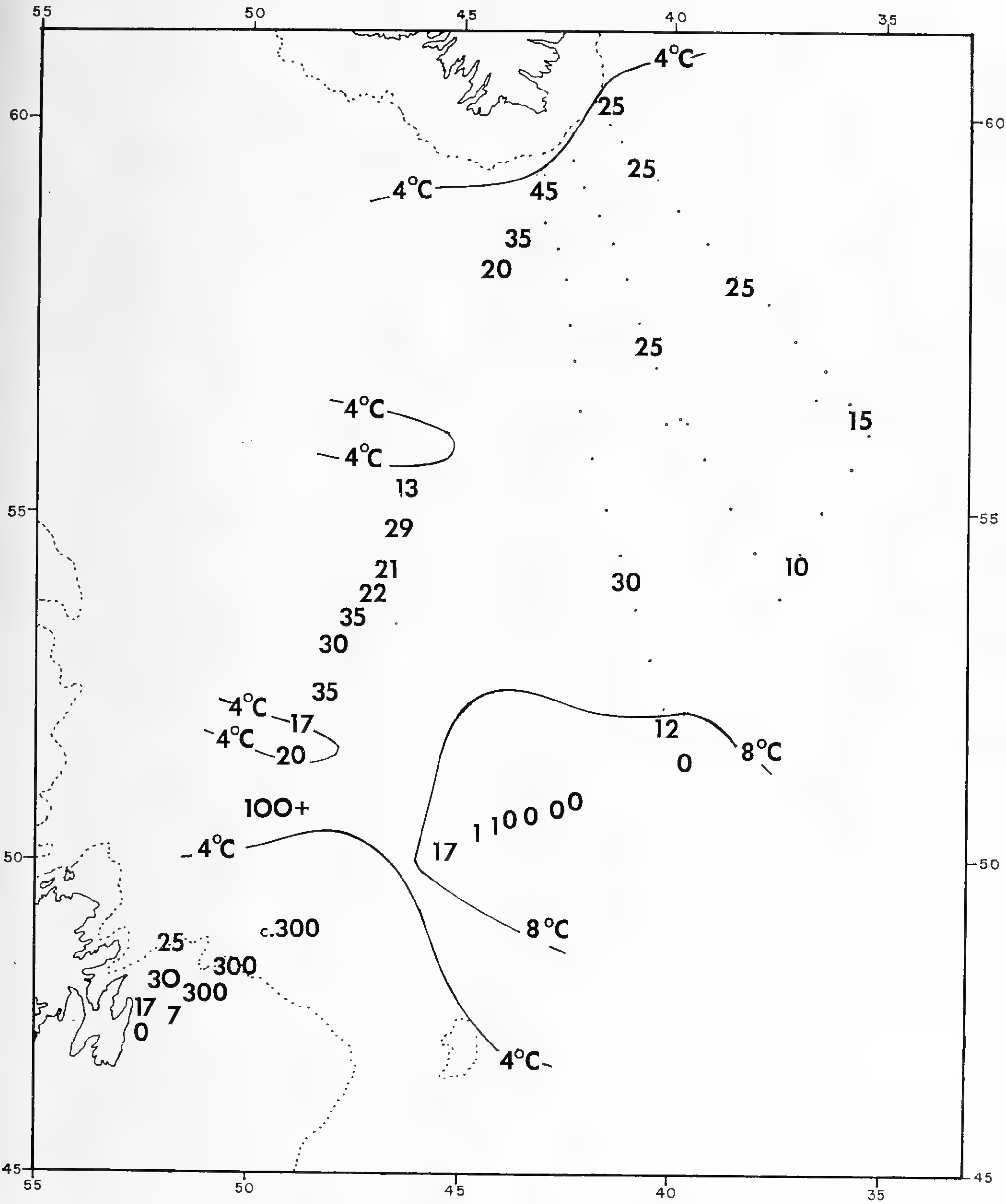

FIGURE 2. The distribution of Fulmars in the survey area. Each figure represents the number of birds counted during a half-hour transect. The 40°C and 8°C surface water isotherms are also plotted.

ranged from 0.4-6.1 cells/ml. This figure is very low, if one compares it with the peak values of c.150 Coccolithophorids/ml. and c.500 Diatoms/ml. found in samples taken by Steemann Nielsen (1943: Figure 2) southeast of Iceland, in late May. Steemann Nielsen's figures during April are of the same order as ours, but they increase sharply to these peak values with the plankton "bloom" in mid May. No doubt our survey area, too, would be much richer in plankton later on in the year. But at the time of our visit, the waters southeast of Cape Farewell were certainly impoverished.

ANNOTATED LIST OF SPECIES

1. Fulmar *Fulmarus glacialis*

a. *pelagic distribution*

Fulmars are known to concentrate around the Newfoundland Banks in early spring (e.g. Rankin and Duffey 1948, Fisher 1952), and fig. 2 shows some very high counts there — as many as 300 birds/half-hour. The densities are much lower elsewhere — of the order of 25 birds/hour for the survey area and most of the return voyage. But the densities on the outward voyage are particularly interesting; there is a sharp contrast between the high densities in the cold Banks water, and the negligible numbers of Fulmars in the warm gyre farther east. The birds did not reappear until we were in colder water again, at the southern corner of the survey area. Rees (pers. comm.) also found very few Fulmars in this warm water area.

The concentration of birds in the colder waters has been noticed by other workers. For instance, Rees (1965) says:

"Oceanographic boundaries in the western Atlantic are particularly sharp and a strong connection between the distribution pattern and the hydrography can be seen. This is well shown by the spur of the distribution area, which runs southwestwards across the Nova Scotian and New England Banks, in the cool waters sandwiched between the coast and the warm-slope water gyre."

Farther north, he found (Rees 1963) that Fulmars were common in the cold waters of the Labrador current southeast of Belle Isle, but suggests that their absence from the strait west of Belle Isle is due to the preponderance there of "less productive" water from the Gulf of St. Lawrence. To the east, Rankin and Duffey (1948) found very few Fulmars in winter in an area in mid Atlantic around 50° 30°W, and they note that this coincides with a northward extension of warm, Gulf Stream water.

The same holds good of the Pacific Fulmar *F. g. rodgersii.* Kuroda (1955, 1960) found that it was the dominant summer sea bird in the cold waters off the Kuriles and west Aleutians. He notes that it has a "preferred temperature range" of 3.5°-7°C; it was almost entirely absent from warmer waters, at 8°-10°C or over. So it seems that the Fulmar's pelagic distribution both in the north Pacific and the northwest Atlantic is fairly closely correlated with the distribution of the colder water — and so, presumably, with the plankton associated with it. But this correlation breaks down in the eastern Atlantic, where Fulmars are very common in the warmer waters around the

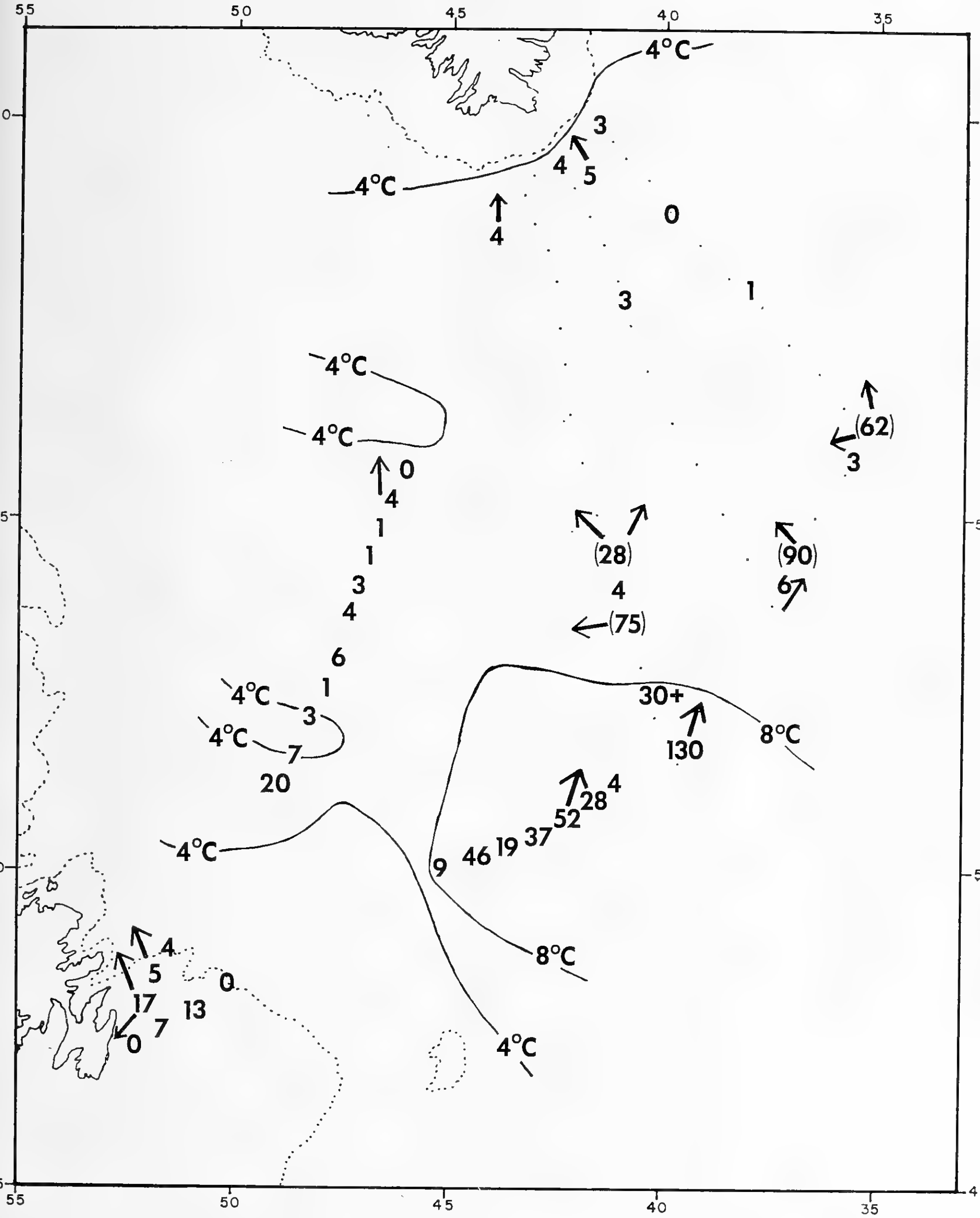

FIGURE 3. The distribution of Kittiwakes in the survey area. The figures in brackets are half-hour counts of birds passing by, or attracted to, the stationary ship; the others are half-hour transects as in fig. 2. Arrows show directions of migration.

British Isles — as Fisher's (1952) maps show. However, Fisher also shows that the Fulmar has only spread into these waters within the last 200 years, and Salomonsen (1965) shows that this spread is confined to large-billed birds, and probably originated at a single colony. So the occurrence of Fulmars in these warmer waters is, in a sense, atypical; it seems legitimate to regard the Fulmar as being basically a cold water bird.

This is an important point which has received too little attention. Most of the work on Fulmars has been done in the eastern Atlantic, and so has been inevitably biased towards the "atypical" warm water birds, and the reasons for their spread. What we need is more emphasis on "normal" Fulmar ecology, in cold waters — along the lines of Rees' work. The physical and biological oceanographic surveys of the waters off the Atlantic coast of Canada would provide an ideal framework for such research.

b. *the distribution of the colour phases*

As well as counting the birds, I estimated the proportion of those in "dark phase" plumage. (I am using "dark phase" to cover Fisher's (1952) plumage types D plus DD.) These dark birds were rare both in the survey area and on the outward and return voyages. I have 39 counts in which the sample size was 20 or more; in 16 there were no dark birds, in 9, under 2%, and in 14, between 2-5%; I saw no higher proportion than this. Within this rather narrow range of variation, there was no obvious link between the number of dark birds in a sample, and the place where the sample was taken.

This low proportion of dark birds contrasts with Salomonsen's (1965) observations. On a voyage in May, he found 5-10% dark Fulmars in a series of transects immediately east of Cape Farewell, and over 10% in two June transects. (My 11 samples, north of 58°N in the Cape Farewell area, averaged 2.4%). Salomonsen correlates the proportion of dark birds with the presence of cold, "lowarctic" water; yet our surface temperatures are similar to his. Nor was there any evidence of dark Fulmars in the equally cold waters we crossed south and west of Cape Farewell on the return voyage. It is hard to account for this discrepancy — and, it would be unwise to base too much on the records of a single voyage. But it is at least possible that water temperature (and whatever that means in terms of plankton) may not be the only factor influencing the distribution of the two colour phases.

The fact that the birds I saw were mainly pale-phase Fulmars implies that these early spring Fulmars came from colonies in which pale-phase birds predominate. To judge from Fisher (1952), this rules out the colonies in the eastern Canadian Arctic. The likeliest areas are Disko, West Greenland, in Britain, and in Iceland; birds from Disko and Britain have been recovered in Newfoundland or on the Banks. Since the breeding birds of all these areas are on their colonies in mid April (Fisher 1952; Salomonsen 1950), it is very likely that the birds I saw were non-breeders — perhaps sub-adults.

2. Kittiwake *Rissa tridactyla*

After the Fulmars, the Kittiwakes were the commonest birds on the cruise; oddly enough, their distributions are almost exactly opposite. Fig. 3

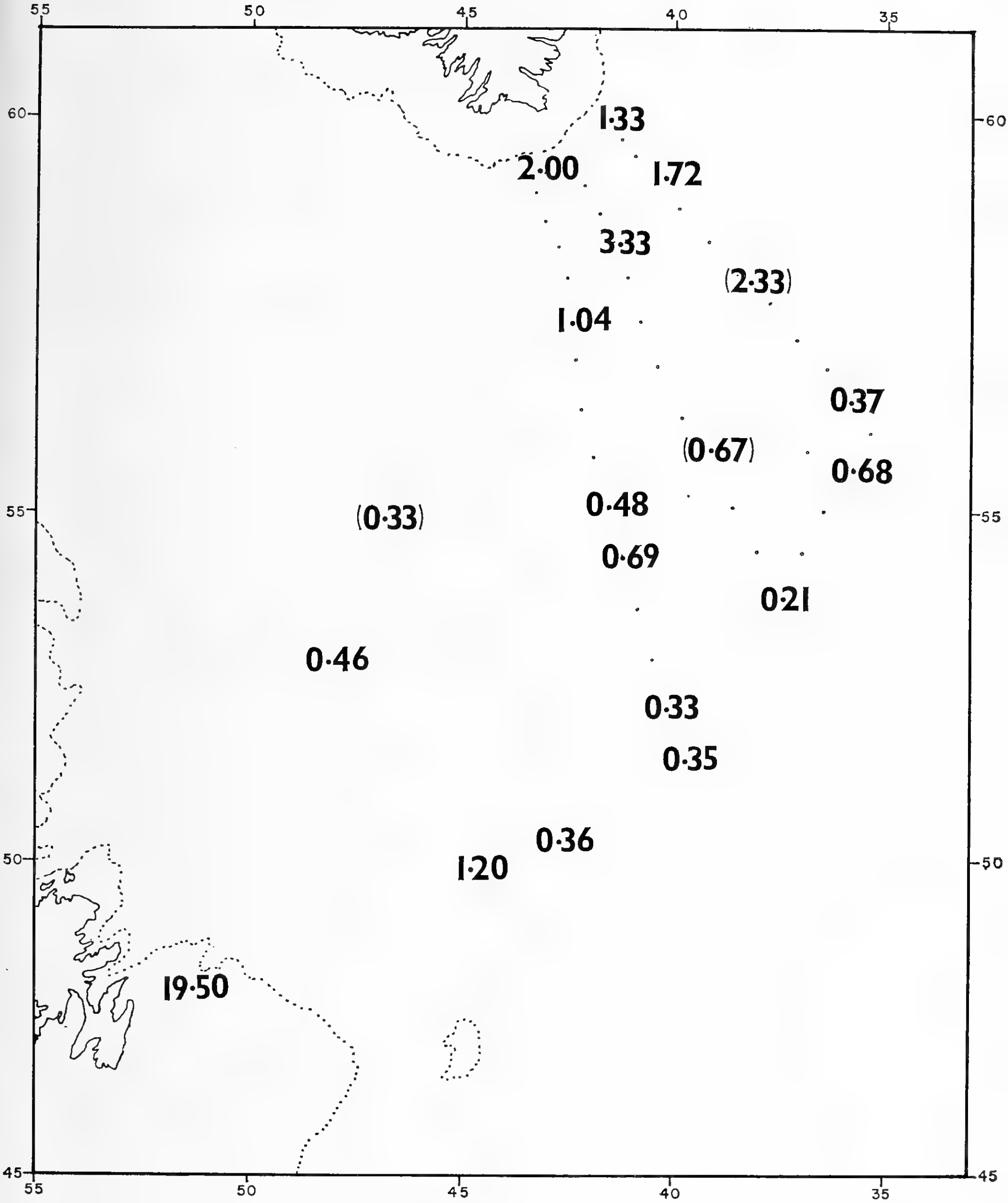

FIGURE 4. The adult: first winter ratio of Kittiwakes in the survey area. Ratios in brackets are based on samples of less than 20 birds.

shows that Kittiwakes were the commonest in the last half of the outward voyage, and at the southern corner of the survey area, in the warmer waters where the Fulmars were rarest. In fact, the Kittiwake's southen limit is well south of the Fulmar's; Rankin and Duffey (1948) show that it lies between 43°N (at 50°W) and 49°N (at 30°W) in April. The northern limit is less well known; Rankin and Duffey think that it ranges from at least 48°N (at 50°W), through 55°N (at 40°W) to 58°N (at 30°W) at this time of year. Fig. 3 shows clearly that between 40°-45°W there are Kittiwakes ranging all the way up to Greenland; however, the northern limit for *most* of the birds is at about 53°N.

However the position is a complicated one, since many of the birds I saw were clearly migrating. I noted the direction of this movement whenever I could, and this is shown by arrows on Figure 3. Migration was easier to follow when the ship was hove-to at an oceanographic station than on a transect; I have added some counts for the largest flocks I saw at such stations. (These counts are bracketed on the map; they represent the number of birds passing the stationary ship in half an hour.) In the survey area, most of the birds seemed to be moving roughly north, but there was also a westerly component which was particularly obvious for the return voyage transects off the Newfoundland coast. These directions confirm Wynne-Edwards (1935) report of a "landward" spring migration.

Most of these migrants were adult birds. I compared the proportions of birds in adult, as against first-winter plumage in different samples. (I realise that many of the birds I classed as "adults" could have been second-year, non-breeding sub-adults.) Figure 4 shows the proportion of first-winter birds in the samples; it declines close to land. So, too, does the number of Kittiwakes of any age. It looks very much as though the adults are moving to the breeding colonies at this time of year, leaving the non-breeders behind in the winter areas. Salomonsen (1950) notes that the adults first return to the southwest Greenland colonies in March, and to west Greenland in April. But I also found that some of the first-winter birds were also moving north; no doubt this is the start of the movement which, by the early summer, will clear all the Kittiwakes from the open Atlantic at these latitudes (Wynne-Edwards 1935). This movement is well under way by mid May, when Rees (pers. comm.) found flocks of up to 200 Kittiwakes on the southwest Grand Bank — 75-95% of them first winter birds.

It is not easy to tie my observations on Kittiwake distribution in with those of Rees (1963). In April-May, I found that the Kittiwakes — and particularly the first winter birds — are concentrated in relatively warm water well offshore. But in November Rees reports large numbers — 80% of them first-winter birds — in the cold Labrador current southeast of Belle Isle, close to the Newfoundland coast. We obviously need a lot more data before we can fit these two pieces of the jigsaw together.

3. *Larus* gulls

I saw Herring Gulls *L. argentatus*; Greater and Lesser Blackbacks *L. marinus* and *L. fuscus*; Iceland Gulls *L. glaucoides*; and Glaucous Gulls *L. hyperboreus*.

The distributions of these species are interesting. Figure 5 shows that the Herring Gulls were only seen in Newfoundland waters. Similarly, I only saw Iceland and Glaucous Gulls close to the Greenland coast, though there are apparently still a few Glaucous Gulls of the Newfoundland Banks at this time of year (Rees, pers. comm.) All the positively identified Greater Blackbacks were also close to these coasts. The only *Larus* gulls seen far out to sea were the Lesser Blackbacks.

These Lesser Blackback records are remarkable. It is an Old World species, known to breed no farther west than Iceland; there is only one record for Greenland (Salomonsen 1950), and as far as I know it has not been seen in the North Atlantic west of 58°N, 15°W (Rankin and Duffey 1948). I spent a long time working on this gull in Britain, and I am in no doubt of the identification. (I relied mainly on the yellow leg colour to separate them from the Greater Blackbacks – fortunately, they were attracted to the ship, so this was not too difficult. Size was unreliable unless I had the two species sitting close together on the water. All the birds I saw had very dark grey, rather than black backs – they were presumably of the British and Iceland subspecies *L. f. graellsii* – but I could not always reliably distinguish this from the jet black of the Greater Blackbacks.)

It is possible that earlier observers on the North Atlantic sea-lanes confused these birds with Greater Blackbacks, but I do not think this is very likely. Both Wynne-Edwards (1935) and Rankin and Duffey (1948) were British observers, who undoubtedly knew the species; in any case, they record very few Greater Blackbacks so far from land. It seems more likely that my observations reflect a recent extension in the breeding range of these gulls. They began to colonise Iceland only 50 years ago (Wynne-Edwards 1962); it may be that they have now moved on to Greenland.

Whether the birds I saw came from Greenland, Iceland, or even Britain, they were obviously a long way out to sea from their breeding colonies. This is not very surprising. Bourne (1963) notes that in winter they are found in offshore rather than inshore waters off the west African coast. But even in the breeding season they have a tendency to fly out to sea to fish, whereas Herring Gulls tend to scavenge close to the shore (Brown, 1967).

The great majority of these *Larus gulls* were fully adult. Taking the five species together (and including some records off the Nova Scotian coast on May 11, not shown in Figure 5), I have a total of 45 sightings of adults, against 12 of sub-adults. None of these sub-adults had much brown in their plumage – and what little they had was confined to the upper surfaces. I never saw any dark-bellied, first-winter birds, though these were common enough in St. John's and Halifax harbours. Similarly, G. C. Phillips (1962) found in Britain that first-winter gulls were seldom seen far from land. Phillips has shown that fish are slower to flee from a white as against a dark overhead object, and this presumably makes the dark, first-winter birds inefficient for fishing. Whichever is cause and effect, these first-winter birds seem to get most of their food from scavenging along the shore.

4. Sooty Shearwater *Puffinus griseus*

I saw a single bird on April 26, at 54°25′N, 41°15′W. To judge from J. H. Phillips (1963) and Rees (1964), this is abnormally early to find this species so far north. But as Rees (pers. comm.) points out, this probably reflects the absence of observers as much as of birds at this time of year.

5. Small petrels

I saw a few small petrels on May 9; 6 half-hour transects between c.52°00′N, 48°00′W and c.50°30′N, 49°15′W produced a total of 15 birds. But by the morning of May 10, at 47°52′N, 52°04′W (see Figure 1), the sea was covered with them, skimming low over the surface into the light wind. In 2½ hours, I estimate that over 1,000 birds crossed the ship's path, immediately in front of the bows. The size of the whole flock must have been many times larger than this.

The identification of these birds presents some problems; the choice lies between Leach's Petrel *Oceanodroma leucorrhoa* and Wilson's Petrel *Oceanites oceanicus*. Unfortunately, the birds were "pattering" along the water, in such a way that I could not satisfy myself on such diagnostic characters as leg length or web colour. But the flight behaviour seemed to be that of Wilson's – none of the hundreds of birds I saw showed the jerky, bounding flight so typical of Leach's. Against this, Leach's is the likeliest small petrel in these waters in early May (e.g. Palmer 1962).

Since the ship was not at an oceanographic station, I have no way of explaining this sudden and surprising concentration of birds. Rees (pers. comm.) suggests that the birds might have been feeding on fish eggs, since there are known to be pre-spawning concentrations of cod *Gadus* sp. in these waters at this time of year.

I was told that an unidentified small petrel flew aboard the ship on April 18, at 48°03′N, 44°49′W, over Flemish Cap.

6. Gannet *Morus bassanus*

I saw a single bird outside St. John's harbour on April 23; another just southeast of Cape Farewell on April 29; and a third at c.51°15′N, 49°00′W on May 9. All three were fully adult in plumage.

7. Common Eider *Somateria mollissima*

A flock of c.50 birds were moving north along the coast, just outside St. John's harbour, on April 23.

8. Scoters *Melanitta* sp.

I was told of a dark duck with white wing-patches, seen on April 14 at

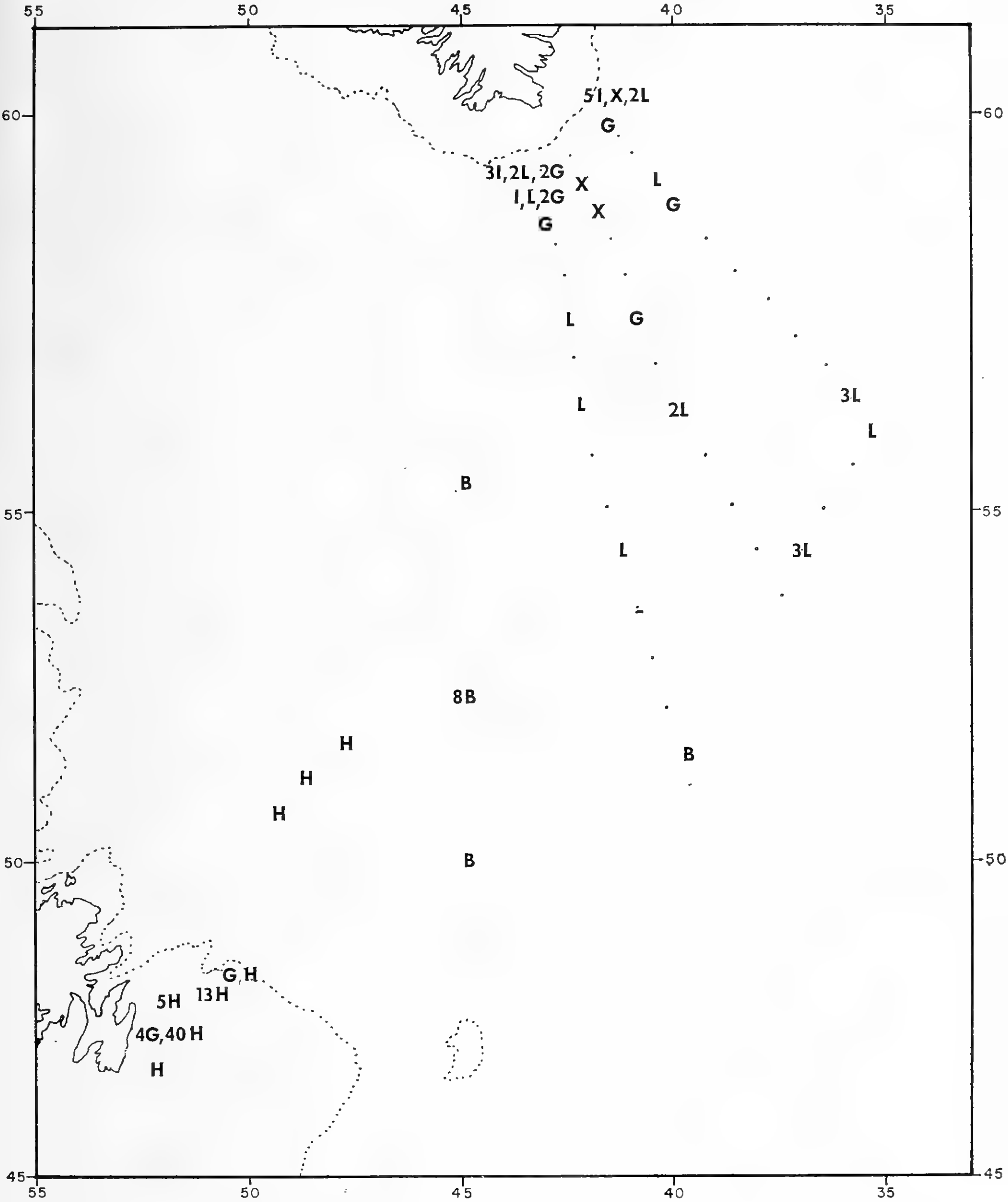

FIGURE 5. The distribution of the *Larus* gulls in the survey area; every record of one of these gulls is plotted on the map. Key: G = Greater Blackback; L = Lesser Blackback; B = unidentified Blackback; H = Herring Gull; I = Iceland Gull; X = Glaucous Gull.

57°45′N, 44°00′W, and of 4 more, on May 10, at c.47°00′N, 52°35′W. It seems likely that these were all White-winged Scoters, *M. fusca*.

9. Skua *Catharacta skua*

I only saw these birds in ones and twos; they were commonest off the Greenland coast, where I had eight sightings. I also saw single birds at c.50°30′N, 43°15′W (April 24), 52°15′N, 40°15′W (April 25) and 55°40′N, 35°48′W (May 4). On April 16 Lazier saw a flock of 6 at 53°05′N, 44°00′W, which apparently followed the ship down to 50°00′N, 44°00′W.

In the Northern Hemisphere, Skuas breed only in Orkney, Shetland, the Faeroes, and Iceland. At least in the southern colonies, they are on their breeding grounds by April (Fisher and Lockley 1954), so it is likely that my birds were non-breeders. This would fit in very well with the banding data. Landsborough Thomson (1966) shows that there are several recoveries of sub-adults, in their second or third years, from west and southwest Greenland, but that younger and older birds apparently do not visit these waters.

10. Jaegers *Stercorarius* sp.

I only saw these birds, like the Skuas, in ones and twos. But unlike the Skuas, there was no particular concentration near the Greenland coast. Nine of my sighting were Pomarine Jaegers *S. pomarinus*, and the tenth (close to the Newfoundland coast) was Parasitic *S. parasiticus*. All but one of the Pomarines were pale-phase birds.

Rees (pers. comm.) found a preponderance of Pomarines on the southwest Grand Bank between May 8-19, 1962, getting up to 20 round his ship at times. On the other hand, Rankin and Duffey (1948) found that the Parasitic was the commoner species. But the difference is probably not very significant; the two birds arrive on their breeding grounds at different times (Salomonsen 1950), so the species one sees will probably depend on the timing of one's cruise.

11. Alcids

I saw all three "large auks" – Razorbills *Alca torda*, Common and Thick-billed Murres *Uria aalge* and *U. lomvia*; they were often difficult to distinguish, and so I shall group them together. I also saw Dovekies *Plautus alle*. There were scattered groups of both large auks and Dovekies all over the survey area, and the outward and return voyages, but with one exception these groups were always small – seldom more than 5 birds in a half-hour watch.

The exception was on the return voyage, on May 9 (*see* Figure 1); we passed through large numbers of Thick-billed Murres and Dovekies flying northwest – presumably heading for breeding colonies on the Labrador coast or farther north. The highest counts of Murres (38 and 32 per half-hour) were centred on c.52°45′N, 47°30′W. Dovekies were also common there (44 and 80 per half-hour, on the same two transects) but they were also very common farther south – 56/half-hour at c.50°15′N, 49°15′W.

I was struck by one curious point. Even at the high densities of May 9, both flew in small groups rather than in continuous dense waves, and yet the

Dovekie groups were consistently larger than those of the large auks. 79 Dovekie groups averaged 3.21 birds, and 108 large auk groups averaged only 2.18 birds; the difference is probably significant ($\chi^2 = 10.96$, $p < 0.05$). I cannot suggest the function of this social behaviour difference among wintering birds. Perhaps it has something to do with the relative availabilities of the species' foods.

12. Wheatear *Oenanthe oenanthe*

A Greenland race male was found on board on the morning of May 5 (57°45′N, 37°50′W), and stayed at least as far as 58°57′N,39°55′W. It was presumably on passage from Ireland or France (Freuchen and Salomonsen 1959).

13. Snow Bunting *Plectorophenax nivalis*

A single male flew alongside the ship for a short while on April 29, as we were approaching Cape Farewell.

SUMMARY

The aim of this paper has been draw attention to the possibilities for combining ornitholgoical and oceanographical research. I have illustrated these possibilities by describing the birds seen on an aceanographic cruise on the CSS HUDSON to the South Labrador Sea, in April-May 1966.

Fulmars were the commonest birds in the area. Their highest densities were in the cold waters off the Newfoundland coast, and their lowest in the warm water gyre northeast of the Grand Bank. The birds were almost entirely in pale-phase plumage.

Kittiwakes were the next commonest species; their densities, by contrast, were highest in the warm water gyre, and lowest in the cold coastal waters. Some migration was in progress. Adults were commonest near the coast, the first winter birds out at sea.

The distributions of Herring, Iceland, Glaucous, and Greater Black-backed Gulls are shown to be mainly coastal. The only pelagic *Larus* gulls were a few Lesser Blackbacks south of Greenland; these birds were far to the west of the previous westernmost records.

A list of other species seen is added.

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THE VASCULAR FLORA OF TANQUARY FIORD, NORTHERN ELLESMERE ISLAND, N.W.T.

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In 1964 and 1967 the first author spent summer field seasons carrying out botanical studies on northern Ellesmere Island, stationed at Tanquary Camp (81°25′ N, 76°55′ W), one of the field stations of the Defence Research Board of Canada expeditions (Operation Tanquary). Tanquary Camp lies at the head of a fiord system penetrating deep into north-central Ellesmere Island. All studies were carried out within 20 kilometers of Tanquary Camp.

The northwest side of the head of Tanquary Fiord rises very sharply to peaks about 1,500 meters in height. But on the southeast side of the fiord the slopes rise gently to more rounded peaks 500 to 900 meters in height. The major rivers occupy very wide U-shaped valleys, but smaller rivers and creeks, which are usually directly glacier-fed, form deeply V-shaped gullies. On the larger river deltas there are extensive gravel terraces in three levels. Where smaller rivers and creeks enter the fiord there are extensive wet deltas, usually grading into drier plains. In places hard clay barrens border the fiord for several kilometers. There are few large bodies of fresh water near Tanquary Camp; a small kettle lake near the camp and the two Omega Lakes, 10 kilometers to the northeast, are the only lakes. Permanent ponds are more numerous.

Detailed descriptions and photographs of the plant habitats are being published separately (Brassard, 1968) in a paper which also brieflly summarizes the geology and climate of the Tanquary Fiord area. Additional information about Tanquary Fiord appears in Barry (1964), Brassard (1967), and Hattersley-Smith and others (1963, 1964, 1967).

Annotated List of Vascular Plants

The following data are given for each species: collection numbers, commonness, abundance, the habitats in which the species grew, the altitudinal range, additional comments. Sequence of genera and nomenclature follow Porsild (1964) in most cases, but in some groups a narrower species concept is used here.

Collection numbers 1 to 32 are those of a small collection made at Tanquary Camp in 1963 by J. S. J. Haight (Hattersley-Smith, 1964). The Haight collection is in the National Herbarium, Ottawa (CAN). All collection numbers over 1300 are those of Brassard. Voucher specimens of Brassard's 1964 collections (nos. 1300-2000) are in the Fowler Herbarium, Queen's University (QK) and the main duplicate sets are in the National Herbarium (CAN), the Botanical Museum, Copenhagen (C) and the New York Botanical Garden (NY). Brassard's 1967 specimens are at CAN and NY.

Commonness within the whole Tanquary area is indicated by u — ubiquitous, vc — very common, c — common, o — occasional, r — rare, vr — very

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rare. The abbreviations for abundance within the habitats are gd — generally dominant, ld — locally dominant, ga — generally abundant, la — locally abundant, na — seldom or never abundant.

The habitats are also abbreviated and listed in a sequence of increasing wetness (as in Brassard, 1968): CB — hard clay barrens, SD — sand dune, GT — gravel terraces, GS — gravel slopes, AS — active scree slopes, DP — dry plains, RS — stable rock slopes, DHS — Dryas hummock slopes, CHS — Cassiope hummock slopes, WD — wet deltas, SH — shorelines, FW — flat wetlands, A — aquatic.

Cystopteris fragilis (L.) Bernh. ssp. *dickieana* (Sim.) Hyl. 1496, 1940, 3258. o, na. RS. 50-500 m. The plants are small, although always sporulating.

Equisetum arvense L. var. *alpestre* Wahlenb. 1, 1343, 1419, 1463, 1568, 3102, 3265. o-c, la. DP, RS, WD, FW, A. 0-600 m. Much more widespread in the lowlands. Strobili are rare and may form on green or pale shoots. Extremely vigorous in one locality, with sterile plants erect, 20-30 cm tall.

Equisetum variegatum Schleich. 2, 1395, 1722. o, na. DP, CHS, WD, FW. 0-500 m. In contrast to *E. arvense*, which is much more common in the wetter habitats, *E. variegatum* is also common in drier sites. Most vigorous and abundantly sporulating when growing on *Cassiope* hummocks

Alopecurus alpinus J. E. Sm. 3, 1346, 1388, 1400, 1549, 1724. u, ga. SD, AS, DP, RS, WD, SH, FW. 0-600 m. One of the most common grasses and equally common and abundant in almost all habitats and at all altitudes.

Phippsia algida (Sol.) R. Br. 3274. vr, na. 800-900 m. Only encountered at the highest locality investigated.

Arctagrostis latifolia (R. Br.) Griseb. 1555, 1570, 1787, 1947. o, na. DP, FW. 0-700 m. Mainly on poorly vegetated clay meadows, associated with *Carex stans* or *Alopecurus*. Viviparous plants were found in one locality.

Calamagrostis purpurascens R. Br. 1654, 1845, 1863, 3262. o, na. GT, GS, AS, RS. 0-200 m. Plants usually growing singly. Occasionally extremely vigorous with culms 55-60 cm tall.

Deschampsia brevifolia R. Br. 5, 1564, 1577, 1610b, 1626, 1628, 1682, 1729, 1749, 1765, 1874, 1961. u, ga. CB, SD, GT, DP, WD, SH, FW. 0-300 m. Among the most widespread plants at Tanquary. Found under all environmental conditions but best developed in the drier habitats.

Trisetum spicatum (L.) Richt. 1958. o, na. DP, AS. 100-500 m. Occasional on loose sandstone scree.

Poa abbreviata R. Br. 1484, 1610a, 1617, 1642, 1676, 1718, 1841, 1888. vc, la. GT, GS, DP, RS, SH. 0-900 m.

Poa alpigena (Fr.) Lindm. var. *alpigena*. 1801. vr?, na. WD. 25 m. Evidently quite rare. The only collection had empty anthers.

var. *colpodea* (Fr.) Schol. 1545, 1583, 1648, 1877. o, na. DP. 0-50 m. Always very sparse and only in the lowlands.

Poa arctica R. Br. ssp. *arctica*. 1943. o, na. RS. 100-300 m. Both the typical subspecies and ssp. *caespitans* are less common and abundant than had been expected.

ssp. *caespitans* (Simm.) Nannf. 3142b. o, la. DP, WD. 0-600 m.

Poa glauca M. Vahl. 1484a, 1493, 1538, 1580, 1585, 1596, 1608, 1612, 1616, 1633, 1636, 1681, 1714. u, ga. CB, GT, GS, AS, DP, RS, WD, SH. 0-800 m. All collections have very glaucous leaves and deep purple spikelets but there is an extreme variation in size (mature culms 5-30 cm tall).

Poa hartzii Gand. 1546, 1569, 1598, 1637, 1719, 1862, 1962. vc, la. GT, GS, DP, RS, WD, SH. 0-200 m. Less common than either *P. abbreviata* or *P. glauca.* The spikelets are always a deep bronze colour. No intermediates to *P. glauca* were found, in contrast to Lake Hazen where Savile (1964) states ". . . intermediates range from nearly typical *hartzii* to nearly typical *glauca*, indicating substantial introgression."

Poa sp. 1675, 1906, 1945. r, na. AS, RS, DHS. 100-400 m. These three collections clearly represent the same taxon, but cannot be definitely assigned to any species. All plants were extremely vigorous and densely caespitose. The inflorescences, although one-flowered, are like those of *Poa*, but in all cases the florets are completely empty. The inflorescences are deep purple (as in *P. glauca*) but the leaves are very bright green, quite unlike any other *Poa.* Simmons (1906, p. 162) described a new variety of *P. glauca* which he called var. *tenuior.* His description and photograph (Pl. 9) seem to match these Tanquary specimens rather closely.

Pleuropogon sabinei R. Br. 3315. vr, la. FW. 500 m. Truly rare since all suitable habitats were carefully checked for this conspicuous grass. The plants, from the edge of a small pond, are the smaller "f. *terrestris*".

Colpodium vahlianum (Liebm.) Nevski. 4, 1794. r?, na. WD. 0-10 m.

Dupontia fisheri R. Br. 1763, 1853, 3080. o, ga. SH, FW. 0-50 m. Abundant where it occurs, yet restricted to a few lowland localities.

Puccinellia angustata (R. Br.) Rand & Redf. 1436, 1678, 1727, 1860. o, la. CB, GS, DP. 0-200 m. Variable in size and morphology. Several populations with very open panicles resemble *P. poacea* but were referred by Porsild to *P. angustata.*

Puccinellia phryganodes (Trin.) Scribn. & Merr. 1650, 1751. o, la. SH. 0-10 m. Restricted to intertidal and periodically inundated areas and always sterile.

Puccinellia poacea Th. Sør. 6, 1595, 1635, 1782. o, la. GT, GS. 0-100 m. Especially near the shore.

Puccinellia vaginata (Lge.) Fern. & Weath. 1486, 1753. o, la. CB. 0-10 m. The plants which Porsild revised to this species grew widely scattered and locally as the only trace of vegetation on hard clay barrens.

Festuca baffinensis Polunin. 1354a, 1582a, 1610c, 1632, 1673, 1800. o, na. GT, DP, RS, WD. 0-600 m. The commonest *Festuca* at Tanquary.

Festuca brachyphylla Schultes. 1354b, 1592b, 1643, 1744. o, na. DP, RS, SH, FW. 0-600 m. Some rather small collections with only a few scabri on the lemmas are intermediate to *F. hyperborea.*

Festuca hyperborea Holmen. 1354c, 3193a. r?, na. RS, WD. 500-800 m. Restricted to high altitudes at Tanquary.

Agropyron violaceum (Hornem.) Lange. [= *A. latiglume* (Scribn. &

Sm.) Rydb. *sensu* Porsild]. 1544, 1641, 1726. o, na. SD, GT, AS, DP, SH. 0-600 m. Much more common in the lowlands, but never abundant.

Eriophorum angustifolium Honck. *sensu strictu.* 1560b, 1742, 3132a. o, la. FW. 50-100 m. Always in very wet areas, especially pond margins. The peduncles are perfectly smooth throughout, even on old plants. Specimens with weak scabri are referred to *E. triste,* which seems about equally common.

Eriophorum scheuchzeri Hoppe. 1405, 1638, 1741, 1875. vc, ld. DP, WD, FW. 0-500 m. Often dominant or co-dominant, especially below 100 m. More widespread and abundant than *E. angustifolium* or *E. triste.*

Eriophorum triste (Th. Fr.) Hadač & Löve. 1560a, 3122, 3262. o, la. DP, FW. 50-100 m. Although it may grow with *E. angustifolium,* pure populations of each species were more common. *E. triste* seems to prefer drier sites.

Kobresia myosuroides (Vill.) Fiori & Paol. 9, 1467, 1597, 1806, 1970. vc, ld. GS, RS, DHS. 0-200 m. At Tanquary in part replacing both *Carex nardina* and *C. rupestris,* which are much more restricted. *Kobresia* is often associated with *Dryas* but sometimes forms tussocks of its own.

Carex bigelowii Torr. *ex* Schw. 3103, 3106b. o, la. WD. 50-100 m. Much less common than *C. stans,* but sometimes occurring with it. The latter sometimes approximates it in morphology and the two may be introgressing.

Carex boecheriana L., Löve & Raym. [= *C. capillaris* L. var. *robustior* (Lge. & Drej.) Böch. *sensu* Porsild, pers. comm. 1966]. 1556, 1810, 1973. o, na. DP, CHS, FW. 0-100 m. All specimens have the terminal spikelet staminate only at the base.

Carex maritima Gunn. 7, 1309, 1404, 1728, 1751, 1974. c, la. SD, DP, WD, SH. 0-500 m. The most common sedge after *C. stans.* Always fruiting and with extensive underground runners.

Carex membranacea Hook. 1748. vr, na. WD. 20 m. Only a few plants were found, in a sheltered wet delta.

Carex misandra R. Br. 1561, 1658, 1745, 1824, 1857. c, na. GS, DP, DHS, CHS, FW. 50-400 m.

Carex nardina Fr. var. *atriceps* Kük. 1889. o, na. GS. 500-700 m. Surprisingly less common than in other high arctic areas.

Carex rupestris All. 1858, 3142a. o, la. DP, WD. 0-100 m. Only in the lowlands.

Carex saxatilis L. var. *rhomalea* Fern. 1850, 3131. o?, la. FW. 50-100 m. Perhaps more common than it appears.

Carex stans Drej. 8, 1308, 1552, 1723, 3106a, 3133, 3262. u, gd. DP, WD, FW. 0-700 m. Extremely important in the Tanquary vegetation, almost always dominating the flat wetlands.

Carex ursina Dew. 1764, 3079. o, la. SH. 0-10 m. Only on wet intertidal and shoreline clay.

Juncus albescens (Lge.) Fern. 1739, 3132b. o, na. FW. 50-200 m. Never conspicuous.

Juncus arcticus Willd. 1653, 1846. o, la. DP, SH. 0-50 m. All plants were found in unstable habitats (storm beaches, deltas of large and erratic rivers), but fruiting abundantly and apparently well-established in four localities.

Juncus biglumis L. 1352a, 1553, 1578, 1873, 1948, 3107, 3197. vc, la. DP, RS, CHS, WD, FW. 0-600 m. By far the most common *Juncus* at Tanquary. Vigorous (20 cm tall) in several localities.

Juncus castaneus Sm. 1455. vr, na. WD. 25 m. Only one small clone was found, in wet clay.

Luzula confusa Lindeb. 1938. o, la. RS. 0-800 m. Surprisingly less common than in surrounding areas.

Luzula nivalis (Laest.) Beurl. 1509, 1627, 1660, 1734, 1775, 1835, 1893, 1905, 1941. c, na. AS, RS, CHS, WD, FW. 0-800 m. Both *Luzulae* are more frequent at higher altitudes but do not form an extensive belt as in central Axel Heiberg Island (Beschel, 1961).

Salix arctica Pall. var. *brownii* Anderss. 10, 1306, 1523, 1842. u, gd. CB, GT, GS, AS, DP, RS, DHS, CHS, WD, SH, FW. 0-800 m. By far the most widespread and abundant species in the Tanquary Fiord area, as it is everywhere on northern Ellesmere Island. Leaf shape is variable, even on the same plant. The species reaches its flowering peak by mid-June, and most of the plants begin losing their leaves by early August.

Oxyria digyna (L.) Hill. 11, 1386, 1597, 1838. c, la. SD, GS, RS, CHS, WD, SH. 0-600 m. Although usually vigorous, some dwarf specimens were found. Most common in dry areas below 100 m.

Polygonum viviparum L. 12, 1473, 1625. c, na. GS, AS, RS, DHS, WD, SH, FW. 0-700 m. Rarer than had been expected. Also most common in the lowlands but in wet hummocky or marshy areas.

Stellaria crassipes Hult. 16, 1944. r, na. DP. 0-200 m. One of the rarer members of the *S. longipes* group.

Stellaria edwardsii R. Br. 1559a, 1572b, 1750, 1795, 1911, 1944. o, la. GS, SD, DP, WD, FW. 0-200 m. With *S. monantha*, the most widespread *Stellaria.*

Stellaria humifusa Rottb. 1566, 1649. o, la. SH. 0-10 m. Prominent only along the seashore, where it flowers profusely.

Stellaria laeta Richards. 17, 1414, 1565. r, na. WD, SH. 0-10 m. Variable in sepal pubescence and ciliation.

Stellaria laxmanni Fisch. *sensu* Hultén. 1355a, 1537. vr, na. RS. 200-600 m. Porsild (1961) rejects Hultén's opinion that this Siberian plant occurs in the Nearctic, but does not propose a separate name for plants with the combination of characters given by Hultén. The Tanquary Fiord material is too scanty to provide a definite answer.

Stellaria monantha Hult. 1355b, 1500, 1542, 1572a, 1730, 1849, 1861, 1931, 1949, 3137. vc, la. GT, AS, DP, RS, SH. 0-600 m. The most widespread and abundant *Stellaria* at Tanquary. Vegetative characters vary widely – some collections are stunted with broad fleshy leaves, while others are etiolated and bright green.

Cerastium alpinum L. ssp. *lanatum* (Lam.) Asch. & Graebn. 13, 1356, 1389, 1412, 1465, 1519, 1573, 1710, 1821, 1936. c, la. GT, AS, DP, RS, WD. 0-600 m. Extremely variable.

Cerastium arcticum Lge. 1413, 1618, 1630. r-o, na. GT, WD. 0-50 m. Only in the lowlands. Doubtfully distinct from the preceding (Porsild, pers. comm. 1967).

Cerastium beeringianum Cham. & Schlecht. 3174. r?, la. SH. 0-10 m. Apparently very localized.

Cerastium regelii Ostf. 14, 1796, 3193b. r, na. WD. 0-600 m. Not common even along the Tanquary Fiord shoreline.

Sagina intermedia Fenzl. 3249. vr, na. WD. 50 m. Very localized but fruiting abundantly.

Arenaria rossii R. Br. 1695a. vr, na. WD. 10 m. Only one small sterile cushion was found.

Arenaria rubella (Wahlenb.) Sm. 1424, 1623, 1640, 1809, 1847, 1902, 1912. vc, la. GT, GS, AS, DP, WD, SH. 0-600 m. Especially common on dry sand and gravel at low altitudes. Always flowering.

Silene acaulis (L.) Jacq. var. *exscapa* (All.) DC. 3198. vr, na. GS. 500 m. Only one cushion of *Silene* was seen at Tanquary and its extreme rarity is difficult to explain.

Melandrium affine (J. Vahl) Hartm. 3167. vr, na. RS. 200 m. By far the rarest *Melandrium.*

Melandrium apetalum (L.) Fenzl ssp. *arcticum* (Fr.) Hult. 15, 1428, 1508, 1557, 1579, 3309. o-c, la. RS, CHS, WD, FW. 0-500 m.

Melandrium triflorum (R. Br.) J. Vahl. 1399, 1444, 1466, 1547, 1725, 1756. c, ga. GT, GS, DP. 0-100 m. Widespread but only in the dry habitats, and much more so than *M. affine*. Plants with only one capsule per stem are not rare.

Ranunculus hyperboreus Rottb. 1458, 3130. o, la. SH, FW, A. 0-400 m. Most often sterile although flowering profusely in one locality.

Ranunculus nivalis L. 3322. r?, na. DHS. 800 m. Apparently restricted to high-altitude snowbed areas, and much less common than *R. sulphureus.*

Ranunculus pedatifidus Sm. 1571, 1671. o, na. RS, FW. 100-400 m.

Ranunculus ? sabinei R. Br. 3325b. vr?, na. DHS. 800 m. The plants are depauperate and a definite identification is not possible.

Ranunculus subrigidus W. B. Drew. 1459, 1590. vr, na. A. 60 m. Only sterile, and very rare, but there are few suitable habitats. The leaves are very rigid when removed from the water, quite unlike the flaccid leaves of *R. trichophyllus.* Porsild confirmed the determination.

Ranunculus sulphureus Sol. 1427, 1521, 1898, 3063, 3325a. o-c, na. DHS, WD, FW. 0-800 m. The only common *Ranunculus.* Especially in mossy places.

Papaver radicatum Rottb., *sensu lat.* 18, 1391, 1422, 1432, 1457, 1708, 1814, 1907, 1959. u, ga. GT, GS, AS, DP, RS, CHS, WD, SH. 0-900 m. Leaf shape, petal colour and latex colour are very variable; most combinations of the last two were observed but plants with yellow petals and white milk predominate. On Ward Hunt Island (83° N) there seems to be a greater percentage of poppies with white petals (H. Serson, pers. comm. 1964).

Cochlearia officinalis L. ssp. *groenlandica* (L.) Porsild. 20, 1326, 1387, 1402, 1967. c, la. GS, WD, SH. 0-50 m. Only abundant near the shore.

Eutrema edwardsii R. Br. 23, 1559. o, na. WD, FW. 0-100 m.

Cardamine bellidifolia L. 1352, 3091. r, na. RS, FW. 500-600 m. Restricted to high altitudes and very scattered even there.

Lesquerella arctica (Wormskj.) Wats. 1322, 1337, 1839, 1910. u, ga. GT, GS, AS, DP, RS, WD. 0-400 m. Among the most widespread crucifers at Tanquary, especially in the lowlands.

Draba arctogena E. Ekman. 1323, 1339b, 1353, 1393, 1411c, 1454, 1456a, 1481, 1510, 1587, 1611, 1615, 1622, 1819, 1848, 1909a, 1919, 1960. u, ga. GT, GS, AS, DP, RS, WD, SH. 0-600 m. *D. arctogena*, *D. cinerea*, and *D. groenlandica* are about equally common at Tanquary. All grow in dry gravelly places, wet deltas and dry slopes. Several collections were mixtures of two or three of the above species. *D. arctogena* was the most commonly collected of the three, however.

Draba bellii Holm. 21, 1384, 1410, 1813, 1963. c, la. GT, GS, AS, DP, WD, SH. 0-400 m. All Tanquary plants with deep yellow flowers belong here, as *D. alpina* was surprisingly absent.

Draba cinerea Adams. 1339a, 1456b, 1485b, 1488, 1639, 1732, 1876, 1909b, 1980. vc, la. CB, GT, AS, RS, DHS, WD. 0-200 m.

Draba glabella Pursh. 1747. vr, na. GT. 30 m. Only one plant was encountered.

Draba groenlandica E. Ekman. 1339c, 1344, 1394, 1411b, 1439, 1456c, 1550, 1679, 1720, 1754, 1901, 1909c. vc, la. CB, GT, GS, AS, DP, DHS, WD. 0-500 m.

Draba lactea Adams. 1385, 1411a, 1667, 1836b, 3087a. o, na. DP, WD, FW. 0-500 m.

Draba oblongata R. Br. 1563, 3087b. r, na. SH, FW. 0-500 m. One of the rarest *Drabae* at Tanquary.

Draba subcapitata Simm. 1401, 1613, 1619. o, na. DP, WD. 0-300 m.

Erysimum pallasii (Pursh) Fern. 22, 1320, 1324, 1423, 1696, 1859. o, la. GS, AS, DP, RS, WD, SH. 0-500 m. One of the earliest plants to flower. Most common in the lowlands.

Braya humilis (C. A. Mey.) Robins. ssp. *arctica* (Böch.) Rollins. 1338, 1453, 1589, 1731, 1783. o, la. GT, GS, AS, DP, DHS, WD, FW. 0-500 m. Common only in dry places.

Braya purpurascens (R. Br.) Bunge. 19, 1620, 1766, 1840, 1965. o, la. GS, DP. 0-400 m. Always very distinct from the following, larger, and with much more elongated glabrous fruits.

Braya thorild-wulffii Ostf. 1443, 1489, 1621, 1651, 1721, 1843, 1966. o, na. GT, GS, DP, SH. 0-200 m. As common as *B. purpurascens* but never abundant. Plants are very small, have decumbent scapes and rounded, hairy capsules.

Saxifraga caespitosa L. *sensu lat.* 1332, 1350, 1417, 1503, 1904. c, ga. GS, AS, RS, WD, FW. 0-800 m. Most abundant on stable rock slopes. Rarely with two flowers per scape, the second always very reduced.

Saxifraga cernua L. 24, 1351, 1409, 1709, 1738, 1892, 1930. vc, ga. GS, DP, RS, CHS, WD, FW. 0-900 m. One of the more common saxifrages at Tanquary. Best developed on wet clay deltas and most reduced in wet sedge meadows.

Saxifraga flagellaris Willd. ssp. *platysepala* (Trautv.) Porsild. 1415, 1661, 1695, 3065. o, la. WD, FW. 0-800 m.

Saxifraga foliolosa R. Br. 1737. r-o, na. FW. 50-500 m.

Saxifraga hirculus L. var. *propinqua* (R. Br.) Simm. 1554, 1574, 1733. c, la. FW. 0-500 m.

Saxifraga hyperborea R. Br. 3307. vr, na. FW. 400 m. The rarest saxifrage at Tanquary. Plants are decumbent, less than 5 cm tall, and have pink petals and dark reddish sepals.

Saxifraga nivalis L. 1348, 1418, 1512, 1666, 1878. o, la. GS, RS, WD, FW. 0-800 m. Especially on mesic rock slopes.

Saxifraga oppositifolia L. 25, 1317, 1335, 1421, 1844. u, la. GT, GS, AS, DP, RS, DHS, CHS, WD, SH, FW. 0-900 m. Ubiquitous but rarely forming any appreciable part of the total plant cover. Plants are extremely variable in the number of floral parts and petal colour.

Saxifraga tenuis (Wahlenb.) H. Sm. 3306, 3317. r, la. RS, FW. 400-600 m. Much rarer than the related *S. nivalis*, and always very distinct from it.

Saxifraga tricuspidata Rottb. 1349, 1420, 1492. u, ga. GS, AS, DP, CHS, WD. As common as *S. oppositifolia* and replacing it at high altitudes. Occasionally invading some rather wet habitats.

Potentilla hyparctica Malte. 3064. r, la. RS, FW. 500-700 m. Apparently only at high altitudes.

Potentilla nivea L. ssp. *chamissonis* (Hult.) Hiit. 1588, 1686, 1887, 1908. o, na. GT, AS, DP, RS. 50-500 m. Rarer than *P. rubricaulis* but in similar habitats.

Potentilla pulchella R. Br. 27, 1345, 1437, 1543. o, la. GT, GS, DP, SH. 0-100 m. Especially common along the shore.

Potentilla rubricaulis Lehm. 1392, 1398, 1438, 1464, 1539, 1677, 1715, 1757, 1805, 1971, 3142c, 3267. vc, la. GT, GS, AS, DP, SH. 0-200 m. The most widespread *Potentilla* at Tanquary. Vigorous specimens were 30-50 cm tall.

Dryas integrifolia M. Vahl. 26, 1374, 1468, 1870. u, gd. GT, GS, AS, DP, RS, DHS, CHS, WD, SH, FW. 0-800 m. Second only to *Salix* in commonness and abundance, and often dominating large areas. Only absent at the highest altitudes.

Epilobium latifolium L. 28, 1446, 1562. c, la. SD, GT, GS, AS, DP, WD, SH. 0-500 m. Mostly in dry habitats. Less than 100 plants were seen flowering in 1964, but flowering was quite widespread in 1967.

Hippuris vulgaris L. 1693. vr, la. A. 60 m. Extremely rare at Tanquary, but suitable habitats are also rare. The plants were all sterile, growing in 10-15 cm of water in the early summer, later only in wet muck.

Cassiope tetragona (L.) D. Don. 1329, 1607, 1707. vc, gd. GS, RS, CHS. 0-700 m. Restricted to places where snow accumulates and remains longest. Almost always forming hummocks which it dominates. Flowering even in late August.

Vaccinium uliginosum L. var. *alpinum* Big. [= *V. gaultherioides* Big.] 1969, 3158. o, la. CHS. 80-500 m. Like *Cassiope* apparently restricted to snow accumulation areas. Only found sterile.

Androsace septentionalis L. 1452, 1480, 1808. o, na. GS. 0-100 m.

Armeria maritima (Mill.) Willd. ssp. *labradorica* (Wallr.) Hult. 29, 1652, 1752. o, la. SD, SH. 0-50 m.

Pedicularis arctica R. Br. 30, 1383, 1397, 1408, 1440, 1482, 1777. vc-u, ga. GS, DP, RS, DHS, CHS, WD, FW. 0-200 m. By far the most common *Pedicularis*. Plants are distinct, with well-formed teeth and a style protruding several millimeters from the dark pink helmet.

Pedicularis capitata Adams. 31, 1396 1434, 1576, 1918. o, na. GT, GS, DP, RS, DHS, CHS, FW. 0-500 m. Mainly associated with *Dryas*.

Pedicularis hirsuta L. 1483, 1584, 1609, 1706. o, na. DP, RS, DHS. 0-300 m. Much less frequent than *P. arctica*. The hood is very pale pink and usually without teeth.

Pedicularis sudetica Willd. ssp. *albolabiata* Hult. 1551, 1575. o, la. FW, A. 50-100 m. Plants are preferentially grazed by muskoxen.

Erigeron compositus Pursh. 32, 1442, 1540, 1890, 1957. c, ga. GT, GS, AS, DP, SH. 0-500 m. One collection (1957) is var. *glabratus* Macoun, the others var. *discoideus* Gray.

Chrysanthemum integrifolium Richards. 1788, 1869, 3104. o, la. DHS, CHS. 50-400 m.

Arnica alpina (L.)Olin ssp. *angustifolia* (Vahl) Maguire. 1956. r, na. AS. 100-200 m. Only observed in three localities and probably truly rare. Restricted to S-facing scree sopes.

Taraxacum arctogenum Dahlst. 1435, 1541b, 1581. o, ga. GS, AS, DP. 50-200 m. Only in the driest habitats.

Taraxacum phymatocarpum J. Vahl. 1594, 1644. r, na. GS, SH. 0-700 m. The rarest dandelion at Tanquary.

Taraxacum pumilum Dahlst. 1429, 1541a, 1820. o, na. GS, AS, DP, WD. 0-500 m. Slightly less common than *T. arctogenum*, and in both dry and moist places.

GENERAL RESULTS

In the Tanquary Camp area the two most widespread and abundant species are *Salix arctica* and *Dryas integrifolia*. Other ubiquitous plants include *Alopecurus*, *Deschampsia*, *Poa glauca*, *Papaver*, *Lesquerella*, *Draba arctogena*, *Saxifraga oppositifolia* and *S. tricuspidata*.

Surprisingly rarely found were *Phippsia*, *Pleuropogon*, *Cerastium regelii*, *Arenaria rossii*, *Silene*, *Melandrium affine*, *Ranunculus sabinei*, *Potentilla hyparctica*, *Pedicularis hirsuta* and *Arnica*. All but the last of these species are much more frequent in the more oceanic parts of the High Arctic and their rare occurrence may be a reflection of the extreme continentality of Tanquary Fiord.

Two of the species which the first author found at Tanquary Camp, *Eriophorum angustifolium* and *Juncus arcticus*, were not previously known from Ellesmere Island or any of the other Queen Elizabeth Islands, and their known range is greatly extended. The previous northernmost collections of *Eriophorum angustifolium* were from Inglefield Gulf, West Greenland (77°21′ N) and Erik Harbour, Baffin Island (72°30′ N). The previous northern limit of *Juncus arcticus* was Dusen Fjord, West Greenland (73°19′ N) and Clyde Inlet, Baffin Island (69°50′ N).

Tanquary Camp is also the northernmost known locality for *Dupontia fisheri*, *Puccinellia vaginata*, *Carex membranacea*, *C. ursina*, *Stellaria humifusa*, *Draba glabella*, and the northernmost Canadian locality for the genera *Sagina* and *Vaccinium*. The collection of *Armeria maritima* at Tanquary along with a recent unpublished one near Gilman River in the Lake Hazen area (J. Brousseau *coll.* 1967) extend the known Canadian range of this genus as well.

The foregoing list comprises 119 species in 52 genera and 20 families. Several years of collecting have yielded about 115 species for the Lake Hazen basin (Savile, 1964). Since Tanquary Fiord is so far from the open coast it possesses a very continental climate similar to that at Hazen, and also has the maritime habitats which Lake Hazen lacks. Fewer than 100 species are known from Alert (Bruggemann & Calder, 1953; Porsild, 1964). The combined area of northern Ellesmere Island (north of the line joining Greely Fiord and Archer Fiord) harbours 143 vascular plant species. Following the same species concept as in this paper Beschel (1961, 1963) gives the flora of Axel Heiberg Island as 137 species. The flora of Peary Land, North Greenland, now stands at 106 species (Fredskild, 1966). Several other high arctic areas are very much poorer in numbers of species. Only 51 species were reported from Cornwallis Island (Schofield & Cody, 1955), and the northwestern Queen Elizabeth Islands have an even more impoverished flora, with only 49 vascular species (Savile, 1961).

The continental areas of northern Ellesmere and Axel Heiberg Islands thus have a much greater diversity of plants than any of the surrounding areas. The only area of comparable size in the Nearctic north of 75° N which contains a more diverse flora is the Thule region of Greenland (NWn in Böcher *et al.*, 1957), with 156 vascular species.

Acknowledgements

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NEW AND IMPORTANT ADDITIONS TO THE FLORA OF THE SOUTHWESTERN YUKON TERRITORY, CANADA

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Three species normally associated with prairie and subalpine plant communities have been discovered in the Kluane Ranges of the southwest Yukon Territory. Not only have these species been unreported for the Yukon, but their new stations are greatly disjunct from the previously known range of each species.

Hulten (1941 to 1950), Porsild (1951, 1966) and Johnson and Raup (1964) have suggested the relict nature of prairies in this area. The plants discussed below reinforce the writer's hypothesis that the Shakwak Valley and the adjacent Kluane Ranges to the west provided refugia for plants of prairie and subalpine communities. Today communities with corresponding species are widespread 1200 to 1500 miles to the south and east. Furthermore, they are now clearly linked with steppe vegetation of Asia. Hulten (1963) reports 60 species occurring in western America which have disjunct ranges centered in the Yukon, and 10 species of Asia or Eurasia which reach the southwestern Yukon Territory. Similarly, Porsild (l.c.) indicates 18 prairie and 14 subalpine species whose known distribution in this part of the Yukon is widely disjunct from the northern prairies or Rocky mountains.

While the pre- and interpleistocene glacial history of the Shakwak Valley and the Kluane Ranges is not yet clear, circumstantial evidence for refugia other than the obvious nunataks can be tentatively put forth. The Shakwak Valley and its major connecting valleys approximately follow the line of separation between the Cordilleran ice cap and the western extension of the Laurentian ice field. Apparently, ice advances from one source were accompanied by at least partial retreat of the other, leaving some portion of the valley or adjacent ranges free of ice.

Today prairie communities are restricted to xeric sites within the boreal forest and form only a small portion of the total vegetation; however, they are common in the central Shakwak Valley.

Erigeron lanatus Hook.

Erigeron lanatus Hook. is a small alpine plant of the Rocky Mountain cordillera. Its range extends from Gunnison Pass in southern Colorado to Waterton Lakes Provincial Park, Banff National Park, Kootenay National Park, Nub Mountain and Windemere in southern British Columbia. Yukon specimens were collected on the north side of Alsek Pass on a steep scree slope, at 4200 feet elevation overlooking the entrance of the Desadeash River into the Kluane Ranges (137° 47′ W; 60° 46′ N). A voucher specimen (*Neilson #1307*) is deposited in the herbarium at the Natural History Museum in Stockholm, Sweden.

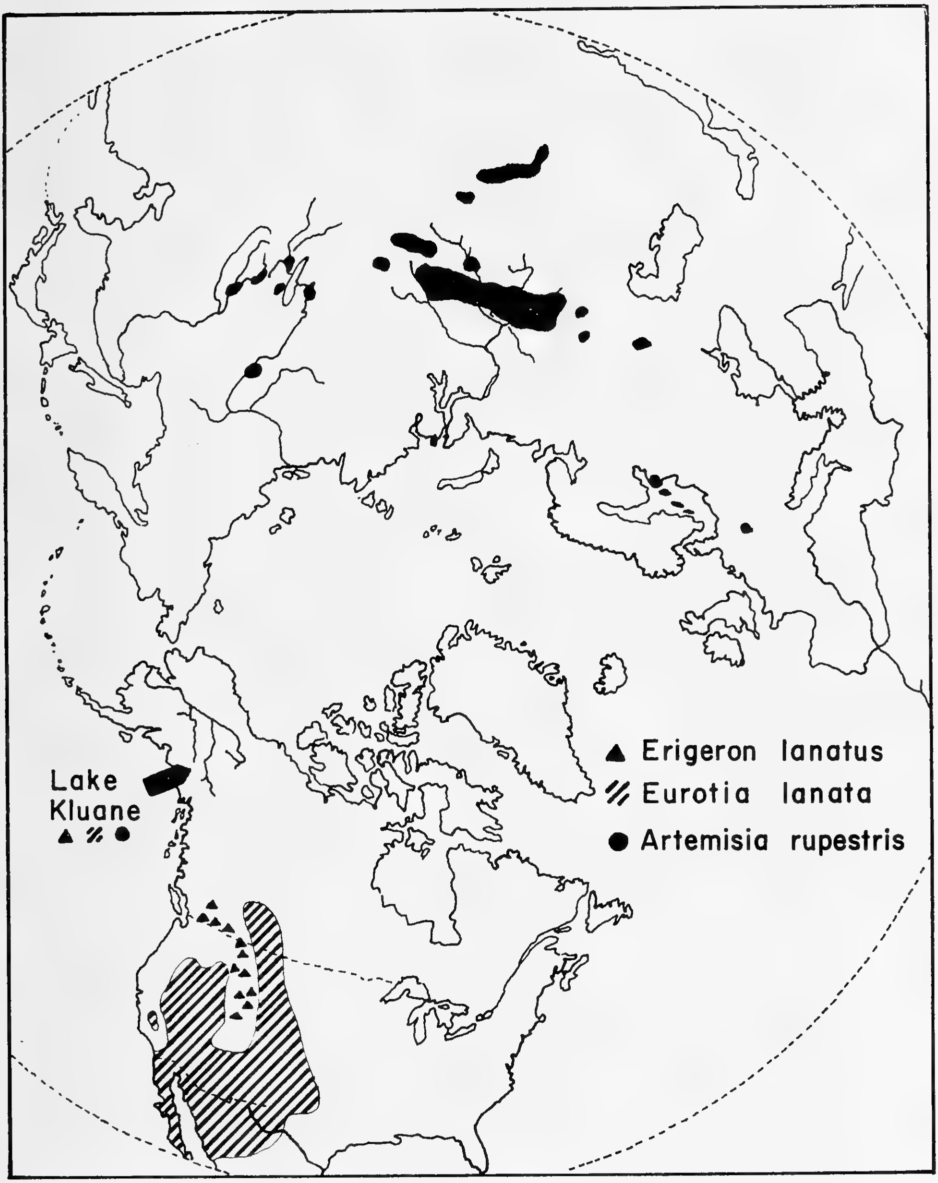


FIGURE 1. The known geographical distribution of *Erigeron lanatus* Hook., *Eurotia lanata* (Pursh.) Moq., and *Artemisia rupestris* L. in relation to the Yukon populations at Kluane Lake.

Eurotia lanata (Pursh) Moq.

Eurotia lanata is a plant of dry prairies and rocky desert slopes. It is found in the Great Basin, Lower California, the Mojave Desert, the dry plains of western Texas, the short-grass prairie states, and north to the vicinity of Calgary in central Alberta. It has a close relative, *Eurotia ceratoides*, which is widespread in the xeric portion of Asia.

E. lanata is highly prized as winter forage for domestic sheep throughout its range. The small scattered populations growing at this new station were grazed by the native Dall sheep common in the area. All plants observed arose from heavy crowns, were 8 inches high, and their stems were relatively thin compared to Great Basin material. The long pilose hairs which typically extend over the dense stellate pubescence were more dense and spreading in comparison to herbarium material from other parts of the species' range. In aspect, these plants appear more delicate and woolly than their southern counterparts.

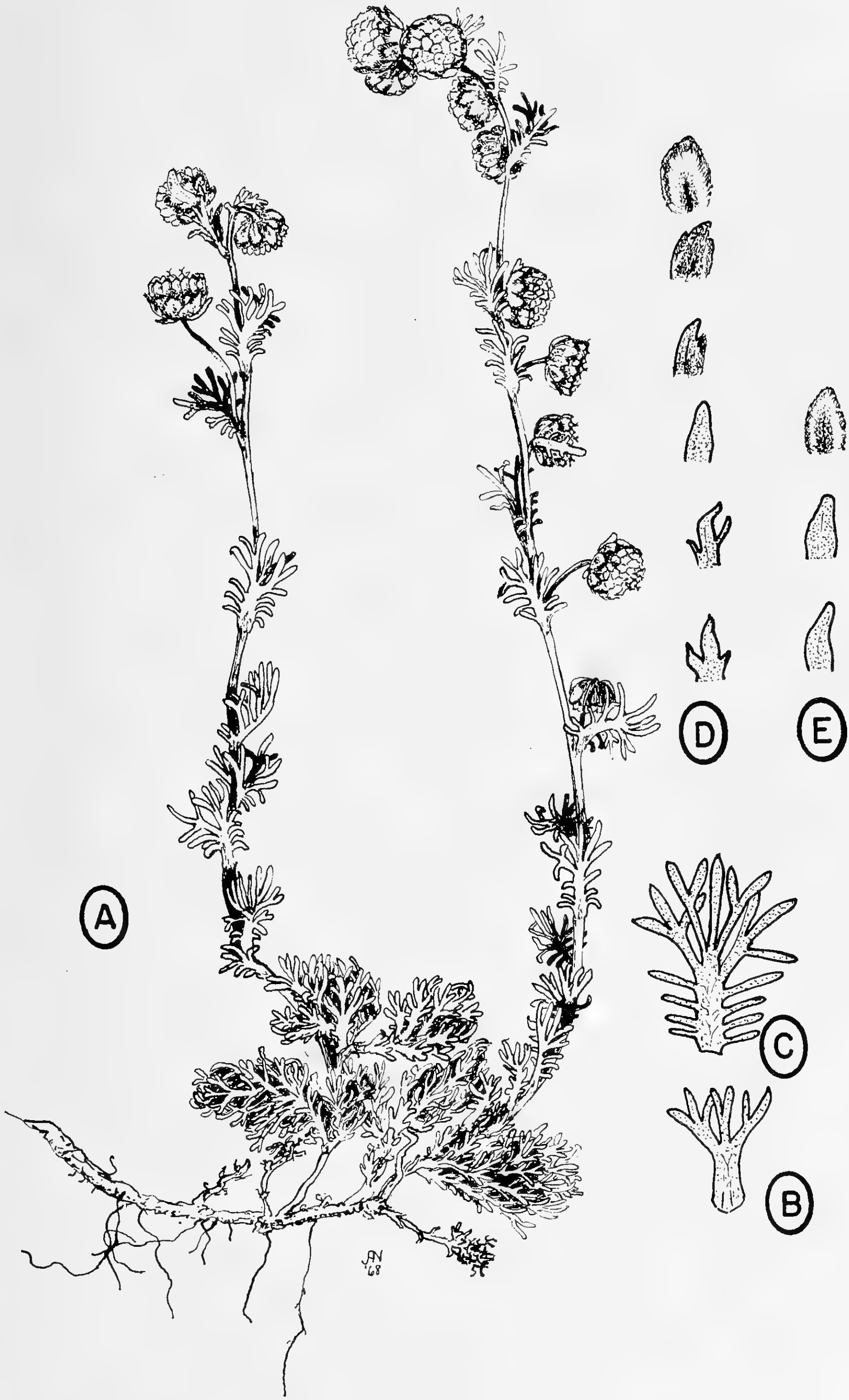
The Yukon populations are 1200 miles from the nearest recorded stands in Alberta (see map Fig. 1), and were discovered in an open, xeric, gravelly, hillside environment in the Kluane Ranges (Sheep Mountain and the connecting ridge to the west; 138° 32′ W; 61° 02′N, *Neilson #1151* and *#1238*). A portion of *#1151* is deposited in the National Herbarium of Canada where there is also an unreported specimen of *Eurotia lanata* collected on July 12, 1944 by H. M. and L. P. Raup (*#12412*) from one of the more easterly populations on the same hillside.

Artemisia rupestris L.

On the same hillside on which the preceding plant occurred, a widespread Eurasiatic sagebrush, *Artemisia rupestris*, was discovered. This perennial has not been previously reported from North America. Its nearest known station is on the Lena River drainage in eastern Siberia, a distance of some 3200 miles from the Yukon populations. From the Lena River the species is distributed southward along the Shilka River drainage near Mongolia, then eastward through the mountains of Kirghis, across the steppes of Kazakastan and central USSR, to southern Germany and the Swedish offshore islands of Oland and Gottland. (See map Fig. 1.)

This plant has no morphologically similar relative in North America. The habit of the vegetative branches is somewhat reminiscent of *A. frigida* when it suffers from drought, and indeed, it has been mistaken for it (c.f.

FIGURE 2. *Artemisia rupestris* L. A. Habit sketch of *A. rupestris* L. ssp. *woodii* n. ssp. (X1). B. Leaf from lower portion of vegetative shoot (X3). C. Leaf from middle of fruiting stem (X2¼). D. Morphological variation in bracts and phyllary (top) from head of *A. rupestris woodii* (X2½). Lower three types are vegetative, the other two show slight development of a dark scarious margin similar to that of the phyllary. One to four of any types of these may be found subtending a single head. E. Morphological variation in bracts and phyllary (top) from heads of *A. rupestris rupestris* (X2). Note the narrower dark scarious margin of the phyllary which is sometimes lacking altogether.



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specimen at the National Herbarium of Canada *CAN108195*). The sticky, glandular, dark green leaves of *A rupestris* lack the silvery gray pubescence typical of *A. frigida*. The receptacle is always covered with coarse hairs in *A. rupestris*. This seems to be more reliable as a key character than for *A. frigida* in which receptacle hair is absent in some populations. The habit of the flowering stems and heads might be compared to *A. arctica* or *A. alaskana*. The former is entirely glabrous and the latter is gray pubescent and lacks glands of any kind. The size of the heads of *A. rupestris* is intermediate between the two.

Inasmuch as this species is new to North America, a brief description is appropriate.

Artemisia rupestris L. is a caespitose, pungently aromatic, sticky glandular perennial, forming dense, circular, dark-green mats about one to three feet in diameter. Vegetative shoots are decumbent or weakly ascending, one to two inches long. The leaves are dark green, 5 to 10 (15) mm long, once or twice pinnately divided to near the midrib, punctate glandular or with a few simple or branched hairs along the mid-vein. It is always ciliate near the base of the broadly winged petioles.

Fruiting stems are 8 to 25 (30) cm tall, erect, punctate glandular and pubescent with small stellate hairs with occasional long simple or branched hairs. Lower cauline leaves are similar to those on vegetative shoots; median cauline leaves are more spreading, up to 20 mm long, and have thinner, longer lobes. The petioles have narrower wings. The upper leaves are much reduced and become nearly linear. 5 to 20 heads are borne on a narrow raceme. Lower heads are often borne on peduncles 1 to 5 cm long. All heads measure 6 to 9 mm across and 3 to 4 mm high, and are nodding in habit. Florets are sticky glandular and the receptacle is covered with stiff white hairs ¾ the length of the floret.

Clearly, the Yukon material should be included with the Eurasiatic *A. rupestris* L. but it does differ in several critical respects. The outer phyllaries are broader with a more rounded apex. These have a broad, scarious, iridescent margin which is lacking or poorly developed in typical *A. rupestris*. More important, the bracts subtending the head are reduced in number — at most four, often none. In the Eurasiatic material there are four to seven which are consistently linear with herbaceous obtuse or acute tips. Those of Yukon plants vary from weakly pinnatifid (rare) to linear (sometimes with a dark scarious tip). In most European material the lobes of the leaves on vegetative shoots are acute and sometimes mucronulate in contrast to the blunt or obtuse condition of those from the Yukon. As far as can be determined from herbarium sheets, neither European nor Asiatic material has the pronounced differences in the habit of vegetative and fruiting shoots apparent in the Yukon plants. Densely spaced leaves and their appressed or slightly spreading habit give the vegetative shoots of Yukon plants a club-shaped appearance. In Eurasiatic material the internode length is slightly longer and leaf habit is loose and much more spreading, therefore similar to the fruiting stems of both groups. See Fig. 2.

These differences are sufficiently distinct and uniform to conclude that the Yukon plants represent a geographical race.

Artemisia rupestris L. spp. *woodii* n. ssp.

Una vel, duo bracteae subtentae involucrum vel omnino deficientes lineares vel parum pinnatae saepe ad extremum scariosae. Externa phyllaria lata quarum margines latae, scariosae, iridescentes, fimbriatae interdum ciliatae.

Neilson #1242 collected Aug. 20, 1967. Open prairie on gentle slope (25%), southern exposure, on fine loess soil over shist gravels and scree. Below rock glacier, dry site. 138° 32′ W – 61° 03′ N; Sheep Mountain, elevation 3000; Klaune Ranges, Vicinity of Kluane Lake, Yukon Territory, Canada.

The plant is named in honor of Dr. Walter A. Wood, pioneer scientific explorer of the St. Elias Ranges, former President of the American Geographical Society, and Director of the Icefield Ranges Research Project of the Arctic Institute of North America.

The holotype is deposited in the National Herbarium at the Museum of Natural History in Washington D.C. Isotypes are deposited at the Herbarium of the National Musuem of Canada in Ottawa; The Natural History Museum in Stockholm; The Dudley Herbarium at Stanford University in Palo Alto, California; The Herbarium of the University of California at Berkeley, California; and the Gray Herbarium, Harvard University, Cambridge, Massachusetts.

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CRUSTACEA OF THE DELTA MARSH REGION, MANITOBA

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INTRODUCTION

THE PURPOSE OF THIS PAPER is to list the species and comment briefly on the ecology of the Crustacea collected during a limnological study of the Delta Marsh, from May to September of 1965 and 1966.

Little is known about the crustacean fauna of Manitoba. Reed (1963) and Watson and Lawler (1965) deal with collections from small lakes in northern Manitoba, but the southern regions of large glacial lakes have virtually been ignored. In contrast to this surrounding areas have been fairly well investigated. A number of regional listings exist for Saskatchewan (e.g. Moore 1952; Rawson 1957; Wilson 1958), as well as for the Minnesota-North Dakota regions to the south of the present study area (e.g. Herrick and Turner 1895; Young 1924).

THE STUDY AREA

The Delta Waterfowl Research Station, located at the south end of Lake Manitoba (50°10′N, 98°10′W), was used as the base of operations for this study. The station is located in the large 36,000 acre marsh (Hochbaum 1944) from which most of the samples were taken. In addition to the marsh proper, collections were made from sloughs, gravel pits and roadside ditches in an Aspen Parkland area 15 miles southwest of Delta.

The area under study lies at the head of the Mississippi flyway system and in an area once covered by the Wisconsin ice sheet during Pleistocene glaciation. With the advance of the Valders ice sheet, Lake Agassiz II was created. This advance also blocked off the connection of this area with the Nelson River system in the north. With the retreat of the Valders ice sheet, Lake Agassiz II became connected to Lake Superior, to the east, through the Black Sturgeon spillway. A final drainage occurred when the Keewatin ice sheet melted and Hudson Bay became exposed. From C_{14} dating of Lake Agassiz II deposits, it is estimated that final drainage occurred prior to 36,000 years ago. The two large lakes in Manitoba presently, Lake Manitoba and Lake Winnipeg, are what remain of Lake Agassiz.

The climate is described by Thornthwaite (1931) as sub-humid, microthermal, and moisture deficient in all seasons. The mean summer temperature for July is 76.4°F, the mean date of first freezing September 15, the mean date of last freezing June 1. Annual precipitation is between 25 and 50 cm. with 80% as rain and 20% as snow (Ehrlich, Poyser and Pratt, 1957; Atlas of Canada, 1958).

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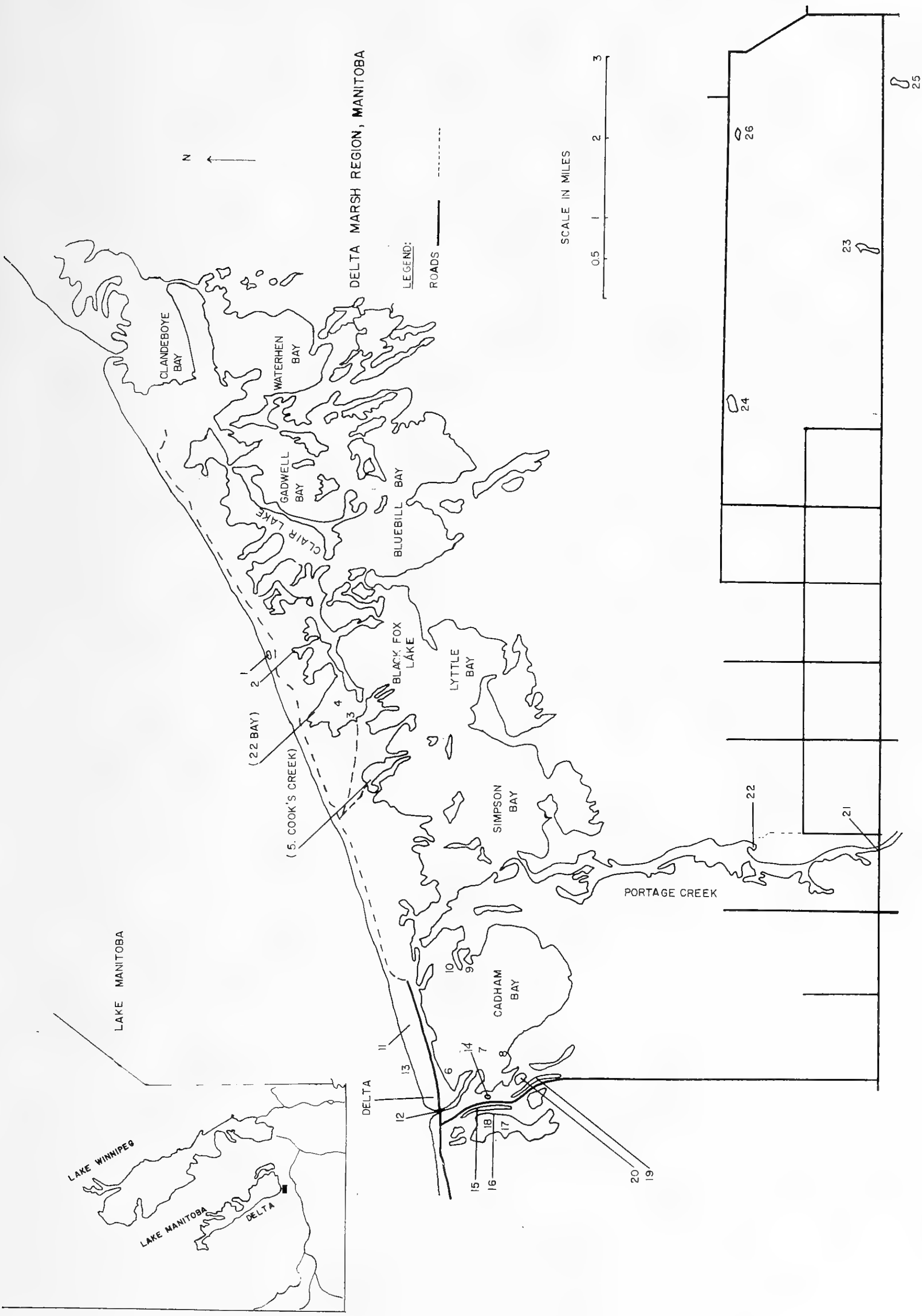
FIGURE 1. A map of the Delta Region (50 10′ W., 98 10′ N.), showing the location of the 26 permanent sampling sites.


DELTA MARSH REGION, MANITOBA
LEGEND:
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CLANDEBOYE BAY
WATERHEN BAY
GADWELL BAY
CLAIR LAKE
BLUEBILL BAY
BLACK FOX LAKE
LYTTLE BAY
(22 BAY)
(5. COOK'S CREEK)
SIMPSON BAY
PORTAGE CREEK
CADHAM BAY
DELTA
LAKE MANITOBA
LAKE WINNIPEG
LAKE MANITOBA
DELTA

Sampling Sites and Collecting Methods

Twenty-six permanent sampling points were established after a preliminary survey of the area. Sites were chosen to represent different habitats with replication. A brief description of each site is given in Table 1 and locations of all sites are shown in Figure 1.

During 1965, samples were taken from all sites at weekly intervals from June 6 to August 29. In 1966 collections were made every two weeks from May 31 to September 23. Crustacea were collected with a plankton tow net (173 meshes/sq. inch). Five litre quantitative samples were taken with a Kemmerer water bottle. Specimens were preserved in 70% alcohol with 5% glycerin. When it was desired that eggs remain in the brood pouch of the cladocerans, 95% alcohol was used. Permanent mounts of homotypes have been deposited in the collections of the National Museum of Canada and at Bishop's University.

Annotated Species List

Short notes on the ecology and the geographical distribution of the species, especially concerning previous records in Manitoba and the surrounding area, are included. No attempt has been made to discuss any taxonomic problem at great length. Ostracods which are mainly benthic and periphytonic, have been omitted from this study, because they were turned up in collections in lower frequency than casual observations of their populations suggested, although different methods of collecting than those used here might give a more accurate picture of this group as it occurs in the present study area. Although a limited effort was made to collect decapod crustacea with baited minnow traps, no specimens were obtained. No effort was made to collect isopods or mysids which are also known to occur in southern Manitoba.

With the exception of the Amphipoda, nomenclature of all crustaceans considered herein follows the authorities quoted in Edmondson (1959). Amphipod classification is after Bousfield (1958).

ANOSTRACA

Chirocephalopsis bundyi (Forbes), 1857

An uncommon species restricted to two small temporary ponds (sites 1 and 14), and disappearing before the end of June in both years. Males and ovigerous females were collected.

Widely distributed between 40° and 65°N. latitude in North America (Hartland-Rowe, 1965). Reported previously from Manitoba (Edmondson, 1959).

NOTOSTRACA

Lepidurus couesii (Packard), 1875

Found only in the Aspen Parkland region of the present study area. Specimens, both male and gravid females, were collected from clear water roadside ditches with very fine silt bottoms. Animals disappeared with the eventual complete dry up of the ditches before mid-June of both years. It

TABLE 1. — A brief description of the permanent sampling sites.

Site	Locality in relation to Delta, Manitoba	Description of habitat
1	7 miles east.	Temporary pond on wooded ridge bordering Lake Manitoba. Firm bottom, emergent vegetation, max. depth 4 ft.
2	7 miles east.	Very shallow artificially created marsh area (NO QUANTITATIVE SAMPLES TAKEN HERE).
3	22 Bay, Delta Marsh.	West shore. Ooze bottom, *Phragmites communis* and Scirpus validus border, max. depth 2 ft.
4	22 Bay, Delta Marsh.	Open water 300 yds. from shore site. Soft bottom, no aquatic vegetation, max. depth 5 ft.
5	Cook's Creek, Delta Marsh.	Blind marsh creek closely associated to 22 Bay. Soft ooze bottom, often with much *Enteromorpha sp.* max depth 3 ft.
6	Cadham Bay, Delta Marsh.	South shore. Soft ooze bottom, bordered with *P. communis* with some submergent *Potomogeton pectinatus*, max. depth 2 ft.
7	Cadham Bay, Delta Marsh.	Open water 400 yds. from shore. Soft bottom, no submergent vegetation, max. depth 5 ft.
8	Cadham Bay, Delta Marsh.	North shore. Border of *S. validus* and *P. communis*, hard sand bottom, max. depth 2 ft.
9	Cadham Bay, Delta Marsh.	South side of Dog Point. Hard sand bottom, no aquatic vegetation, max. depth 3 ft.
10	Cadham Bay, Delta Marsh.	North side of Dog Point. Hard sand bottom, a little *S. validus* in water, max. depth 3 ft.
11	Back Marsh, Delta Marsh.	Artificially flooded area. Soft bottom, much *P. communis* and a variety of submergent vegetation, max. depth 2 ft.
12	Lake Inlet, Delta Man.	Mouth of culvert on marsh side. Hard sand bottom, *Myriophyllum exalbescens* in water, max. depth 2 ft.
13	Lake Manitoba	100 yds. from shore. Hard sand bottom, no submergent vegetatioa, max. depth 2 ft.
14	Delta Road, 1 mile south.	Small temporary pond. Soft gumbo bottom, surrounded by *Scolochloa festucacea*, max. depth 2 ft.
15	Delta Road, 1 mile south.	Roadside ditch. Soft bottom contained *Enteromorpha sp.* and *P. pectinatus* max. depth 6 ft.
16	School Bay, Delta Marsh.	East shore. Soft bottom, bordered with *S. validus*, max. depth 1 ft.
17	School Bay, Delta Marsh.	Open water 200 yds. from shore. Soft bottom, no submergent vegetation, max. depth 4 ft.
18	School Bay, Delta Marsh.	With a patch of *S. validus* 200 yds. from shore. Soft bottom, max. depth 3 ft.
19	Delta Road, 3 miles south.	Roadside ditch. Soft bottom, gradually filled with *Cladophora sp.*, max. depth 6 ft.
20	Delta Road, 3 miles south.	Shallow slough. Soft gumbo bottom, filled with *M. exalbescens*, max. depth 3 ft.
21	6 miles south, 3 miles east.	Portage creek bridge. A small pond formed by depression in the old creek bed. Soft bottom, max. depth 4 ft.
22	5 miles south, 3 miles east.	Lower portage creek. Part of creek connected to the Delta Marsh. Soft bottom, much *Enteromorpha sp.*, max. depth 2 ft.
23	6 miles south, 10 miles east.	Gravel pit in Aspen Parkland. Hard gravel bottom, no vegetation, max. depth 3 ft.
24	5 miles south, 9 miles east.	Roadside slough. Firm clay bottom, contained much *Certium sp.* and *Lemn trisulca*, max. depth 5 ft.
25	6 miles south, 12 miles east.	Gravel pit in Aspen Parkland. Hard bottom, no submergent vegetation, max. depth 7 ft.
26	5 miles south, 12 miles east.	Gravel pit in Aspen Parkland. Soft bottom, much *M. exalbescens*, max. depth 5 ft.

was observed however, that some animals remained alive even when almost all the water had evaporated and when the water temperatures were in excess of 30°C *Lepidurus* populations were subject to very heavy predation by the larvae of *Dytiscus* sp. Distributed throughout Manitoba, Alberta, Saskatchewan, (Edmondson, 1959).

CONCHOSTRACA

LYNCEIDAE

Lynceus brachyurus (O. F. Muller), 1725

An uncommon early summer form rarely found after mid-June. Both males and ovigerous females were collected from two temporary ponds (sites 1 and 14) and two roadside ditches (sites 15 and 19). Reported as a cosmopolitan species from Asia and North America; in the latter from areas as widely separated as Quebec and Colorado (Edmondson, 1959). Not specifically mentioned for Manitoba.

CYZICIDAE

Caenestheriella setosa (Pearce), 1912

Only one specimen was collected, a non gravid female, from an irrigation ditch leading from Cadham Bay, in mid-June of 1966.

A North American species, previously reported only as far north as South Dakota (Edmondson, 1959).

Cyzicus mexicanus (Claus), 1860

No live specimens were collected but many carapaces were found in windrows along the shore of lower Portage Creek (site 22) in the spring of 1965. No carapaces were observed in the 1966 field season.

A widely dispersed species, previously found in Manitoba (Edmondson, 1959).

CLADOCERA

LEPTODORIDAE

Leptodora kindtii (Focke), 1849.

A species found in low numbers in Lake Manitoba (site 13) and the adjacent man-made inlet to the marsh (site 12). This species was most abundant in the regular collections during or just after a strong onshore wind, indicating a limnetic habitat. Females only, some gravid, were collected. Collections made in the deeper lake water apart from the regular sampling schedule, failed to detect any variation in abundance through the spring and summer months.

Common in lakes of northern U.S.A. and Canada. Listed for Saskatchewan (Moore, 1952) and northern Manitoba (Reed, 1963).

POLYPHEMIDAE

Polyphemus pediculus (Linné), 1761

A numerically rare species found infrequently in mid summer at a gravel pit (site 23) and a dugout (site 26) both in the Aspen Parkland region. Females only, some gravid, were found.

Listed in Saskatchewan (Moore, 1952), Ontario and Manitoba (Reed, 1963).

CHYDORIDAE

Eurycercus lamellatus (O. F. Muller), 1785

Found in low numbers and sporadically in the vegetation of a temporary pond (site 1), at the shore sites of large bays (sites 3 and 16) and in Cook's Creek (site 5). A few gravid females were found in July.

Common on continent except in far north. Collected in southern Saskatchewan by Moore (1952).

Acroperus harpae (Baird), 1853

A very uncommon species, a few non gravid females having been collected in the Back Marsh (site 11) in August 1965. This species might be more widely distributed and more abundant, but missed because of its small size and resemblance to immature forms of the more common species (*Pleuroxus trigonellus*.

Saskatchewan (Moore, 1952), Churchill and Caribou, Manitoba (Reed, 1963).

Kurzia latissima (Kurz), 1864

Only one female, without eggs was found in the Back Marsh (site 11) on July 18, 1965.

A widespread littoral species throughout North America (Brooks, 1959). Not reported previously in Manitoba.

Leydigia quadrangularis (Leydig), 1860

Only two non gravid females were collected at the shore of 22 Bay (site 3) on August 29, 1965.

This species is reported from several lakes in southern Saskatchewan (Moore, 1952). Not previously listed in Manitoba.

Alona quadrangula (O. F. Muller), 1785

A numerically rare and infrequently collected species found at the shore of Cadham Bay (site 8), in the vegetation of School Bay (sites 16, 17 and 18), and from a semi-permanent slough (site 20), during June and July of 1965 only. Since this species is known to live near the mud-water interface, it was probably largely missed by the sampling procedure used in this study.

A periphytonic species reported previously from Pelly, District of Keewatin by Reed (1963).

Alona rectangula (Sars), 1861

A numerically rare species occurring in the weedy waters of most sites. There were no gravid females collected.

A common species in North America. Listed in Saskatchewan (Moore, 1952).

Pleuroxus procurvus (Birge), 1878

Found frequently and in high numbers only in the Back Marsh (site 11) in 1965. Also found infrequently and in low numbers at the shore of Cadham

Bay (site 6), in a temporary pond (site 14) and in a dugout (site 26). Females only, some ovigerous, were collected.

Common in northern U.S.A. (Edmondson, 1959). Not listed previously for Saskatchewan or Manitoba.

Pleuroxus trigonellus (O. F. Muller), 1875, Fig. 2A.

A common widely distributed species in the study area. Females only, some gravid, were noted in the collections.

Moore (1952) recorded *P. denticulatus* and *P. aduncus*, two closely related species, from lakes in southern Saskatchewan. Reed (1963) lists *P. denticulatus* from Fort Churchill, Manitoba.

The species in this study is thought to be *trigonellus* rather than *denticulatus* because of the following characteristics. The apex of the post-abdomen is rounded and not truncate; there is no distinct cluster of marginal denticles at the apex; there are usually 14 to 16+ marginal denticles. In addition to this the length of the postanal part is not 1.5 times greater in length than the anal emargination, but just slightly longer (fig. 2A).

Chydorus sphaericus (O. F. Muller), 1785

A very common form, females only, some ovigerous, having been found at all sites except a temporary pond (site 1), a roadside ditch (site 15) and a gravel pit and dugout in Aspen Parkland (sites 25 and 24). A smaller form of this species, found in deeper limnetic habitats (sites 7-10, 12, 13, 17), was collected and constitutes variety *minor* Lilljeborg.

Common in southern Saskatchewan (Moore, 1952) and reported from Fort Churchill and Caribou Manitoba (Reed, 1963).

Dunhevidia crassa (Kind), 1853.

Only two females were found, both bearing eggs, in the weedy waters of a temporary pond, on July 25, 1965.

Described by Edmondson (1959) as uncommon everywhere in the U.S.A.

SIDIDAE

Diaphanosoma brachyurum (Lieven), 1848, Fig. 2B,2

An uncommon species, collected in low numbers from a roadside ditch (site 15) and in high numbers from a vegetation-filled dugout (site 26), between July and September in both years. The peak of reproduction was in mid-August which also coincides with the highest recorded water temperatures (maximum 29.1°C). The complete absence of this species in collections early in the season shows it to be a warm stenotherm.

Northern Saskatchewan and Ontario (Reed, 1963), North Dakota (Young, 1924).

Diaphanosoma leuchtenbergianum (Fisher), 1850, Fig. 2B,1

A common species in Lake Manitoba (site 13) and the open water sites of large marsh bays (sites 7-10, 17). Appears to be a warm stenotherm not appearing in the samples before mid-July and disappearing by mid-September.

Gravid females reached a peak in mid-August.

Brooks (1959) follows Rylov (1935) and Wagler (1937) in saying that *D. leuchtenbergianum* is merely a limnetic variety of *D. brachyurum*. This is supported by the present study since the former species was collected from Lake Manitoba and deep marsh bays, but never in shallow parts of the marsh.

D. leuchtenbergianum is obviously different from *D. brachyurum* (fig. 2). The eyes of the former are smaller, it is hyaline as opposed to yellow and the reflexed antennae reach or exceed the posterior margin of the carapace.

Common in lakes of southern Saskatchewan (Moore, 1952). Not listed previously in Manitoba.

DAPHNIDAE

Daphnia magna (Straus), 1820, Fig. 2C,1

A very common species often co-occurring with *D. pulex* in most littoral habitats of the study area. A few males of this species were collected from various sampling sites in both summers. Ephippial eggs were often seen. *D. magna* was the largest of the four Daphnia species collected and is easily distinguished from the others (fig. 2C).

This species appeared to peak both at the beginning of sampling (end of April) and in mid-September, thus suggesting that it is a cold stenotherm. This is by no means definite and other factors might very well be responsible for this type of seasonal distribution.

A west coast species also reported from Nebraska and North Dakota (Brooks, 1959). Moore (1952) lists it in lakes of southern Saskatchewan.

Daphnia pulex Leydig 1860 emend. Richard 1896. Fig. 2C,4

A very common species found frequently and in high numbers at most sites in the study area throughout the sampling period. Small numbers of male specimens, associated with ephippial and non-ephippial females, were found occasionally through the summer.

A common species everywhere on the continent. Reported from Saskatchewan (Moore, 1952), North Dakota (Young, 1924), Labrador (Reed, 1963).

Daphnia rosea Sars 1862 emend. Richard 1896. Fig. 2C,3

An uncommon species found in the Aspen Parkland (sites 24 and 26) where it coexisted with *D. pulex*, a species very similar in size and appearance. The immature forms of this species are distinguished by a toothed projection near the apex of the helmet (fig. 2C,5).

A western species, reported as far east as Prince Albert Park, Saskatchewan (Brooks 1957), and from Nettiling Lake, Baffin Island (Reed, 1963) its farthest recorded northeastern point.

Daphnia retrocurva (Forbes), 1892, Fig. 2C,2

Found only in Lake Manitoba in the present study. This species appeared most frequently after a strong onshore wind, confirming the fact of its

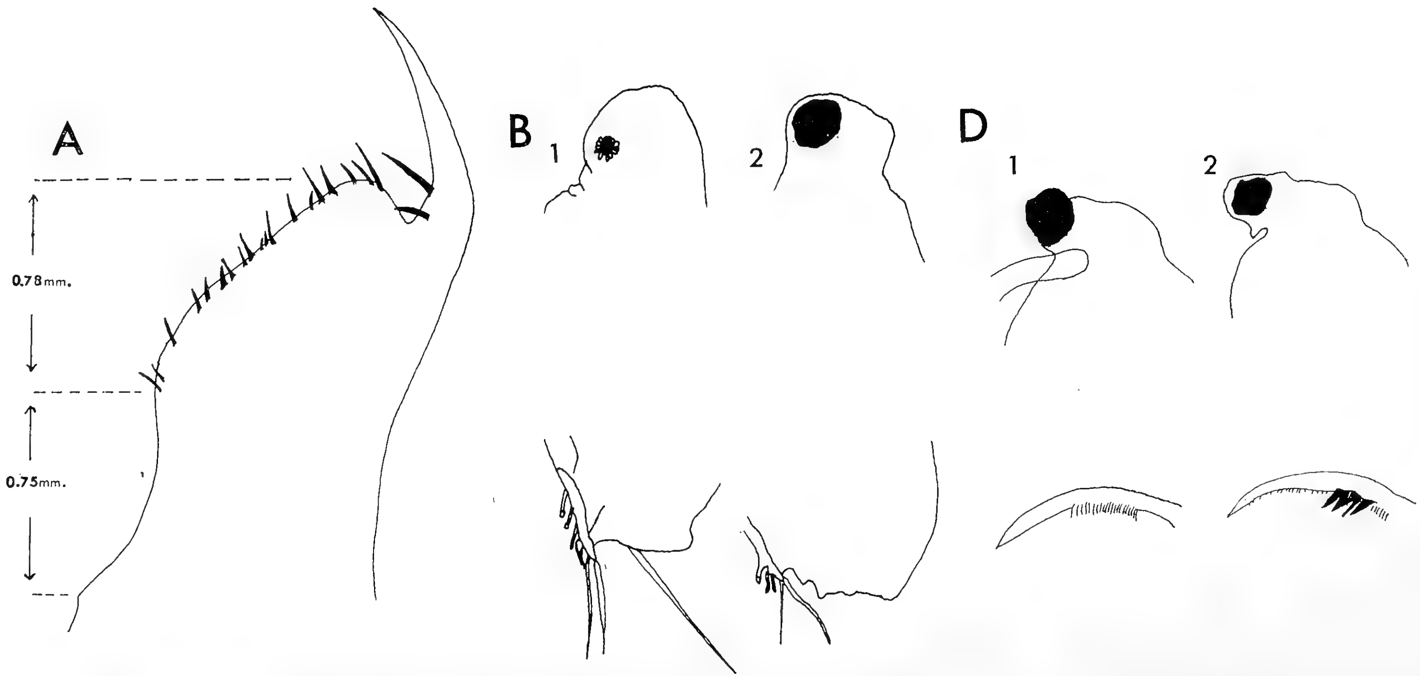

FIGURE 2. Postabdomen of *Pleuroxus trigonellus* female (400x). B. 1 *Diaphanosoma leuchtenbergianum*, 2 *D. brachyurum*. C. Helmets and postabdomens of: 1 *Daphnia magna* 2 *D. retrocurva* 3 *D. rosea* 4 *D. pulex* 5 *D. rosea* immature helmet with toothed projection. D. 1 *Ceriodaphnia reticulata* 2 *C. pulchella*.


C
1
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limnetic habitat. It appeared to be equally abundant throughout the summer months, but nothing definite can be said of its seasonal distribution because of the low numbers in which it was found. Some gravid females were collected but no ephippia were seen.

Reported from Reindeer, Manitoba (Reed, 1963). A limnetic species confined to lakes of the glaciated portion of the continent which lies east of the Rocky Mountains (Brooks, 1957).

Simocephalus vetulus (Shoedler, 1858)

An uncommon species found in low numbers throughout the summer in weedy waters of small bodies of water. It appears to be a true littoral dweller, always living among aquatic vegetation. Females with eggs were observed. There is a slight suggestion that this species might be an early summer form, but this is not certain since it did persist in very low numbers throughout the summer.

A species found everywhere in North America. Listed for Fort Churchill and Caribou, Manitoba (Reed, 1963).

Scapholeberis kingi (Sars), 1903

An uncommon species found infrequently and in low numbers in the vegetation of many sampling sites. Females with eggs and ephippia were collected.

Moore (1952) lists *S. mucronata*, considered by Brooks (1959) to be synonymous to *S. kingi*, in lakes of Saskatchewan.

Ceriodaphnia reticulata (Jurine), 1820, Fig. 2D,1

Found only once in a clear water roadside ditch 6 miles south and 8 miles east of Delta, on June 29, 1965. The ditch contained no aquatic vegetation and was approximately four feet deep. The animals were observed in small distinct swarms made up of several hundred individuals. Larvae of the *Dytiscus* sp. beetle were seen to be feeding on these swarms.

A common widely distributed form in North America. Reported in Saskatchewan (Moore, 1952), but not previously in Manitoba.

Ceriodaphnia pulchella (Sars), 1862, Fig. 2D,2

One of the most common species in this study, being found frequently and in high concentrations at every sampling site. Females only, often gravid, were seen.

Common everywhere on the continent. Moore (1952), for Saskatchewan, lists *C. quadrangula* (O. F. Muller) a species very similar to *C. pulchella*, considered to be synonymous with the latter by some authors (e.g. Drost, 1925; Pejler, 1965).

Moina macrocopa (Straus), 1820

A rare species, found infrequently and in low numbers in School Bay (site 18), Portage Creek (site 22), a gravel pit (site 23) and a slough (site 24) at various times during the summer.

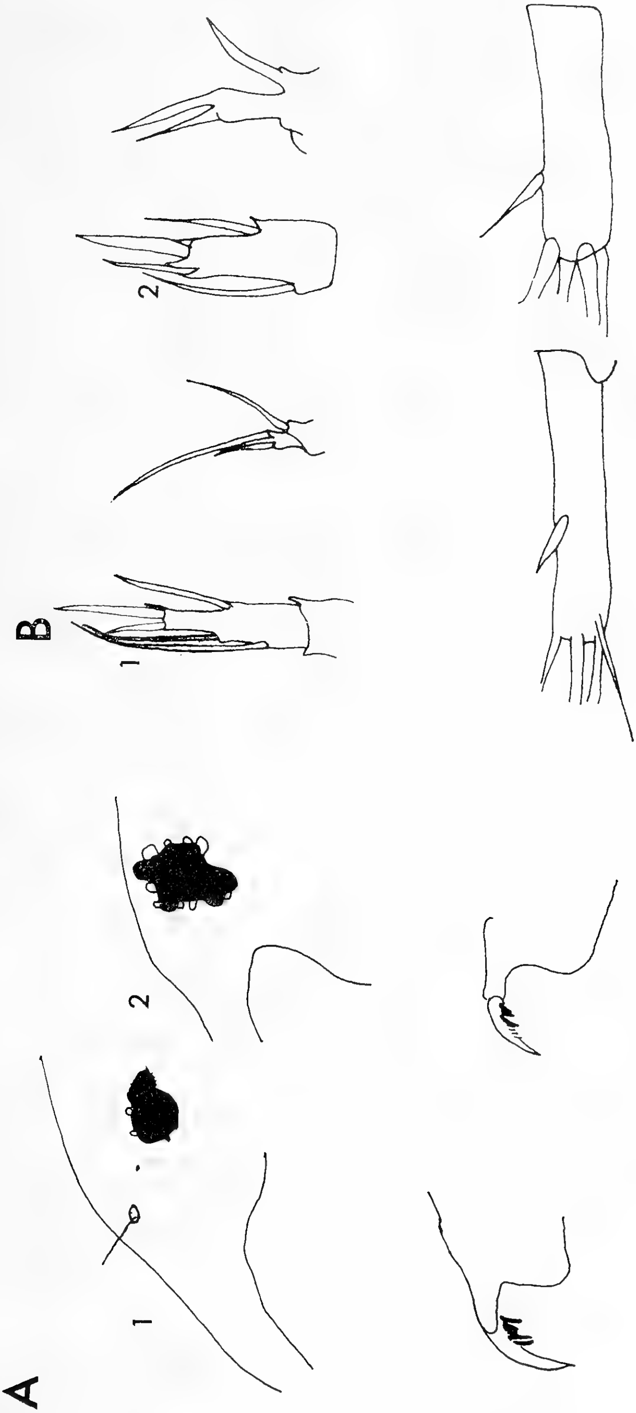

FIGURE 3. R. 1 *Bosmina longirostris* 2 *B. caregoni*. B. Fourth exopod, fifth leg and furcal ramu: of: 1 *Cyclops thomasi* 2 *C. naous*.

Found in high numbers and frequently only at an artificially created "pothole" which had been fertilized with NH_3NO_3 and H_3PO_4. Females with eggs and ephippia were seen.

This is widely distributed on the continent and closely resembles *M. hutchinsoni* (Brehm) reported from Saskatchewan by Moore (1952).

BOSMINIDAE

Bosmina longirostris (O. F. Muller), 1785, Fig. 3A,1

Collected occasionally and in low numbers in 22 Bay (sites 3 and 4), Cook's Creek (site 5) and Cadham Bay (sites 6-10). Some gravid females were seen. This species shows a definite late summer peak and can be classified as a warm stenotherm.

A common and widely distributed North American species, listed from the District of Keewatin by Reed (1963).

Bosmina coregoni (Baird), 1857, Fig. 3A,2

Found only in the lake sites 12 and 13. Females only, some bearing eggs, were collected. Although no definite seasonal trend in the abundance of this species was noted from the regular sampling data, a great concentration of *B. coregoni* was seen at the end of April, 1966. The collection which showed these high numbers was taken at approximately 150 meters offshore near some large pieces of floating ice. All females in this sample were gravid.

A great number of forms exist in the *B. coregoni* complex. Thus Moore (1952) lists *B. obtusirostris* Sars and *B. longispina* Leydig as distinct species occurring in Saskatchewan. Leider (1956) has shown that extensive hybridization occurs between these different forms, and (Brooks, 1959) groups them all in to one species, *B. coregoni.*

Reported previously in Manitoba (Reed, 1963).

MACROTHRICIDAE

Macrothrix rosea (Jurine), 1820

Collected only once from a *Lemna* sp. covered small depression in Portage Creek (site 21), on September 8, 1966. No gravid females were noted although a good population was present.

Common in marsh areas of the continent (Brooks, 1959). Not listed before in Manitoba.

COPEPODA

CALANOIDA

Epischura lacustris (S. A. Forbes), 1882

A total of four specimens, two males and two non-gravid females, were collected on June 3 and June 27, 1966 at the lake inlet (site 12). Both collections were after a strong onshore wind, suggesting that the normal habitat of this species is the deeper waters of Lake Manitoba.

Reported from several localities in northern Manitoba (Reed, 1963; Watson and Lawler, 1965), in northern Ontario (Reed, 1963) and in lakes of Saskatchewan (Wilson, 1958).

Diaptomus leptopus (S. A. Forbes), 1882

Males and gravid females were found mainly in the dugouts and sloughs (sites 23-26) of the Aspen Parkland region away from the main marsh area. This species appears to be a warm stenothermal form not appearing in the regular samples before mid-July.

A common species from east to west coasts in northern U.S.A. and Canada. First reported for Saskatchewan by Marsh (1929) and listed in northern Ontario by Reed (1963).

Diaptomus arcticus (Marsh), 1920

Males and gravid females occurred in high numbers in roadside ditches and sloughs (sites 15, 19, 20) in the marsh region. No specimens were collected after mid-June of either summer suggesting that this is a strict cold stenothermal species.

A species with a western arctic distribution, reported for Saskatchewan by Wilson (1958) and from the District of Keewatin by Reed (1963).

Diaptomus wilsonae (Reed), 1958

Only a few specimens were collected at 22 Bay (sites 3 and 4) in 1965. Both males and gravid females were observed.

Reported from several collections in northern Manitoba and one locality in northern Ontario (Reed, 1963).

Diaptomus sicilis (S. A. Forbes), 1882

A species found frequently at a temporary pond (site 1), in large bays sites 3, 4, 6-10), in Cook's Creek (site 5) and in Portage Creek (site 22).

A common species from coast to coast in northern U.S.A. and Canada. Listed in Saskatchewan by Willey (1931) and later by Moore (1952) as *D. tenuicaudatus*, a species considered synonymous to *D. sicilis* by Wilson (1958).

Diaptomus siciloides (Lilljeborg), 1889

Found only at the lake sites (12 and 13) throughout the summer. Males and gravid females were collected. One collection made in late April when there was ice floating on the lake, yielded a high number of this species with all the females gravid. Collections made later in the summer never contained more than a few, if any, ovigerous females.

Known for most of the continent. Listed for Saskatchewan (Moore, 1952), and North Dakota (Young, 1924).

Diaptomus nudus (Marsh), 1924

A very common species occurring abundantly throughout the summer in marsh areas and small ponds. The number of gravid females reached a peak in late June and early July in both years.

A western species distributed east to Manitoba and the Hudson Bay region (Wilson, 1958). Reed (1963) records it from Coral Harbour, Southampton Island, which is the most northeastern point in its distribution.

Diaptomus sanguineus (S. A. Forbes), 1876

Only one sample (site 26), in late May contained this species. It was very numerous at the time and made up of males an dovigerous females. This suggests that this species is a cold stenotherm.

Found across Canada and northern U.S.A. Recorded for Saskatchewan (Wilson, 1958) and as far east as the coast of Labrador (Reed, 1963).

Diaptomus oregonensis (Lilljeborg), 1889

Found only once in very low numbers at the open water site of 22 Bay on June 6, 1965. Males and non-reproductive females were present.

A widespread species in the northern part of the continent. Found in Saskatchewan (Marsh, 1929; Moore, 1952; Wilson, 1958).

CYCLOPOIDA

Eucyclops agilis (Koch), 1838

Infrequent and never in high numbers at three sites in the Aspen Parkland region (sites 24-26). Both sexes were collected, the peak of reproduction occurring in July.

A widespread species reported from the District of Keewatin and northern Ontario (Reed, 1963).

Cyclops (*Acanthocyclops*) *vernalis* (Fischer), 1853

Abundant and frequently collected at all sites except the lake (sites 12 and 13); a temporary pond (site 14); a gravel pit (site 25), and a dugout (site 26). Males and females were collected, the reproductive peak occurring in mid-July, although some gravid females were seen as late as September 22, 1966.

Widespread and common in North America. Listed for Churchill, Manitoba (Reed, 1963).

Cyclops (*Acanthocyclops*) *thomasi* (S. A. Forbes), 1882, Fig. 3B,1

Unlike Gurney (1933), Reed (1963) considers *C. thomasi* a separate species from *C. bicuspidatus*, as did Sars (1918) and Kiefer (1929). Reed states that *C. thomasi* is a limnetic species, whereas the *C. bicuspidatus* of Gurney's study is a littoral dweller. The observations made during this study support the fact that *C. thomasi* is indeed limnetic, being restricted to Lake Manitoba (site 13), a deep marsh Bay (site 7) and a deep clear water gravel pit (site 25).

Found in several localities in northern Manitoba (Reed, 1963; Watson and Lawler, 1965).

Cyclops (*Acanthocyclops*) *navus* (Herrick), 1882, Fig. 3B,2

C. navus is very similar to *C. thomasi* and they were long considered the same species. It was first described as a separate species by Yeatman (1959). It is a littoral form whereas *C. thomasi* is limnetic. It differs from the above species in the more distally positioned lateral setae of the furcal rami, and the stouter setae of the fourth terminal endopods (fig. 3B,2).

A comon littoral form throughout Canada (Yeatman, 1959). Recorded from Caribou and Brandon, Manitoba (Reed, 1963).

Cyclops (Microcyclops) varicans rubellus (Lilljeborg), 1901

Found only at site 19, a roadside ditch. Both sexes, some gravid females, were collected. This species is probably more common in the study area but missed because of its small size.

Listed in northern Manitoba (Reed, 1963; Watson and Lawler, 1965).

Macrocyclops albidus (Jurine), 1820

Not common, but collected regularly and in low numbers in the Back Marsh (site 11) and two sites in the Aspen Parkland region (sites 24 and 26). Both sexes were seen, gravid females being observed from June 30 to August 22.

One of the most common North American copepods. Reported in Saskatchewan (Moore, 1952) and northern Manitoba (Watson and Lawler, 1965).

HARPACTICOIDA

Onychocamptus mohammed (Blanchard and Richard), 1891

Always found in low numbers in the weedy waters of a temporary pond (site 1), large bays (sites 3, 4, 6-10, 16-18), in Lake Manitoba (sites 12, 13) and in Cook's Creek (site 5). This species was found regularly in 1965 but very rarely in 1966. Both males and gravid females were seen.

Laophonte mohammed, considered to be synonymous with *O. mohammed* (Yeatman, 1959), is reported from Saskatchewan by Moore (1952).

AMPHIPODA

HYALELLIDAE

Hyella azteca (Saussure), 1858

Found among submergent vegetation frequently and in high numbers at a temporary pond (site 1), 22 Bay (sites 3 and 4), the artificially flooded Back Marsh (site 11) and a slough (site 24), from June to September 1966. It was much less abundant in 1965. Both males and reproductive females were collected.

GAMMARIDAE

Gammarus lacustris lacustris (G. O. Sars), 1864

Collected regularly and in good numbers at an old gravel pit (site 25) and a dugout (site 26) in the Aspen Parkland region. Also found less frequently and in low numbers in Cadham Bay (sites 6-10) and Portage Creek (site 21). Males and ovigerous females were observed.

Widely distributed from Baffin Island and the Hudson Bay drainage west to Alaska and the Yukon and south to California (Bousfield, 1958).

DISCUSSION

Distribution of species in the study area

The majority of Crustacea identified in this study are littoral and periphytonic in habitat. This was to be expected as most samples were taken from shallow vegetation-filled marsh waters. Many species were collected from semi-permanent or temporary bodies of waters. This was true for three species of phyllopods, *Chirocephalopsis bundyi*, *Lepidurus couesii* and *Lynceus brachyurus*, although two conchostracan species *Caenestheriella setosa* and *Cyzicus mexicanus* were found in large permanent marsh bays.

The Cladocera, which make up the bulk of the species, are composed of 14 littoral species, five limnetic species and seven species found in either habitat. In the Copepoda, 13 species are littoral dwellers and three are limnetic. Both species of amphipods are littoral, living in close association with the submergent vegetation of the marsh bays and sloughs.

Limnetic species were found mainly in Lake Manitoba and at the open water sites of large marsh bays. Two species which have been previously described as limnetic dwellers were found in very small bodies of water. *Ceriodaphnia reticulata* was collected once from a relatively deep clear water roadside ditch, which contained no submergent vegetation. *Cyclops thomasi* was found frequently at a deep clear water gravel pit (site 25), which was also free of aquatic vegetation.

Leptodora kindtii, *Daphnia retrocurva*, *Bosmina coregonia*, *Epischura lacustris* and *Diaptomus siciloides* are limnetic species found exclusively in Lake Manitoba. *Diaphanosoma leuchtenbergianum* and *Cyclops thomasi* are the only limnetic species also found in the open water sites of large marsh bays.

A number of littoral cladocerans were collected very infrequently and in low numbers. These include such species as *Acroperus harpae*, *Kurzia latissima*, *Leydigia quadrangularis* and *Dunhevidia crassa*. These species, although probably not very abundant, appeared rarer than they actually were because of the sampling methods which tended to select against species living in very weedy habitats. The same is true of species such as *Alona quadrangula* which live near the bottom mud.

Distributional records

The present study lists two species of Conchostraca, 16 of Cladocera, and one each of Harpactacoida and Cyclopoida which, as far as can be determined, have not been listed previously for Manitoba. Most of these species have been reported from areas immediately outside the province, and thus would be expected to occur in Manitoba. A few species in this study do fill in gaps in known distribution and extend previously recorded ranges.

Diaptomus nudus was recorded from Coral Harbour, Southampton Island, its most easterly known point (Reed, 1963). The previous eastern record was from Saskatchewan (Wilson, 1958). *Daphnia rosea* shows a similar record, having been listed for Lake Nettiling, Baffin Island (Reed, 1963) and previously only as far east as Saskatchewan (Brooks, 1957). The occurrence of these two species in the present collections extends their known ranges in the southeast, and suggests that they may be found further east and south than the Lake Manitoba basin.

The range of *Diaptomus wilsonae*, first described by Reed (1958) and collected from Fort Churchill, Manitoba and Attawapiskat, Ontario, is extended slightly to the south. Conversely, the range of *Caenestheriella setosa* is extended somewhat northward, having previoulsy been found only as far north as South Dakota (Mattox, 1959).

Comparisons with faunas of other areas

Moore (1952), in his study of the lakes of the southern half of Saskatchewan, states that there is a paucity of species in the semi-arid prairie regions of Canada. He points this out by comparing his total of 31 cladoceran and 14 copepod species with the total of 88 species reported by Carl (1940) in British Columbia and 49 species of Cladocera in Bigelow's collections from southern Ontario. This opinion of low species diversity in Saskatchewan could have resulted from Moore's failure to investigate different habitats. This is shown to be true by Wilson (1958), who lists 17 additional species of Calanoida found mainly in the same geographic area covered by Moore's previous study.

The present study has listed a total of 26 species of Cladocera and 16 of Copepoda from an area of less than 70 square miles in southern Manitoba. The total number of species in this study does not differ significantly from the totals reported by Moore. However, considering the relatively smaller size of the Manitoba study, the numbers collected here suggest that the crustacean fauna of southern Manitoba is quite diverse. Indeed, more intensive collections from the Delta area alone will undoubtedly reveal more species than are reported herein. The large number of species in the small area covered in the present study is due to the great habitat diversity included in the selection of sampling sites.

Origin and Affinities of the Fauna

The present fauna of Manitoba had its beginnings during the retreat of the Pleistocene glaciation. Points of origin and affinities of the fauna are difficult to determine because most of the Cladocera and Copepoda are highly cosmopolitan in their distribution. The calanoid copepods, especially the genus *Diaptomus*, are more restricted in their North American distribution and give some ideas of the patterns of postglacial redistribution.

Diaptomus oregonensis and *D. silicoides* show a pattern of distribution suggestive of a southwestern origin, while *D. sicilis* appears to originate in southern Saskatchewan (Moore, 1952). *D. nudus* and *D. arcticus* are western species showing a dispersal eastward via the north, a pattern previously commented upon by Wilson (1958).

Epischura lacustris is the only species which shows eastern faunal affinities. It is northeastern in distribution, ranging as far west as Saskatchewan.

SUMMARY

1. Forty-nine species of Crustacea consisting of five members of the Phyllopoda, 26 of the Cladocera, 16 of the Copepoda and two of the Amphipoda were identified from two summers of collecting in the shallow marsh waters at the south end of Lake Manitoba.

2. The majority of the species collected were littoral dwellers inhabiting vegetation-filled waters. This was true of all species with the exception of five cladocerans and three copepods which were found to be strictly limnetic inhabitants. These were found mainly in Lake Manitoba, but also occasionally at the open water sites of large marsh bays and in deep oligotrophic smaller bodies of water such as gravel pits and roadside ditches.

3. Two species of Conchostraca, 16 of Cladocera and one each of Cyclopoida and *Harpacticoida* are listed which, as far as can be determined, have not been recorded previously in Manitoba. The known ranges of *Diaptomus nudus* and *Daphnia rosea* are expanded to the southeast, while those of *Caenestheriella setosa* and *Diaptomus wilsonnae* are extended north and south respectively.

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OBSERVATIONS ON NATURAL MORTALITY AND NATIVE USE OF EIDER DUCKS ALONG THE BEAUFORT SEA COAST

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MORTALITY OF KING EIDERS, *Somateria spectabilis,* and other sea birds in the Beaufort Sea area can be quite extensive. Natural catastrophes due to late break-up of the sea-ice can cause a 10 per cent starvation loss of the population which uses the Arctic coast migration routes, but heavy losses can also be caused by predation and from freezing-in before the birds reach flight stage in the autumn. However, native kill usually amounts to only one per cent or less of this population.

On Monday, June 22, 1964, the *Tundra Times* of Fairbanks, Alaska, carried the following note from their Point Barrow reporter, Guy Okakok, headlined "Open Water Late in Coming to Farthest North Region."

> "Yesterday, a word came into Barrow that several ducks died of starvation. Why did they die? Answer is clear and simple. Its because they can't find any water nowheres. . ."

This is the first published report, and an accurate one, of an extensive die-off of King Eiders and other seabirds during the spring migration along the Beaufort Sea in 1964.

The spring migration of King Eiders eastward along the Arctic coast begins in late April and reaches a peak in mid-June. The male birds precede the females and move from open lead to open lead. Later, they are joined by Oldsquaws, *Clangula hyemalis,* Arctic Loons, *Gavia arctica,* Red-throated Loons, *Gavia stellata, and* Thick-billed Murres, *Uria lomvia.* This migration is usually well offshore, but touches close at Point Barow (156° W long), Toker Point (133° W long), Atkinson Point (131° W long), Cape Dalhousie (130° W long), Baillie Islands (128° W long) and Cape Parry (125° W long) on the mainland. Many birds branch off across Amundsen Gulf to nesting sites on Banks Island and Victoria Island.

The 1964 season was one of the most severe in recent history of the western Arctic. Close pack ice was present nearly continuously even late in August and September. It was one of the few years recorded where continuous ice stretched from the mainland to Banks Island. Even the well-defined polynia in Amundsen Gulf off Cape Parry froze over and remained frozen from January until mid-July when the first open leads formed. Mr. Jean Boulva of the Fisheries Research Board (personal communication) reported there was no sign of break-up at Cape Parry during the first week of July, and that complete break-up was not noted north of the Cape until August 10.

A severe northwest storm May 15 to 17 forced King Eiders ashore and inland. When the storm was over, I found six adult males in the snow near my camp at Anderson River Delta (129° W long), 50 miles south of Cape

Dalhousie. They were weak and emaciated and were easily collected. Fox-eaten remains of several other King Eiders were picked up. The gizzards of all were empty of food; two contained small pieces of flint. Four of these birds (all adult males) weighed 840, 900, 1021, and 1137 grams. The mean weight of 41 healthy King Eiders from Point Barow in August was 1668 grams (Thompson and Person, 1963). A starving adult male Pacific Eider, *Somateria mollissima* v. *nigra* picked up at Anderson River June 6 weighed 1411 grams.

There were from 5 to 33 nematodes in the gizzards of these birds. The largest King Eider had 74 acanthocephalid worms averaging 27 mm in the small intestine. These have not yet been identified. The other three eiders had remains of tape worms in small quantities.

The high incidence of starving eiders close by my camp caused me to make inquiries as to the extent of the die-off. The Royal Canadian Mounted Police at Herschel Island, Sachs Harbour, and Tuktoyaktuk were contacted and I flew a survey of Tuktoyaktuk Peninsula from the mouth of the Mackenzie River to Cape Dalhousie on May 27, 1964. There had been three or four inches of snow two days before and new drifts had formed, burying earlier carcasses. Nevertheless, approximately ten dead eiders per mile were seen in 95 miles of flying. Three Red Foxes, *Vulpes fulva*, and two Arctic Foxes, *Alopex lagopus*, were also noted.

Results of the survey and the reports of starving eiders in 1964 are summarized in Table 1.

From these reports and surveys I estimate that approximately 100,000 King Eiders perished from starvation caused by the unusually bad ice conditions in the Beaufort Sea and vicinity in the spring of 1964. Murres apparently were not affected by the late break-up because they arrived later. However, their nesting was late and they were still sitting on 67 nests when extensive open water appeared Aug. 10 at Cape Parry, site of small colony.

In other years local quick freezes have trapped eiders in late April and early May. Such was the case in 1960 when Banks Island Eskimos found several hundred male eiders on the ice after a —40° cold snap froze the open leads. Manning, Höhn and Macpherson (1956) reported similar local instances of mortality among King Eiders. They thought there must be a connection between the finding by Eskimos of male King Eiders too weak to fly and Porsild's (1951) record of 16 picked carcasses of King Eiders at a Peregrine Falcon nest near Cape Lambton. They also remark on the scarcity of nesting eiders in the summer of 1952 at DeSalis Bay, but indicate this may be attributed to fox predation after a lemming crash.

Between July 24 and Aug. 7 in 1960 I flew surveys of nearly all the water courses and lakes of the waterfowl production areas on Banks Island. The eiders had a fairly successful year: I estimated more than 100,000 King Eiders, compared to Manning, Höhn and Macpherson's (1956) estimate of 150,000 in 1952 and 1953. But the next year I counted a total of only six live eiders during an aerial survey July 25 of Banks Island's best eider production area and from July 25 to Aug. 9 while I was camped at a lake near Big and Egg Rivers.

However we found the remains of 125 young and female King Eiders

TABLE 1. — Results of the survey and reports of starving Eiders (1964).

Area	Dead Eiders	Remarks	Correspondent; Letter Date
40 mi. W of Herschel (140° W long)	25	DEW line personnel	June 24
Herschel, immediate vicinity (139°)	30-35		J. Innes, RCMP June 24
Shingle Point (137°)	6	S. Inglangasuk May 26	June 8
Mackenzie River to Cape Dalhousie	10 per mile (95 miles)	Aerial survey May 27 (3-4 inches snow)	T. W. Barry
Tuktoyaktuk to Inuvik (135°)	12	J. W. Steen; on coast and on East Channel	H. J. Day, RCMP June 8
Whitefish Station (134°)	3	G. Omilogituk May 24	,,
Kittigazuit (134°)	30	J. C. Elias & J. R. Cockney, May 18	,,
,,	5	Eddie Gruben, May 15	,,
Tuktoyaktuk (133°)	200+	Many reports from residents in May	,,
Anderson River Delta (129°)	6 King, 1 Pacific	After storm of May 15-17	T. W. Barry
Sachs Harbour (126°)	300±	Found by seal hunters far out on sea ice, April, May	T. W. Barry
Cape Parry (125°)	4 King, 1 Common	June 23 to July 7; also 2 Old Squaws, 4 Arctic Loons	J. Boulva, Sept 14.
Mould Bay Prince Patrick Island (118°)	200±	May and June	A. Warner

along the 2½ mile shoreline of the lake. The flight feathers of all showed they were flightless when they died. Presumably they had suffered an epidemic or had been caught by a sudden freeze in the fall of 1960 before they could fly. Therefore, there were few female eiders to return to Banks Island in 1961. My estimate of the loss of King Eiders on Banks Island in that year is approximately 50,000 birds. The males apparently escaped loss.

After a spectacular high during the summer of 1960, the lemming, *Dicrostonyx groenlandicus*, population on Banks Island crashed during the winter of 1960-1961. Arctic Foxes which survived the winter in fairly large numbers preyed heavily on eggs of geese and eiders the following summer and undoubtedly further reduced the 1961 reproduction rate. Survey flights in 1962 showed the eiders still absent, while the geese had good reproduction because the weather was good and the fox population had reached its low.

Explorers and scientists have recorded similar periodic die-offs by starvation or freeze-outs along the Beaufort Sea. While on the Franklin search, Collinson (1889) wintered in Camden Bay, Alaska (approximately 70° N, 145° W) in 1853. He said that on October 4, foxes and a wolf were prowling amongst the ducks on the ice formed in a freeze-up September 26. "We found fifteen pintail ducks [Oldsquaws?] . . . so exhausted as to be unable to fly," he reported.

Aside from natural catastrophes, there has been a traditional use of eiders by natives. Simpson (1843) while travelling along the coast towards Point Barrow in August, 1837, noted:

"The fog and cold continued next day. Numerous flocks of white-backed ducks flew near the shore, on their autumnal migration to the westward. A few of us took our station upon hummocks of ice, and shot above a hundred of these large birds. They formed an acceptable change of diet, being fat, and good eating, though rather oily. . ." (p. 139).

". . . But what most attracted our curiosity was an ingenious and novel contrivance for capturing wild fowl. It consists of six or eight small perforated ivory balls, attached separately to cords of sinew three feet long; the sling is thus framed, which, dexterously thrown at the birds as they fly past, entangles and brings them to the ground. During our stay we repeatedly saw these simple inventions effectively used. I likewise remarked some ponds to the point, set round with whalebone nooses, to ensnare the fowl when they come to peck the fine gravel carefully exposed to attract them. . . " (p. 156).

As this excerpt indicates, Point Barrow was a traditional native hunting place for eiders. The same was true of Baillie Islands as long as it was an active settlement, that is until the 1940s when it was abandoned except for one family. Holman Island continues as a native settlement where eiders are hunted.

Thompson and Person (1963) describe in detail the migration and Eskimo hunting methods at Point Barrow. They estimate that the native kill was .5 per cent of the fall migrants in 1953. The spring kill is probably about the same. On the Pacific wintering grounds eiders are seldom hunted.

I estimate the total population of eiders using the Beaufort Sea migration route at 1,108,000 from the following sources:

Banks Island	125,000	Barry (1960) Manning et al (1956) (average of both estimates)
Victoria Island	800,000	Barry (1960)
Queen Maud Gulf coast	8,000	Barry (1960)
Prince of Wales Island	65,000	Manning & Macpherson (1961)
Adelaide Peninsula	10,000	Macpherson & Manning (1959)
Other parts of mainland and islands	100,000	(my own estimates)
	1,108,000	

This figure approximates that of Thompson and Person (1963) who estimate the Beaufort Sea eider population, including King and Pacific eiders, at 1,000,000.

The estimated 100,000 eiders killed by starvation in the spring of 1964 represents at least 10 per cent of the average annual estimated population. In contrast, the total native kill of eiders, which is almost entirely confined to Point Barrow, Alaska,, and to Holman Island, N.W.T., is at most only one per cent of the total population using the Beaufort Sea migration route. When the low harvest rate by Eskimos in the Beaufort Sea area and the almost negligible rate of harvest on the Pacific wintering areas is compared with the natural mortality rates observed in 1964, the myth of over-exploitation of eiders by native peoples is put in better perspective.

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NOTES

Late Winter Oil Pollution in the Bay of Fundy, Nova Scotia

Oil pollution should now be less of a hazard to marine bird life because of regulations prohibiting the discharge of waste oil into the sea. The development of techniques allowing for the recovery and re-use of formerly waste oil has helped, but much pollution by oil still takes place. The following account of such an event which occurred along the Bay of Fundy coast of Nova Scotia is noteworthy for the number of affected bird species even though mortality was believed to be relatively low.

After receiving reports in February, of oiled sea-birds being found along the Fundy shore, six coastal locations extending westward from Halls Harbour to Port George and including Canada Creek, Harbourville, Morden, and Margaretsville, were surveyed to determine the extent of the pollution. Much of the ice and debris at the high tide line was spotted with a thick, black, tar-like substance, identified by local fishermen as "bunker oil." Oil contamination increased from east to west along the 32 miles of seashore, with the greatest amounts of oil spread about the beaches of Margaretsville and Port George. Oil-killed and/or oil-disabled birds were recorded from all six of these locations. In addition, reports received from the Digby area, 40 miles to the west, indicated that many sea-birds there appeared to be oil-soaked. Attempts to estimate total mortality by conducting an inventory in early March were unsuccessful because of heavy snowfalls and low temperatures during this time which added to the difficulties involved in searching for dead or dying birds along the icy beaches.

Bird species that showed signs of crude oil contamination included *Red-throated Loon (*Gavia stellata*), *Horned Grebe (*Podiceps auritus*), *Oldsquaw (*Clangula hyemalis*), *Common Eider (*Somateria mollissima borealis*), *White-winged Scoter (*Melanitta deglandi*) *Common Scoter (*Oidemia nigra*), Red-breasted Merganser (*Mergus serrator*), Purple Sandpiper (*Erolia maritima*), Herring Gull (*Larus argentatus*), *Razorbill (*Alca torda*), *Common Murre (*Uria aalge*), and*Thick-billed Murre (*Uria lomvia*). One or more dead birds of each of the starred species was found as a result of oil pollution. White-winged Scoters apparently were the most abundant species wintering in this region (or perhaps were most susceptible to the oil) as twelve dead scoters were counted in a two-mile segment of coastline, compared with only two or three birds of the other species.

The degree of oiling ranged from a small patch of 2 to 3 centimeters wide on the lower breast feathers of Purple Sandpipers which were observed wading in rock tidal pools containing thin surface films of oil, to thoroughly oil-soaked scoters, eiders, and murres. Other species recorded in the contaminated area but without obvious signs of oil-caused disabilities or oil-marked plumages included Red-necked Grebe (*Podiceps grisegena*), Great Black-backed Gull (*Larus marinus*), and Dovekie (*Plautus alle*).

Seven birds found dead along the high tide line were examined in the laboratory. Common to all of these birds, which included three White-winged Scoters, one Common Eider, one Oldsquaw, and two Common Murres, were the oil matted lower breast and abdominal feathers, both contour and down feathers which were stuck together in clumps exposing large patches of skin. Gross examination of the intestinal tract of each bird revealed the presence of brownish colored mucous in both the esophagus and proventriculus. An oily coating on the normally deep yellow lining of the gizzards made them appear dark brown or black. The upper portions of the intestines in all specimens contained a thin light brown mucoid fluid in which were suspended very small black oil spots. The lower intestines of five birds held isolated greasy black masses, 7 to 11 centimeters long. Swollen and hyperemic areas throughout the intestines and, in one bird, the proventriculus, indicated severe gastrointestinal irritation. With the exception of one scoter in which two gastropod columellae were found, none of the specimens contained food items. Acanthocephalans and cestodes were recovered from the intestines of four of the seven birds.

After studying the toxic effects of various oils on waterfowl, Hartung and Hunt (1966) concluded "that the toxicity of ingested polluting oils plays a definite role in the observed waterfowl mortalities due to oil pollution. The magnitude of this role will depend upon the type of oil involved and on the magnitude of additional stresses such as food shortages, parasitism, and cold." In a more recent laboratory study of energy metabolism in oiled waterfowl, Hartung (1967) has shown that because of "insulation break-down" of oiled plumages, increased heat losses to the environment result in accelerated rates of energy metabolism. He states that "Death occurs only when available energy stores are depleted, and is therefore only indirectly due to exposure to cold." In this instance it was impossible to state which factor played a greater role in the observed mortality, exhaustion of energy reserves as a result of cold exposure, or toxicity of the oil.

The field assistance of Dr. Sherman Bleakney, Edward Gittens, Arthur Martell, Eric Mullen and Allen Smith; and the laboratory assistance of Richard Yescott are hereby gratefully acknowledged.

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First Nesting Record of the Mockingbird in British Columbia

IT HAS BECOME increasingly obvious that it is no longer possible to say that "such and such" a bird could not be observed in Victoria. On July 7, 1967, the writer heard the surprising news that a Mockingbird, *Mimus polyglottos*, had been seen since June 27, in the Ten-Mile Point area of our city. This information was further checked by Mr. R. Fryer, who found four bluish-green, blotched and spotted with brown eggs in a nest about four feet off the ground in a cotoneaster bush in the garden of Mr. and Mrs. B. Fairweather.

I spent many hours watching the lone Mockingbird, apparently a female; a male was never observed at any time. Owing to the fact that this was the first specimen I had had the opportunity to observe, I was fascinated by its "wing-flashing" while apparently searching for insects, a habit that has been very well documented. On the basis of the summary by Hailman (Wilson Bulletin 1960, 72:356) and my limited observations, it would appear to be that the wing-flashing is used to flush insects, while foraging for food.

Presumably owing to the fact that as previously mentioned, a mate was never seen, she was quite nervous and when off the nest was "bombed" by Robins, Violet-green and Barn swallows.

Godfrey (1966, The Birds of Canada, National Museum of Canada, Bulletin 203, p. 292) mentions a nesting of the Mockingbird at Didsbury, Alberta. As far as I can ascertain this is the closest record in Canada to the one in Victoria. It is known to nest also in southeastern Oregon.

On July 25, the eggs were "candled" and of course, found to be clear. They were collected with the nest together with a portion of the cotoneaster shrub by Mr. Michael D. Miller, of the Provincial Museum and myself, and are now deposited in the Provincial Museum, Parliament Buildings, Victoria, B.C., as the first record in British Columbia of the nest and eggs of the Mockingbird.

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A Wood Frog from Northern Manitoba

WHEN LOGIER AND TONER published their revised *Check list of the amphibians and reptiles of Canada and Alaska* (1961, Royal Ontario Museum, Life Sciences Division, Contribution 53) the northern limit of the Wood Frog, *Rana sylvatica*, between the 110th Meridian and Hudson Bay, was marked by records from Lake Athabasca and Churchill. Subsequent publications have added important records: Hasbala Lake 59°58′N, 102° 03′W) in extreme northeastern Saskatchewan (Nero and Cook, 1964, Can. Field-Nat. 78(4):268-269); Windy River (approximately 60°37′N, 99°55′W) at the northwestern extremity of Nueltin Lake, N.W.T. (Harper, 1963, Proc. Biol. Soc. Wash. 76:159-168); and Hinde Lake (61°12′N, 103°40′W), N.W.T. (Weintraub, 1967, Can. Field-Nat. 81(2):106-109).

In view of the rarity of northern collections and the hiatus in records between Churchill and the above localities, an adult *Rana sylvatica* taken in northern Manitoba is worth reporting. It was captured at the Wolverine River (59°07′N), north of Shethanei Lake and south of MacLeod Lake, by the writer on July 17, 1966.

The specimen was taken in one of the few narrow strips of wet sedges occurring along the river edge. In general the area consists of broad rolling hills of glacial till with prominent eskers. Vegetatively, the area is transitional from boreal forest to subarctic tundra. Stands of black spruce are interspersed with broad, sweeping sedge-heath meadows which, with their permafrost polygons and undrained tundra ponds are strongly reminiscent of the coastal tundra. The subarctic effect is heightened by the presence, as breeders, of such avian species as Parasitic Jaeger and Lapland Longspur.

The specimen is an adult female measuring, after preservation, 40 mm snout-vent, 17 mm tibia (tibia/body ratio .425) and lacking a mid-dorsal light line. It has been deposited in the study collection of the Manitoba Museum of Man and Nature. This was the only frog seen in 10 days of river travel in the region. As Churchill is located at 58°45′N, this specimen is the northernmost record from Manitoba. The northern limit of the species seems to angle to the northwest following the tree line, and this specimen is within the range predictable on this basis.

The writer gratefully acknowledges the generous aid and dogged persistence of Francis R. Cook in ensuring that the specimen was eventually examined and this note finally prepared.

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Censuses of the Ipswich Sparrow on Sable Island

THE IPSWICH SPARROW (*Passerculus princeps*), a close relative of the widespread Savannah Sparrow (*P. sandwichensis*), nests only on Sable Island, some 90 miles from the nearest mainland of Nova Scotia. Little has been added to our knowledge of the bird since Dwight's (1895) monograph

Such insular forms are of considerable evolutionary and demographic interest. In 1967 I began a long-term study of the Ipswich Sparrow. The bird is on the List of Rare and Endangered Bird Species in the "Red Book" of the International Union for the Conservation of Nature, and concern for its status has been expressed elsewhere as well. Therefore it seems worthwhile to record a preliminary estimate of its population size. The study was supported by the Canadian Wildlife Service. I am grateful for the assistance in the field of Dr. M. J. Harvey and Mr. K. McKay and for kindnesses of residents of Sable Island, particularly Mr. and Mrs. F. Androschuk and Mr. and Mrs. N. Bell.

Censuses of small birds are often based on counts of singing males, but this method was unsuitable because song of the Ipswich Sparrow was infrequent in some places and at some times. The birds were, however, easily flushed from the very open habitat, and two observers weaving back and forth through the chosen census areas could be almost certain of seeing every individual. The birds could generally be flushed in suitable directions to avoid the possibility of "repeats". Where habitats are uniform or uniformly diverse, it may be desirable to census randomly chosen, like-sized areas for calculations of fiducial limits of estimates. On Sable Island, where large regions are unvegetated and uninhabited by birds, and where convenient census areas are often naturally delimited, it was decided to make counts in representative areas of different sizes. Some of these were measured in the field and others from aerial photographs, greatly enlarged.

A total of 13 areas was censused between June 1 and 12, 1967, most of them more than once (Figure 1, Table 1). Results of repeated counts, usually a day or two apart, suggest a marked stability of numbers at this time. Birds on the boundaries of censused areas and possible "repeats" were counted as 0.5 and account for non-integral totals.

Areas 2 and 7 were shifting sand with thin and local cover of marram grass (*Ammophila breviligulata*) and some patches of the halophyte *Arenaria peploides* in the open area 2. The bird in area 7 was a male that sang persistently from a dead twig in a slightly denser patch of grass. On aerial photographs and on the map by Cameron (1965) areas 2 and 7 appear as unvegetated, and are thus designated on Figure 1. Although birds appeared occasionally even on beaches remote from vegetation, censuses on these two areas suggest that all unstabilized terrain on Figure 1 may be ignored in preliminary estimates of population size. Small "blowouts" and bare spots within the censused areas were crossed and used freely by birds, and only large ones are marked as unstabilized on Figure 1.

A chi-squared test for equal density in all remaining areas indicates that they are not equivalent ($\chi^2=33.2$, d.f.$=10$ $P <$ 0.001). However, almost all the variance comes from area 12, which consists of two islets and a narrow, heavily vegetated peninsula in a line crossing the largest pond on the island. The birds may have been attracted from surrounding habitats to feed along the shores and in the generally rich herbage. If this unusual habitat is excluded, there appears to be no significant heterogeneity among the remaining census areas ($\chi^2 = 7.5$, d.f. $= 9$, $P < 0.6$). It is, however, possible to

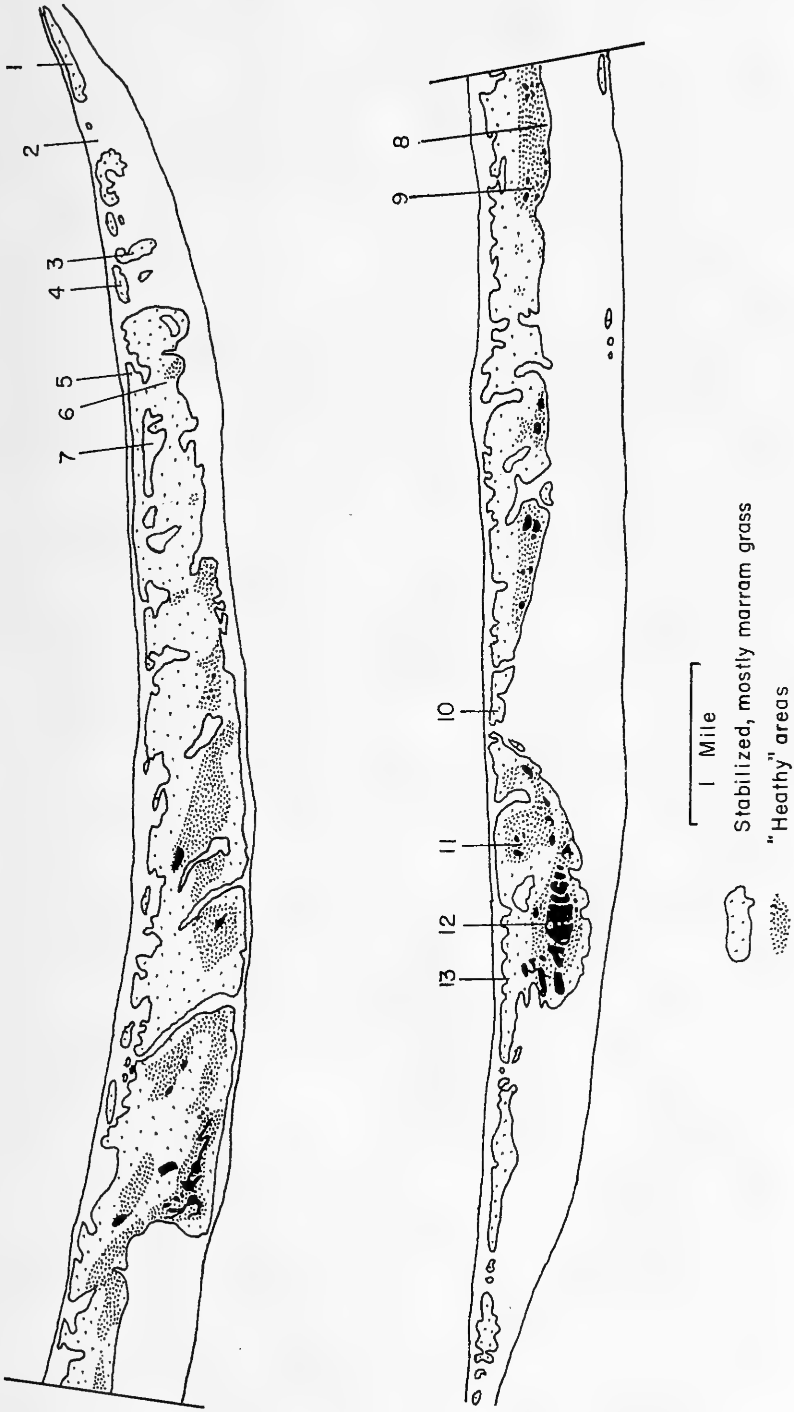

FIGURE 1. Map of the stabilized terrain on Sable Island, Nova Scotia. After map in Cameron (1965) with "heathy" areas from aerial photographs of June, 1964.

TABLE 1. — Censuses of the Ipswich Sparrow on areas noted on Figure 1.

Area No.	Size (ha.)	Dominant cover	No. Birds	No./ha.
1	10.4	Marram, pea	32	3.1
2	9.9	Unstabilized, marram	1	0.1
3	5.8	Marram, pea	25, 23	4.1
4	3.0	Marram, pea	10, 12	3.7
5	3.0	Marram, pea	11, 10	3.5
6	2.7	Dry meadow, shrubs	6.5, 10, 7.5	3.0
7	3.1	Unstabilized, marram	1, 1, 1	0.3
8	0.4	Marram, pea	2	5.0
9	2.5	Juniper and bog	13, 15.5	5.7
10	3.7	Marram, pea	8	2.2
11	1.2	Juniper, swale, bog	4.5, 7.5, 5	4.7
12	1.1	Lush islets and peninsula	10, 13, 13	10.9
13	0.7	Marram, pea	2, 3	3.6

divide up the island into two broadly different habitats. The general cover of the island is marram grass, with beach pea (*Lathyrus japonicus*) commonplace and other grasses and herbs occasional. Other grasses prevail in more stable areas inside the marginal dunes, and low, shrubby growth (*Rosa virginiana*, *Rubus* spp., *Vaccinium* spp., *Myrica pennsylvanica*, etc.) may be conspicuous here and there. All these places appear roughly similar in density and diversity of plant cover. Some parts of the island are much more thickly covered and "heathy", with juniper (*Juniperus* spp.) and crowberry (*Empetrum nigrum*) on dry hummocks and sometimes continuous, and with well developed cranberry bogs (areas 9 and 11). Margins of ponds may be quite lush with grasses, reeds, and sedges (area 12). All these areas are conspicuously dark on aerial photographs taken in early summer, and are delimited accordingly on Figure 1. The total area of the stabilized parts of the island is about 1140 hectares. Of this, about 280 hectares are "heathy".

Assuming a mean density from Table 1 of 3.5 birds per hectare (excluding the unrepresentative area 12) gives a total population of about 4000 birds before any young had been fledged. This is increased only slightly by assuming a higher mean density for the "heathy" areas (from counts in areas 9 and 11). Although at best approximate, the estimate seems to indicate a reassuringly high population in the restricted and vulnerable breeding range of this interesting bird.

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Accepted March 5, 1968

A Convenient Method for Mounting Herbarium Specimens

CONSERVATION of counter space is a usual problem associated with th emounting of herbmarium specimens using Archer's Adhesive. (Rollins, 1955). This problem may be circumvented in large herbaria by the use of specially constructed movable mounting racks (Cody, 1966) or by 'pigeon-hole' devices of a size designed to accommodate a few herbarium specimens at a time. Both types of temporary storage device, while useful in major herbaria, have the disadvantage of requiring storage space themselves when not in use. In small herbaria where mounting of specimens may be less frequent and where available working space is at a premium, there is a need for both a convenient mounting arrangement and one which can be completely disassembled when not in use.

In our herbarium we have found that cardboard corrugates (12″ x 18″) serve this purpose when separated by small blocks of wood (3″ x $\frac{3}{4}$″ x $\frac{3}{4}$″). Fig. 1). If the corrugations traverse the length of the board they will support a larger number of weights (ours are 3″ diameter x 3/16″ and are available through hardware suppliers) than if the yrun the width. However, some curators would prefer standard corrugates because these could be used in the plant press as well.

The advantages of this mounting arrangement should be apparent; a person

FIGURE V. Photograph illustrating the procedure described for stacking recently mounted specimens supported on corrupates and separated by wood blocks.

can complete the mounting of a large number of specimens while remaining in one place and the stack of specimens can then be placed where it will not obstruct working area.

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Accepted March 25, 1968

A Short-billed Marsh Wren *Cistothorus plantensis*, in Nova Scotia

ON OCTOBER 2, 1967, a group from the Nova Scotia Bird Society on a visit to Seal Island, Shelburne Co., observed a Short-billed Marsh Wren, *Cistothorus platensis*. Although this species had been reported previously from Nova Scotia, no specimen had ever been obtained. The bird seen on this occasion was therefore collected by C. R. K. Allen, and sent to the National Museum in Ottawa for confirmation of its identity. It is now in the collection of the Nova Scotia Museum of Science, Halifax.

Previously in Nova Scotia the species has been reported as singing (date not known) at Amherst Point Sanctuary by G. F. Boyer (1966. Canadian Wildlife Service Occas. Papers No. 8, p. 39). In addition, the writer saw a marsh wren which he was almost certain was this species at Seal Island on October 4, 1964.

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Muskox Skull from Teshekpuk Lake, Northern Alaska

MUSKOX (*Ovibos moschatus*), once common on the coastal plain of northern Alaska, have been gone from this area since the late 19th century. Scattered, fragmentary reports indicate that originally the muskox may have occurred throughout the coastal plain of the Arctic Slope (Bee, J. W. and E. R. Hall. Mammals of Northern Alaska, pp. 253-255, 1956) but few records of this former distribution of muskox exist in the literature. During summer field work in 1962, I found the oseous horn bases and part of the upper portion of a recent muskox skull embedded in the surface of a low, ice core mound at the east end of Teshekpuk Lake (70°33′29″N, 152°37′40″W). The lush vegetation at this low mound attracted my attention and led to the discovery of the light-colored skull lying on top of the mound. No other muskox bones were found at the site.

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NEWS AND COMMENT

Reorganization of the National Museum of Canada

The Canadian Parliament passed the National Museums Act on December 1, 1967, establishing a corporation to be known as the National Museums of Canada, governed by a Board of Trustees, composed of a Chairman, a Vice-Chairman, ten other appointed trustees and the Director of the Canada Council and the President of the National Research Council as ex officio members of the Board. The purposes of the Corporation as cited under Section 5 of the Act

> "are to demonstrate the products of nature and the works of man, with special but not exclusive reference to Canada, so as to promote interest therein throughout Canada and to disseminate knowledge thereof."

The functions of the Corporation are described further: "to collect, classify preserve and display objects . . . to undertake or sponsor research . . . arrange travelling exhibits . . . publish books and pamphlets . . . undertake or sponsor programs for training persons in museology . . . and establish liaison with other museums with a view to collaboration . . .".

The Act was proclaimed on April 1, 1968, and the appointments of the Board of Trustees and senior officers of the Corporation announced by the Secretary of State, the Honourable Judy LaMarsh. Mr. Jean Ostiguy of Montreal was appointed Chairman of the Board, with Mr. J. R. Longstaffe of Vancouver as Vice-Chairman. Others named to the Board are: Mrs. Phyllis George of Moncton, N.B.; Dr. Amiot Jolicoeur of Ste Foy, Quebec; David Spurgeon of Toronto; George Heffelfinger of Winnipeg; Mrs. Nina Cohen of Sydney, N.S.; Mme Cécile Marcoux-Baillargeon of Montreal; Dr. J. Tuzo Wilson and Prof. Stephen Vickers of Toronto, and Kiyoshi Izumi of Regina. Initially the trustees were appointed for different periods of two to five years to permit an orderly replacement of trustees. Dr. W. G. Schneider, President of the National Research Council, and Dr. Jean Boucher, the Director of the Canada Council, will also serve on the Board.

Mr. Charles J. Mackenzie of Ottawa, formerly Assistant Secretary of the Treasury Board, was appointed Secretary-General of the new Corporation. He will be responsible for the financial and administrative arrangements of the Museums as well as coordinating long-term planning and extension programs. The Administrative Services Branch under T. A. Russell comes under Mr. Mackenzie's supervision.

The Corporation currently comprises five museums situated in Ottawa: The National Gallery of Canada, The National Museum of Man (formerly the Human History Branch of the National Museum of Canada), The National Museum of Natural Sciences (formerly the Natural History Branch), The National Museum of Science and Technology (formerly the Science and Technology Branch of the National Museum) and the Canadian War Museum. Other museums may be established by the Board with the approval of the Governor in Council. The total budget proposed for the 1968-69 fiscal year for the Corporation totals $7,344,500 (including a $1,050,000 non-lapsing purchase account), with a total staff of 374.

On April 1, the appointments of the Museums' directors were also confirmed: Dr. Jean S. Boggs, Director of the National Gallery of Canada, Dr. Wm. E. Taylor, Jr., Director of the National Museum of Man, Dr. A. W. Frank Banfield, Director of the National Museum of Natural Sciences, and Dr. David M. Baird, Director of the National Museum of Science and Technology.

The National Museum of Man is also responsible for the administration of the Canadian War Museum, Curator Lee F. Murray, and comprises the Divisions of Archaeology under Dr. James V. Wright, Ethnology under A. D. DeBlois, Folklore under Dr. Carmen Roy and History under F. J. Thorpe.

The National Museum of Natural Sciences comprises the Divisions of: Botany under Dr. James H. Soper (which houses the National Herbaria), Mineral Sciences under L. Moyd, Palaeontology under Dr. D. A. Russell and Zoology under Dr. E. L. Bousfield (including the new Canadian Oceanographic Identification Centre). Three National Research Council Postdoctoral Fellowships in Systematic Biology and Vertebrate Palaeontology are tenable at the Museum of Natural Sciences. A program of automatic data processing methods was initiated this year in three selected disciplines. Both the Museum of Natural Sciences and the Museum of Man, in addition to extensive staff research, also support University research and graduate training to a modest degree in their respective fields (about $200,000 in 1967).

The National Museum of Science and Technology was made a separate branch of the National Museum of Canada in 1966 and currently comprises divisions of Aviation and Space, Transportation, Agricultural Technology, Communications, Industrial Technology, General Technology and Physical Sciences. It is proposed to develop separate divisions in many of the other branches of Technology as staff is added in the future. Administration of the National Aeronautical Collection in separate quarters is also the responsibility of the National Museum of Science and Technology.

The former National Museum of Canada originated with the Geological Survey of Canada in 1842; the National Gallery was established independently in 1880. After a full cycle of administrative evolution, all these institutions have now been united in an independent corporation under the guidance of a widely based Board of Trustees more attuned to the modern challenges facing museums to-day, and responsible directly to the Secretary of State. It is hoped that under this system the Museums can better serve all the people of Canada.

A. W. F. Banfield,
Director,
National Museum of Natural Sciences.

ALBERTA BUILDS NEW PROVINCIAL MUSEUM AND ARCHIVES

AS A CENTENNIAL PROJECT, the Province of Alberta has chosen to build a Provincial Museum and Archives. The purpose of the Provincial Museum and Archives is to "collect and preserve significant specimens, artifacts and documents and increase and disseminate knowledge of Alberta's Natural and Human History through exhibition, research and educational programs."

This project was one of ten across Canada located in each capital city as part of a Federal-Provincial grants program, whereby the Federal Government paid $2,500,000 to be at least matched by each province. The Museum and Archives Building officially opened on December 6, 1967.

The Natural History Curatorial Division has been concerned almost exclusively with curatorial work, particularly with setting out displays and exhibits and preparing specimens of birds and mammals coupled with some field work. Natural history habitats and displays will eventually take up nearly one half of the space in the building.

HAMILTON NATURALISTS' CLUB PURCHASES CHOICE NATURAL AREA

WE READ in "The Wood Duck", official publication of the Hamilton Naturalist's Club, that the Hamilton Club is in the process of purchasing about 160 acres of Natural Area which is to be known as the "Short Hills Wilderness Area". The area is located some 30 miles from Hamilton, near Fonthill. The purchase price was $10,000 of which $4,000 was paid in cash by the Executive of the Club. A special fund was set up in March, 1968, to raise the remaining $6,000 and by May slightly over 60% of the objective had been attained.

A section of this area is the only remaining remnant of the climax forest which once covered the Niagara Peninsula. Within the area can be found the largest Tulip Trees, Cucumber Magnolias, Beeches and Black Cherries known in Southern Ontario (one Tulip Tree rises 90 feet before the first branch).

In the management of this new natural area the Hamilton Club will utilize the most advanced concept of woodland natural area management known to man, namely *leaving it alone*. The Club is pledged to see that it remains in its natural state, hence it is not the intention to mark out specific trails, to clip branches or remove any growths or obstructions.

The Short Hills Wilderness Area is the second Natural Area to be acquired by the Hamilton Club, the first was "Spooky Hollow" (near Normandale) about three times as large as the Short Hills Area. By preserving these two areas the members and friends of the Hamilton Naturalists Club "have rendered a great service to the citizens of the Country, present and future in providing for the public such natural beauty for their physical well-being and enrichment." (quote from The Wood Duck). The address of the Hamilton Naturalists Club is Main Post Office Box 384, Hamilton, Ontario.

Editor.

CRESTON INDIANS LEASE WETLANDS FOR $50,000

SOME 3,300 ACRES of wetlands on the Lower Kootenay Indian Reserve at Creston B.C. have been leased to the Canadian Wildlife Service by the Band Council for $50,000 per year. These wetlands are among those most important to migratory birds in the Pacific Flyway and will be managed for increased production, and carrynig capacity during migration.

The agreement covers a five-year period. The first $50,000 cheque was presented to Chief Zachary Basil on January 30th, 1968, in the Band's community hall. Presenting the cheque was Dr. David A. Munro, Director of the Canadian Wildlife Service, and Mr. Len Marchand Special Assistant to Indian Affairs Minister Arthur Laing.

The agreement specifies the wetlands will be used for waterfowl management; improvements will be made as additional resources become available. Interested Band members will be trained in management work and derive other income by admitting hunters to certain parts of the Reserve and catering to their needs.

Control of flooding will also permit increased production of forage on the reserve. Higher waterfowl populations will attract hunters and tourists, bringing additional income to the Creston area.

Presently, the capacity of the area to produce waterfowl is limited by destruction of nests by the high spring flood on the Kootenay River. Another factor is the rapid and excessive run-off in the summer that limits the area's capacity to support waterfowl during autumn migration.

The Libby Dam in Montana will take the peak off the spring flood, but additional water control structures in the area will be necessary to manage the area for waterfowl Such controls will have to be approved by the International Joint Commission.

Press Release,
Canadian Wildlife Service,
Department of Indian Affairs and
Northern Development,
Ottawa

University of Guelph Acquires the Cruickston Park Farm

Cruickston Park Farm, in Waterloo County, of about 1,100 acres has been given to the University of Guelph by Matthew Wilks Keefer of Blair. The gift will take effect on the death of Mr. Keefer and the members of his immediate family. In accepting the gift the President of the University, Dr. W. C. Winegard said "This farm will benefit the University in many ways and it will be of particular value in future research programs." The farm is situated along the Blair Road, adjacent to Preston and Galt. The farm has an especially variable and interesting terrain with parts of it still retaining some of its former woodland character. The farm has been known for the development of the standard bred trotting horse and since 1948 it has been operated as a purebred Hereford enterprise.

The vital interest in this land by the University is a result of its focus on fundamental and applied research in the totality of the environment. The property lends itself to experimental projects in conservation, resources development, land planning and landscape architecture — disciplines in which the University of Guelph specializes. What occurs to air, water, soil, vegetation, crop yields, and, indeed, the total ecology of the area as urban changes take place can be continuously observed.

This tract of land, forming a consolidated block, is unique in size, location and significance. More specifically, kept as a single unit, it will provide a base for:

(a) Much needed research into the problems of maintaining and operating efficient and effective agriculture on the edge of urban development. There is an urgent need to find answers to pervasive problems of keeping the agricultural areas close to cities in an adaptable, viable condition.

(b) Controlled observations on the ecological results of urbanization on adjacent agricultural and wooded areas.

(c) Research within a controlled environment, close to urbanization, into interrelated areas such as conservation, land planning, resources development, landscape architecture and environmental design.

(d) National and International meetings and conferences involving applied study programs, environmental demonstrations, and research seminars on the impact of urban development on the total ecology of surrounding rural areas.

[Abstracted from a University of Guelph News Release]

SOME WETLANDS IN MARITIME PROVINCES TO BECOME NATIONAL WILDLIFE AREAS

MARITIME MARSHES important to ducks and geese will be purchased or leased by the Canadian Wildlife Service. The wetlands will be part of a planned country-wide system of National Wildlife Areas. They will be managed for waterfowl, in co-operation with the province concerned, to improve habitat conditions for breeding production, and stopover during migration.

Management considerations for the wetlands will also include upland game, fur bearers, big game, and fish. While some of the areas will become sanctuaries, others will provide increased hunting opportunity because of the management program.

Owing to lack of registration of many changes in land ownership in the Maritimes, it will occasionally be necessary to expropriate to establish ownership. Notice of expropriation will always be advertised so that landowners may identify themselves and claim payment.

Some areas will be acquired outright, and payment will be based on an objective assessment of the value of the land. In some cases, however, the Service will make annual payments to lease marshes or acquire easements to wetlands rights. The Department fo Transport will handle the purchases for the Canadian Wildlife Service.

Press Release,
Canadian Wildlife Service,
Department of Indian Affairs and
Northern Development,
Ottawa

NEWS BRIEFS

The Nature Conservancy of the United States

THE NATURE CONSERVANCY of the United States now has assets of over $8,000,000. Among its more recent accomplishments are the preservation of 2,164 acres on the Potomac River at Mason's Neck, Virgina, near Washington, and the acquisition of St. Vincent's Island (12,000 acres) in Florida. The latter area will become a National Wildlife Refuge. The Nature Conservancy (US) operates its own chapters and cooperates with other private organizations and with agencies of local, state, and federal governments, often advancing them money from its revolving funds for land purchases.

Biological Conservation — A New Journal

A NEW QUARTERLY JOURNAL entitled BIOLOGICAL CONSERVATION and having a world-wide scope is being initiated by Prof. N. Polunin, 1249 Avusy, Geneva, Switzerland. The first issue is to be printed in June and the second in September, 1968. The new journal will be devoted to "the scientific protection of plant and animal wildlife and all Nature throughout the world, and to the Conservation or rational use of Nature Resources of the land and fresh waters, sea and air, for the lasting cultural and economic welfare of Mankind." The journal will include original research papers, survey articles, project reports and proposals, short communications (including notes and comments) news items, reviews of books and important papers and abstracts. More information may be obtained by writing to Biological Conservation, Elsevier Publishing Company, Essex, England or to the editor (Dr. Polunin) in Switzerland.

REVIEWS

Alberta: A Natural History

Edited by W. G. Hardy. M. G. Hurtig, Edmonton, 1967. VIII + 343 pages; numerous plates and figures. $7.50.

Alberta is an artefact of political geography, but by marvellous good fortune the boundaries of the province encompass a land area of environmental diversity probably unequalled in all of Canada. The story of this land, from prairies to Rockies, from short grass to forest to tundra is now available to us in *Alberta: A Natural History*.

In this book it is told how the land was shaped by eons of geological change —marine transgressions, great deltaic deposits, mountain building, and then the crushing pressure of the great glacier.

As the ice left the land, the final sculpturing came under the capricious hand of the climate. Fitting into the demands of this enviroment, characteristic floras and faunas developed in the different regions of the province. With them came man, aboriginal, then his indigenous descendants, and lastly, adventurers, entrepreneurs, and agriculturists from other lands.

The western territory that opened before the newcomers proved itself rich in buffalo and beaver. It was crossed by the main waterways which led to still further lands. It was found to be rich of soil for cereal crops, and splendid for rearing livestock.

Exploration beneath the surface revealed the gifts of the past—coal, oil, gas—and the record of evolutionary history. The record appears in great assemblages of fossils—plants, corals, shells, fish, and dinosaurs, the most dramatic of all. In recent years, tiny teeth and shattered fragments of skeletal parts of ancient mammals have been uncovered by the determined skills of palaeontologists, renewing the importance of the Cretaceous beds of Alberta as rich fossil sources.

Although it is cleared, fenced, paved or laced with seismic exploration trails, Alberta still has wilderness, saved by National Parks (greater in area than those of all the rest of the country) and by its size. It has active naturalists probing and recording all aspects of its rural and urban natural history, and commenting on its wonders and beauties. In their adventures they have built a great store of information about the province.

What better way to celebrate the Centennial of our country than by harnessing the energy of these naturalists to celebrate the glories of this region? That was the question asked and answered by a strong-minded group that began to meet in Edmonton in 1965. The originators found in the natural history societies, bird clubs and other like groups a mechanism to promote province-wide enthusiasm for a Centennial Project to report on Alberta's natural endowments.

The result has been *Alberta: A Natural History*. Patronage and financial assistance were obtained from several utilities companies in the province. A publisher was found in Edmonton. Dr. W. G. Hardy, distinguished author and editor, was retained as Editor-in-Chief. Twenty-five specialist authors contributed the fourteen chapters. The editorial associates and consultants examined hundreds of photographs and commissioned dozens of maps and line drawings for the book. The editors succeeded in establishing a consistent high level of style and readability throughout the book, so that each author's special knowledge comes out, but the narrative runs smoothly. The reader does not lurch from chapter to chapter, trying to accommodate to wildly diverging idiosyncracies of style, as often is the case in technical symposia.

I believe the editors had no easy job. These authors are no different from any others. Each recognized the vast importance of what he was doing and jealously guarded the treasures of his word. It is a tribute to the skill of the Editor-in-Chief and his associates, and the ultimate good sense of the authors, that an even, stirring and nearly complete account of the natural history of this favored area lies before us.

Part I deals with *The Land*. Four chapters successively cover the night skies, the record of the rocks, climate and weather patterns, topography and soils.

Part II forms the largest part of the book. Entitled *Flora and Fauna*, it describes living things and conditions in the seasons and regions of the province. The prairies, the Cypress Hills, winter in the taiga, the effect of man on aquatic habitats—these are selected topics from fourteen sections in seven chapters.

Part III is called *Man*. His history in Alberta is covered concisely from his earliest appearance until today.

The entire book is sumptuously illustrated, but the photographs in Part III deserve special mention. Photographic treasures from the Ernest Brown Collection, the Glenbow Foundation and the collection of Edward S. Curtis illustrate times long gone by. Equally impressive are the physiognomies of proud Indians, to whom the plains were an empire before the white man came.

Throughout the book photographic and cartographic illustrations are excellent. The cartography is especially informative in Chapter Two, *The Record of the Rocks*, as it clearly outlines the advances and retreats of ancient seas. The cartography is less successful in delineating major soil zones (page 88) and vegetation types (page 102). Too much is attempted; impressions are possible, but the accompanying legends are impenetrable. Also, one should cavil at the map on page 186 which purports to show national parks in Alberta, but leaves out Elk Island National Park, a gem of aspen parkland on dead ice moraine, 25 miles east of Edmonton, and a refuge for bison, elk, moose and other wildlife. One rather puzzling map, giving place names of Alberta (page 94), is also colored in (vegetation?) zones, but these are entirely unlabelled. If these be the major vegetation zones, they are far more clearly shown than on the map of page 102.

Perhaps the least satisfactory thing about the book is the quality of the marginal line drawings. The book itself is well-composed, wtih maps and pictures dramatically arranged to illustrate the text. Broad margins carry smaller photographs, line drawings, and maps. Generally the drawings are more impressionistic than conventionally accurate, and that is as it should be in such a book. But there exist truly beautiful line drawings of all the things shown; the standards possible could have been more closely approached had less haste been taken in the creation of the drawings. Perhaps time did not permit; perhaps the authors had little say in their construction.

All these are technical criticisms, and the unfriendly reviewer could winkle out more. However, I am not an unfriendly reviewer. I think the book is an impressive accomplishment, and this judgement is reinforced by the enthusiasm of Albertans for it. It represents an achievement that similar groups in other provinces might emulate, so that the beauties and importance of our land in all its parts could be brought to all its residents.

Alberta is fortunate to have this book and those that can serve as its companions: *The Birds of Alberta* (Salt and Wilk, 1958; 2nd edition 1966); *The Mammals of Alberta* (Soper, 1964); *Wild Flowers of Alberta* (Cormack, 1967). The excellence and popularity of all these books show that interest in nature as well as enthusiasm and skill in picturing and interpreting it is widespread among our increasingly urbanized population. People are still trying to keep in touch with their natural heritage.

Alberta: A Natural History can be highly recommended as a book to see and read for pleasure, as a source of information and as an example for naturalists elsewhere in Canada to follow in appreciation of our land.

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A Comparative Life-history Study of Four Species of Woodpeckers

By LOUISE DE KIRILINE LAWRENCE. 1967. Ornithological Monographs No. 5. The American Ornithologists' Union (Box 23447, Anchorage, Kentucky, 40223). 156 pp., 33 text figs. $3.75 (U.S.).

Readers of *The Canadian Field-Naturalist* will recall the author's outstanding study of the Red-eyed Vireo and her absorbing account of nesting Gray Jays (*Can. Field-Nat.* 67: 44-77; 61: 1-11, respectively). Many have enjoyed her various articles in *Audubon Magazine*. Invariably her publications combine discerning observation with writing excellence.

The subjects of the present study are four species of woodpeckers: the Yellow-bellied Sapsucker, Yellow-shafted Flicker, and the Downy and Hairy woodpeckers. All are familiar species with broad distributions in North America. However, before we have read many pages in this report we are struck by how surprisingly little we really know about many aspects of the life histories of these common birds—and conversely by how very much the author has learned about them in the course of her seven-year (1953 through 1959) study near her home at Pimisi Bay, Ontario.

"Time and patience are surprisingly reliable allies in providing answers to many seemingly insoluble problems" observes the author. It is plain that she put this into practice, for her watches lasted from three to seven hours per day (sometimes even from dawn to dusk) and added up to a total of some 800 hours of concentrated observation. The results show that the formula is eminently a successful one.

Some of the many aspects of life histories covered include inauguration of the breeding cycle, territory, pairing, nest excavation, egg-laying, incubation, the nesting period, and post-nesting activities. There are amazingly many observations of various movements, displays, means of communication (with discussions of drumming, tapping, and signalling posts) food and feeding, even a section on destructiveness in woodpeckers. She has something new on molts and plumages in the Hairy Woodpecker with the discovery that in juvenal plumage the white eye-ring of the adult is either "entirely or partially lacking" (in all juvenals examined by this reviewer the white eye-ring was completely lacking).

The text is remarkably free of typographical errors (the misspelling of the mammalian generic name *Erethizon* is perhaps excusable in an ornithologist!).

Sylvia Hahn's drawings graphically and usefully illusrtate the text. The tail of one of the sapsuckers (p. 10), however, is asymmetrical with one too many (developed) rectrices on the left side.

The time, meticulous observation, and logical interpretaion that combined to produce this work are impressive. Moreover all this is writen in a clear and lively style that transports the reader into the field. Everyone interested in birds should have a copy.

W. EARL GODFREY

National Museum of Ottawa
Ottawa 4, Ontario

Bionomics of the Sandhill Crane

By W. J. DOUGLAS STEPHEN. Canadian Wildlife Service Report Series, No. 2. Ottawa, 1967. 48 pp., 20 figs. $0.75.

This Canadian Wildlife Service project, the basis for the author's Ph.D. thesis, is a careful well-organized study, dealing chiefly with damage to grain crops by the sandhill crane. On the 324-square-mile study area at the north end of Last Mountain Lake, Saskatchewan, from 1961 to 1963, the crane population reached a peak of 18,000 birds. The average flock contained 185 cranes and over 96% fed within three miles of their major roosts. Valuable data is provided concerning food and space requirements and the timing of dispersal from roosts. Of great interest is the method used to train observers to estimate flock size.

In an average year, 350,000 crane feeding days accumulated before threshing was general, with an estimated consumption of 1750 bushels of grain. Acetylene exploders, one per quarter section, were effective in reducing the average number of cranes from 927 to 50 per quarter section. However, the cranes did not leave the area and damage was transferred to other unprotected fields or to planted lure crops.

Stephen indicates that the subspecific characters given by Walkinshaw do not allow accurate assignation of a specimen to a particular subspecies. Measurements of more than two hundred cranes showed something close to a normal distribution curve, "indicating a single population." In this reviewer's opinion, such a curve should not exclude the possibility that two valid subspecies are present, presuming a geographic clinal size variation. A mixed migratory population seems unsatisfactory for the study of subspeciation. I was also surprised by the footnote stating that "exposed culmen is not a common ornithological term" when it is one of the seven standard measurements given by the authoritative work, "Measurements of Birds" (Baldwin, Oberholser and Worley. Cleveland Museum, 1931).

Stephen concludes with a recommendation that "the recreational value of the sandhill crane resource should be developed." This already has been implemented in the form of a local open hunting season on cranes, beginning in 1964.

The Canadian Wildlife Service is to be commended for making available another excellent study.

C. STUART HOUSTON

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Saskatoon, Sask.

Guide to Common Seaweeds of British Columbia

By ROBERT F. SCAGEL. British Columbia Provincial Museum, Department of Recreation and Conservation, Handbook No. 27. Victoria, B.C. 1967. 330 pp. 141 figs. $1.00.

Dr. Scagel, who has published several authoritative papers on the taxonomy, distribution, floristics, and ecology of British Columbia algae, wrote this book "to meet the less critical needs of the layman, or one casually interested in seaweeds and their natural history." It describes and illustrates, with line drawings by Ernani G. Meñez, 132 of the "more common and conspicuous" species of green, brown, and red marine algae and the only three species of marine flowering plants occurring in the area. The 132 algal species represent 92 of the 187 genera reported by Dr. Scagel to be present on British Columbia shores, which, of course, involve all of Pacific Canada. Keys to the 92 genera are included.

Each species is given a short description, including statements on habitat and distribution, on one page and is illustrated by line drawings conveniently placed on the opposing page. In the present format, where nearly all of the descriptions scarcely occupy a half-page, it would appear that 132 additional species could have been described and, moreover, adequately illustrated. The figures are for the most part poorly selected: gross vegetative features, mainly branching habits, of the same species are shown without benefit at different magnifications; gross reproductive features, mostly of the red algae, are not only needlessly duplicated but are also inadequately drawn to be of value. Further, too many of the cm or mm scales indicate either colossal or Lilliputian dimensions; e.g., according to the scales given, *Pterygophora californica* is seven times the normal size; *Enteromorpha linza* is 50 cm tall, but *E. intestinalis* is shorter than 5 cm; *Alaria nana* is 42 cm tall, but *A. marginata* is only 2 cm tall.

Of minor importance is that *Leathesia difformis* (p. 86) and *Cryptopleura ruprechtiana* (p. 296) are misspelled (they are correctly spelled in the figure legends and index), and *Laminaria groenlandica* (p. 120) is inadvertently referred to in one sentence by the synonym *L. cuneifolia*.

The first portion of the guide includes informative sections on the local history of algae collecting, algal distribution and ecology, and the collecting and preserving of specimens. Another section is devoted, in detail and with accompanying diagrams, to the intriguing life histories, or reproductive cycles, of the algae. On the other hand, a following section titled "Structure and Reproduction" merely relates how important gross and microscopic morphological characters are in identification. The omission of a lucid, descriptive explanation of vegetative and reproductive features will likely prove to be a serious handicap to those using the guide. The glossary near the end of the book may be of some help, but like most glossaries it is more explanatory than descriptive.

These shortcomings are unfortunate for the handbook does provide a realistic link in the transfer of knowledge from specialist to non-specialist. It is conceded that the guide's species descriptions, which are essential in distinguishing one alga from another, can be frustratingly ambiguous even to the trained taxonomist. But the fact is, because of multiformity in morphology and reproduction, algae are confusing organisms. Dr. Scagel's comprehensive approach is a welcome departure from the oversimplification attribute of algae handbooks; the interested layman will profit by it.

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The Lichen Genus *Cladonia* in North America

By JOHN W. THOMSON, University of Toronto Press, Toronto. 1967. 5 diagrams, 60 figures, 26 plates, 1 table. 172 pp. $12.75.

The genus *Cladonia*, including such widely recognized species as "reindeer lichen" and "British soldiers", has long been familiar to both lichenologists and amateur naturalists. Because of the taxonomic problems involved in many groups of species and in the absence of a comprehensive, modern, English- language manual, few non-professionals ever attempted identification of *Cladonia* material. John Thomson's new volume provides us with such a manual.

In the preface, Thomson makes a point of saying that the book is a compilation of existing information rather than a monographic treatment. Thus, the scattered information by such authors as

Alexander Evans, Vainio, Ahti, Asahina and others is brought together here. Interestingly enough, although Thomson does not tamper with the greater part of the myriad of forms and varieties in the older papers, he has many opinions and makes a number of taxonomic synonomies with Ahti's recent works (especially his monograph on the reindeer lichens.

The author does make a real effort to bring *Cladonia* names in line with the Code of Botanical Nomenclature. This results in some regretable but necessary name changes of well-known species. Undoubtedly, as more monographic work is done (encouraged by the existence of this manual), other name changes will become necessary.

The key, which the author modestly states is the only real point of originality in the book, unfortunately will be of limited help to non-lichenologists. The reason is simply that Thomson has chosen to make a "natural" key, with the species from each generic subdivision keying out together. The user of the key first has to key out his material to subsection or series before he can begin to key it to species. Unfortunately, there are so many species which are morphological "exceptions" to their generic subunit, very often, this initial key will lead the user astray. Even without the overlap, come of the couplets must necessarily rely on vague and overlapping characters, or characters which sometimes are not even present (e.g., "cups" and apothecia). This is really a great pity because the subsection and series keys themselves are generally quite good and easy to use.

One of the strongest points of this manual is the bringing together of the new information on lichen chemistry with the old morphological descriptions. The keys use chemical characters extensively (although sparingly in the primary couplets). To support this, the text contains a large and tremendously valuable section on "how to do it", with detailed instructions on microchemical crystal tests and 60 excellent photographs of the crystals themselves.

With its broad coverage, species descriptions and chemical notes, the book will be indespensable to anyone seriously interested in identifying species of *Cladonia*. Its publication can be considered an important event in North American lichenology.

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On Integration In Plants

By RUDOLF DOSTAL. Translated by Jana Moravkova Kiely. Edited by Kenneth V. Thimann, Harvard University Press, Cambridge, Mass. 218 pp. $5.95.

There is a little known realm of plant research that lies between classical physiology, on the one hand, and morphology on the other. Briefly it could be described as the study of the interrelations between the various organs of plants and how they determine the ultimate form, structure and function of each other and of the whole plant entity. It would be safe to say no one living scientist has devoted as much time to this study as has Prof. Dostál. Unfortunately, his work is not well known among western scientists. He has published primarily in a Czechoslovakian Journal of limited circulation, and few of his studies had been translated into English. It was, therefore, a pleasant surprise to discover that he had published a resume of his life work and that this book has been translated into English.

The translation has been edited by Prof. K. V. Thimann, formerly of Harvard University who has added valuable footnotes that tend to set the record straight where erroneous claims have been made. However, no attempt has been made to change Prof. Dostál's politically biased statements. This is indeed fortunate for it allows us to see the influence of politics on Soviet oriented science. Prof. Dostál accepts completely the Michurin-Lysenko views on biology. In this regard I quote directly from Prof. Thimann's forword. "The perceptive reader will note how often, even though Lysenko and Michurin may not be directly referred to, the argument is tinged with or even modified by, the Lysenko position. Thus it provides an invaluable outlook on to an area of biological history which some day will attract concentrated attention—the area of administrational control over scientific views". To the young sudent or to those not familiar with Michurin-Lysenko biology I would respectfully suggest a cautious and critical approach to many of the discussions.

However, this book is a treasure trove of ingenious and exciting experiments. The main topics of study are well-defined by the eight chapter headings, namely; 1. Integration at the embryonal level; 2. Experiments on the recapitulation of phylogeny; 3. Correlations, the fundamental basis of integration; 4. Regenerative mechanisms for preservation of the plant's integrity; 5. Polarity as an expression of integration; 6. Transplantation and integration; 7. Integration and the problem of periodicity in plants and 8. External factors and integration.

In his search for the determining factors that are involved in the total growth and development of plants, Dostál often uses surgical excision and alteration of organs to demonstrate their control over the growth and development of other organs. An intriguing example involves the removal of leaves at a critical stage of development on the subsequent growth of the axillary buds of horse chestnut, *Aesculus hippocastanum.* If the timing is correct, the buds will produce shoots bearing leaves with the leaflets in a pinnate rather than a palmate arrangement. Dostál believes this is a reversion to the form of the primitive ancestors of the horse chestnut and uses this example to illustrate his argument that ontogeny recapitulates phylogeny. In reading of these experiments, one sees many other experiments that could and should be done. Even Prof. Dostál in sixty years of research has barely scratched the surface of what can be done.

This book, then, is a story by a brilliant but little known scientist, of a lifetime of research dedicated to determining how specific organs contribute to the growth and development of the whole plant, and how the ultimate plant is the result of the sum total of the morphogenetic donations of all the organs. That the environment modifies these donations, is an important element of Prof. Dostál's theories.

I am happy to see this translation. Prof. Thimann deserves thanks for its appearance and for his expert but not overbearing, editing and notating of the text.

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Famine on the Wind

By G. L. CAREFOOT and E. R. SPRATT. Published by Longmans Canada Ltd. 1967. 231 pp. $7.50.

Although the title of the book does not directly refer to the wind-borne plant parasites, the authors should be congratulated for their deep insight into problems of famine and for their efforts to bring together various interesting information from different sources, to tell the general reader, how only a few of some 30 thousand plant diseases, have profoundly influenced the agriculture, industry, trade and commerce or politics of nations for many, many years.

The book contains 10 sections excluding a prologue on the present and predicted population crisis of the world and a short epilogue on the food crisis. A bibliography with 149 references (C. Staff should read C. Stapp), and an alphabetical index of about 10 pages are given at the end of the book.

In the ten easy-reading sections, historically important crop diseases were elegantly presented from the standpoint of their impact on man's affair, along with their origin, discovery, rapid spread by the wind and rain, disease development and control measures. The main stories were centered around the rusts and smuts of wheat, ergot of rye, mildews of grape, potato blight, coffee rust, banana wilt, a rubber plant disease, chestnut canker and dutch elm disease. Other maladies such as fireblight of apples and pears, crown gall of rosaceous and virus diseases of solanaceous and graminaceous plants were also briefly discussed.

The writers have also attempted to compute the monetary loss from these diseases, admitting that the figures were more or less rough estimates. Even so, they were in the order of a billion dollars.

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Development of Fishes of the Chesapeake Bay Region. An Atlas of Egg, Larval, and Juvenile Stages. Part I

By Alice J. Mansueti and Jerry D. Hardy, Jr. Edited by Earl E. Deubler, Jr. Natural Resources Institute, University of Maryland, Baltimore. 202 pp., 90 fig. 1967. $9.50 (U.S.).

North American studies on larval fishes lag behind those of Europe and this lacuna is now partly filled by Mansueti and Hardy's work. Although the study deals with fishes of the central 275 miles of east coast of the United States, about two-thirds of these species are also found in Canada. Fishes occurring in coastal, estuarine, and tidal freshwaters are treated.

The book includes the following sections: Introduction, Glossary, Species Accounts, Bibliography and an Index to Common and Scientific Names. The introduction presents an account of how the book came to be written, a brief history of the study of larval fishes, and the authors' objectives, methods and sources of material. A map usefully delimits the area covered, the coast from southern Virginia to northern New Jersey—a somewhat larger area than one might expect from the title. Illustrations describing the morphology and development of typical teleosts with free swimming larval stages are a valuable feature. The format for the species acounts is: Adult, Distribution and Ecology, Spawning, Eggs, Yolk-sac Larvae, Prejuveniles, Juveniles, Literature Cited and Additional References. Forty-five species in 14 families from Acipenseridae to Ictaluridae are dealt with in Part I and presumably other parts will be published as they are completed. The Bibliography includes about 900 titles.

The inclusion of a glossary with definitions is a worthwhile innovation in a study of this sort. Leptocephalus, however, might usefully have been included. This term until recently applied only to the rather compressed, leaf-like, and initially hugely-toothed larvae of the Elopoidei, Anguilliformes and Saccopharyngiformes, but has been enlarged to include the elongate subcylindrical larvae of Notacanthiformes. A more precise definition or a redefinition of this term seems to be needed.

Terminology of the early developmental stages of fish is confused in the literature, not only because development is not the same in all fishes but also because there are numerous synonyms. Suprisingly, the terms prolarva and postlarva were not mentioned as synonyms of yolk-sac larva and larva since most

American workers, including Mansueti herself (1964, Ches. Sci. 5: 46-66) accepted Hubbs' (1943, Copeia, 4: 260) suggestion to use these terms. We feel that discarding pro- and postlarva is a progressive step and hope that future biologists will accept the terms suggested by Mansueti and Hardy.

The absence of a larval stage prevails among certain species with large yolk reserves and the development of the white catfish, *Ictalurus catus*, as an example, shows that yolk is retained right up until the adult fin-ray complement is attained (prejuvenile stage). Development proceeds directly from the yolk-sac larva to the prejuvenile. The complete sequence of development shown by the white catfish and the fact that the other 5 ictalurid species have similar eggs with large yolk reserves suggest that none of the species of *Ictalurus* or *Noturus* from the Chesapeake Bay region have larva stages, yet the authors have indicated in the species accounts that the larval stages are unknown.

There is some doubt to us whether the inclusion of small, poor-quality illustrations of adult fish adds anything useful. Since they feel justified in having a picture of the adult present, a better arrangement would have been to place it at the end of the series of developmental stages, so that adult meristic and morphological characteristics could be readily compared with prejuveniles and juveniles.

It should be noted that descriptions taken from the literature which they were unable to verify were termed putative in the accounts of species, but the authors have not warned the reader about this in the introduction. For example the putative larva of the northern redhorse sucker, *Moxostoma macrolepidotum*, as taken from Fish (1932, United States Bureau of Fisheries, Bulletin 47: 320) is not a sucker but rather a minnow. As can be observed in the bibliography, the literature concerned with early stages of fish is extensive. However, their coverage is still not complete for they have missed Balon's (1958, Biologické Pracê Vydavatel'stvo Slovenskej Akadémie vied v Bratislave, IV/6: 7-54) detailed paper on the development of the carp, *Cyprinus carpio carpio L.*

There is no doubt that this study will become an important contribution for North American fishery workers and should stimulate research on the early life of fishes. A plea should go out to all hatchery and research personnel to retain representative stages of known species so that descriptions of now unknown forms can be documented.

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John James Audubon

By ALICE FORD. 1964. Burns and MacEachern, Ltd., 135 Railside Rd., Don Mills, Ont. 488 pp. $10.25.

Based on ten years of research among previously inaccessible correspondence in England, France, and the United States, this new volume on Audubon, by a recognized authority, cannot fail to revive interest in this pioneer artist-naturalist (1785-1851) whose 435 paintings of North American birds revolutionized bird art when published in four volumes in London, England, between 1827 and 1838.

In jail for debt and penniless at age 34, and so despondent at one time that he 'took to the bottle', Audubon nevertheless persisted in his great work, and followed it with the five volumes of his 'Ornithological Biography' (1831-1839).

Well-written and meticulously documented (her bibliography is indispensable), Miss Ford's book is an important addition to the growing collection of Audubonians, particularly insofar as it reveals previously unpublished data about this outstanding personality.

Two of Audubon's plates are misidentified in this volume—the Common Nighthawk and the Red-shouldered Hawk (between pages 82 and 83).

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OTHER NEW TITLES

Moment in the Sun. A Dial Report on the Deteriorating Quality of the American Environment. Robert Rienow and Leona Train Rienow. The Dial Press. 286 p. $6.00 (US). The volume is a simple and somewhat dramatized accounting of the ways in which the American environment is being eroded by the exigencies of progress – growing problems of pollution, water supplies, food resources, soil, health, noise, beauty, privacy, and general degradation of standards of wholesomeness. The senior author is professor of political science at the State University of New York at Albany. A wealth of detail and documentation as well as its easy literary style will make the book valuable for informal reference and general reading on an increasingly urgent subject.

Torrey Canyon: Pollution and Marine Life. A report of the Plymouth Laboratories of the Marine Biological Association of the United Kingdom. J. Smith (Ed.). Cambridge University Press, 1968. 196 p. Illus. $9.50 (US).

Unusual Aquarium Fishes. A. Mark Fletcher, Lippincott, 1968. 143 p. Illus. $4.50 (US).

The Mouse: Its Reproduction and Develpmnt. Robert Rush. Burgess Publishing Co., 1968. 430 p. Illus. $15.75 (US). An embryology textbook.

Wild Flowers of North Carolina. W. S. Justice and C. Ritchie Bell. University of North Carolina Press, 1968. 217 p. About 400 color photographs plus drawings. $7.75 (US).

Plant Communities: A Textbook of Plant Synecology. Rexford Daubenmire. Harper, 1968. 430 p. Illus. $9.75 (US).

The Biological Way of Thought. Morton Beckner. University of California Press, 1968. 200 p. Paperback, $1.95 (US). Compares the ways in which concept formation and explanation in the Biological Sciences differs from those in other Natural Sciences.

Ecological Research and Surveys. Hearings before the Committee on Interior and Insular Affairs, United States Senate, Eighty-Ninth Congress, Second Session on Bill S. 2282. U.S. Government Printing Office, Washington, 1966. 160 p. This Bill authorizes the Secretary of the Interior to conduct a program of research, study and surveys, documentation, and description of the Natural Environmental Systems of the United States for the purpose of understanding and evaluating the conditions of these systems and to provide information to those concerned with natural resources management, and for other purposes. Provides a good insight into the kinds of documentation that is necessary for the passage of a bill designed to maintain or restore natural environments where they are needed.

Of Predation and Life. Paul L. Errington, Iowa State University Press, Ames, Iowa, 1967. Illus. by Dycie Madson. 277 p.

Radiation and Life. George E. Davis, The Iowa State University Press, Ames, Iowa, 1967. 344 p.

Instinct and Intelligence, Behaviour of Animals and Man. S. A. Barnett. Illustrated by Stanley Wyatt, Prentice-Hall Inc. Englewood Cliffs, N.J. 224 p. Illus. $6.95 (US).

An Introduction to the Study of the Ethology of Cichlid Fishes. G. P. Baerends and J. M. Baerends-Van Roon. E. J. Brill, Publisher, Leiden, 1967. Photomechanical Reprint. 243 p. 25 Gld.

A Checklist of Ornamental Trees for Canada. Lawrence C. Sherk. Publication No. 1343. Canada Department of Agriculture, Ottawa, 1968. 23 p. Gives scientific and Common names of trees that can be grown in various parts of Canada. Includes a hardiness classification for each species. This checklist is to be used in conjunction with the Canada Department of Agriculture *Map of Plant Hardiness Zones in Canada* which is available free of charge from the Information Division, Canada Department of Agriculture, Ottawa, Ontario.

Key to the Families of Flowering Plants of the World, revised and enlarged for use as a supplement to *The Genera of Flowering Plants.* J. Hutchinson, Clarendon Press, Oxford University, New York, 1967. 117 p. $5.50 (cloth) and $3.75 (paper) (US).

A Checklist of Flowering Plants and Ferns of the Deep River Area, Ontario. Mary I. Moore. Petawawa Forest Experiment Station, Chalk River, Ontario. Information Report PS-X-4. Department of Forestry and Rural Development. September 1967.

The Fragrant Year: Scented Plants for your Garden and your House. Helen Van Pelt Wilson and Leonie Bell. M. Barrows and Company, New York, 306 p. $10.00 (US).

The Flora of Greenland. Tyge W. Böcher, Illustrated by Ingebòrg Frederiksen with English Translation by T. T. Elkington and M. C. Lewis, Copenhagen. P. Haase & Son 1968.

Harvest Without Planting: Eating and Nibbling off the Land. Erika E. Gaertner. Donald F. Runge Ltd., 243 Pembroke St. West Pembroke, Ontario. 1967. About 70 pages. $2.00.

Dawn of Zoology. Willy Ley, Prentice-Hall, 1968. 280 p. Illus. $7.95 (US).

Fluctuations of Glaciers, 1959-1965. A contribution to the International Hydrological Decade. Peter Kasser — IASH (Unesco Publications, New York), 1967. 52 p. plus 25 multi-page tables.

Checklist of the Vascular Plants of Continental Northwest Territories, Canada. A. E. Porsild and W. J. Cody. Plant Research Institute, Canada Department of Agricutlure, Ottawa, 1968. 102 p. 1 map. Available from W. J. Cody, Plant Research Institute, Central Experimental Farm, Ottawa 3, Ontario.

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Articles

Notes

Reviews

News and Comment

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POPULATION STATUS OF PEREGRINE FALCONS IN THE QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA

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RECENT POPULATION DECLINES of the Peregrine Falcon (*Falco peregrinus*) and other raptors, primarily in the United States and Europe, have brought the plight of those birds to public attention. Some of the declines are well documented (Ratcliffe 1963; Enderson 1965; Ash 1965; Ames and Mesereau 1964). Human disturbance and pesticide contamination have been suggested as causes of the major declines, and evidence for the latter is impressive (Ratcliffe, 1965).

The Peregrine is also a bird which has been sought by falconry enthusiasts for hundreds of years. Recently, falconers have discovered the superior hunting qualities of Peale's Peregrine (*F.p. peali*), the race confined to the northern Pacific Coast of North America. This has resulted in a heavy demand for collection of that bird in British Columbia, particularly in the Queen Charlotte Islands where they nest in relative abundance.

Concern for the worldwide status of peregrines and a desire to allow recreational use of any population surplus motivated the British Columbia Department of Recreation and Conservation to conduct surveys of Peale's Peregrine in the Queen Charlotte Islands in 1965, 1966, and 1967. The surveys primarily involved searching seaside cliffs for active eyries, using patrol boats of the Federal Department of Fisheries. Accessible eyries were climbed to determine the number of eggs or young present. Information was also obtained by personal interview and mail questionnaire, from falconry permittees who travelled to the Queen Charlottes to collect nestling Peregrines. Most of those people are considered to be reliable observers. In cases where the same eyries were observed by more than one party the number of young was identical. Average numbers of nestlings observed by permittees and by Fish and Wildlife Branch personnel have been very similar and thus are combined to give the advantage of increased sample size. An excellent earlier account of Queen Charlotte Island Peregrines is provided by Beebe (1960).

DISTRIBUTION

Distribution of Peregrine eyries in the Queen Charlotte archipelago is roughly correlated with several environmental factors. Firstly, eyries are largely restricted to the Insular Mountains physiographic subdivision, characterized by dissected topography and many associated islands (Holland, 1964) but are virtually absent from the Queen Charlotte Lowlands, a flat region with smooth coastline. Secondly, almost 90% of the known nest sites are located on small islands around the coast of the two main islands — Graham and Moresby, despite the fact that 85-90% of the land area of the archipelago is comprised of the latter two islands. The affinity of breeding Peregrines for small islands in this area appears to result from a similar distribution of their food

Mailing date of this number: 15th October, 1968

supply, primarily small alcid birds. The latter birds do not nest on Graham or Moresby Islands, probably because of the presence there of predators, both native (weasel, *Mustela erminea;* marten, *Martes americana*) and introduced (raccoon, *Procyon lotor*). Eyrie distribution coincides closely with that of known breeding colonies of the major prey species as charted by Drent and Guiguet (1961). The few eyries located on rocky headlands of Graham and Moresby Islands are all near small islands occupied by breeding colonies of prey species.

The presence of land predators is probably of little direct significance to the general distribution of Peregrine eyries because of their cliff-nesting habit and ability to defend themselves. However, the indirect effect of mammalian predation through elimination of the Peregrine food supply can be quite marked. Mink (*Mustela vison*) which were introduced by trappers to Lantz Island off the north tip of Vancouver Island appear to have completely eliminated the colonial birds nesting there (Carl et al 1951). Raccoons introduced to adjacent Cox Island had a similar effect. Beebe (1960) states that "These islands should be the sites of large colonies of seabirds and their attendant falcons, and there is ample evidence that this was once the case". The evidence consisted of abandoned nest burrows and unoccupied potential eyrie sites.

Within the area of high prey abundance, eyrie location is influenced by the availability of suitable nest sites. Although usually restricted to essentially vertical cliffs, nest sites are often within easy reach of the cliff-top. A few can be reached by man without the aid of ropes.

POPULATION STATUS AND STABIILTY

Occupied eyries were located during the Government surveys by cruising the shoreline by boat until suitable nesting cliffs were encountered, then firing a gun to frighten any falcons in the vicinity from the nest or perch. Some nest sites were probably missed because a few cliffs cannot be approached closely due to reefs and other foul ground. A few suitable nest sites are hidden in deep gullies or are screened from the sea by trees and thus may not be noticed. Eyrie sites in this rain-drenched region are generally washed free of faecal material and thus cannot be recognized by the presence of "whitewash".

Although no extensive survey has yet been conducted over the entire Queen Charlotte complex in one season, particular areas have been investigated in some detail and when pieced together a fairly complete picture emerges. Regions covered by the Government surveys are summarized as follows (for geographical orientation please refer to Figure 1):

1965: East and west coast of Moresby and its associated islets.
1966: Langara and Frederick Islands.
1967: Upper east coast of Moresby Island plus west coast of Graham Island including Frederick and Langara Islands.

Falconry permittees visited a variety of areas during those years, but tended to concentrate along the east coast of Moresby Island.

Observations of Fish and Wildlife Branch personnel and of falconry permittees are summarized in Table 1. Most of the observations were of adult

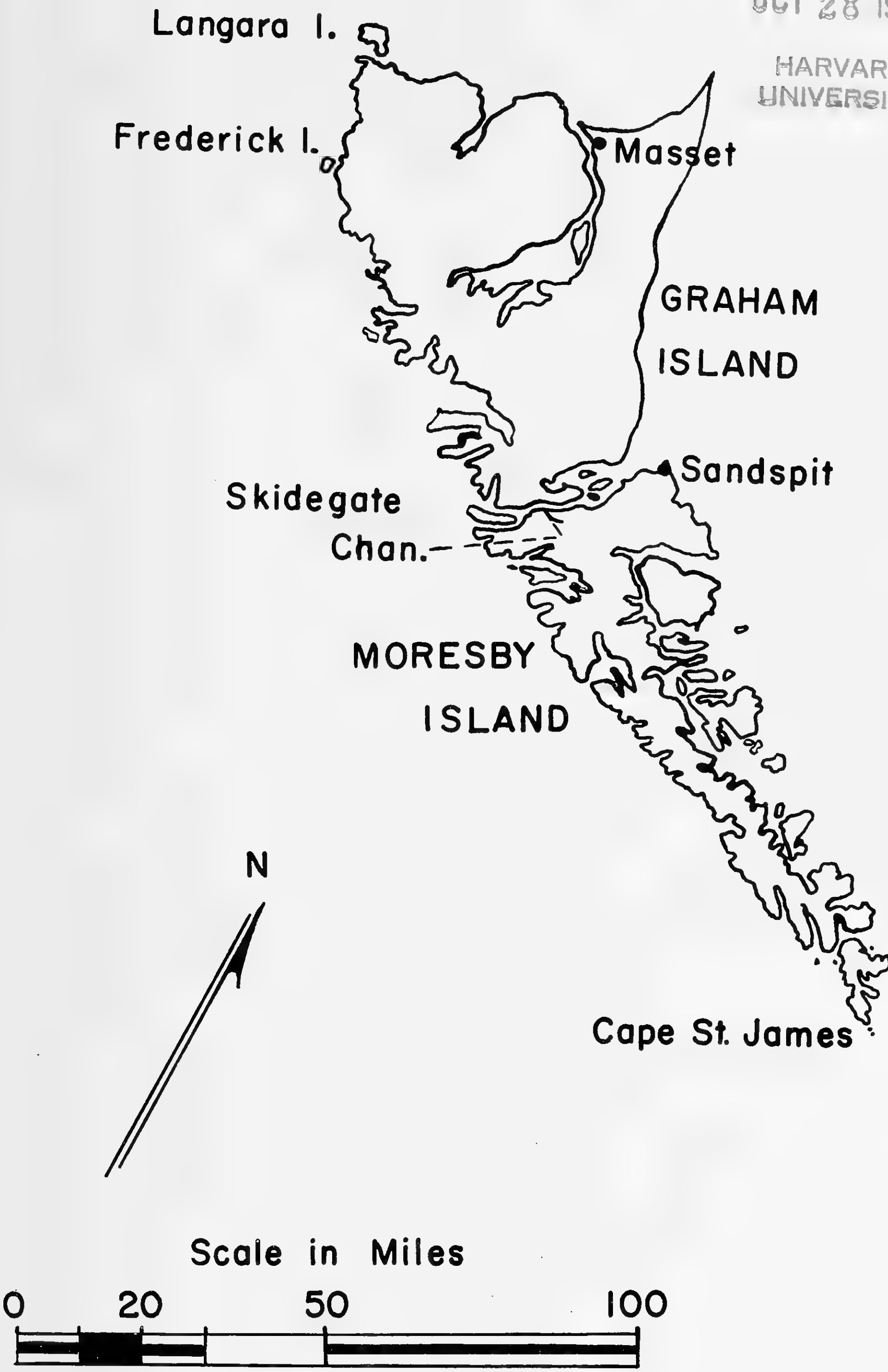

Figure 1. Map of the Queen Charlotte Islands showing locations mentioned in the text.

TABLE 1.—Summary of Peale's Falcon observations in the Queen Charlotte Islands, 1965, 1966 and 1967

Type of Observation	Number of Observations						
	Falconry permittees			Gov't. Surveys			Total
	1965	1966	1967	1965	1966	1967	
1. One or more immature falcons	0	1	1	2	0	2	6
2. Lone adult. Nesting status doubtful	2	4	2	8	3	2	21
3. Active pair of adults but eyrie not climbed or not found	1	3	5	20	3	5	37
4. Active eyrie verified by inspection of eggs or young	6	11	15	1	6	8	47

pairs. A few apparently lone adults have been seen, but some of those could also represent pairs in which one member was not seen. Very few immature birds (one year old) have been noted in the Queen Charlottes during the breeding season. One would expect to see them where food is most abundant — around the alcid bird colonies where the adult falcons are also most numerous. Evidently there is either a heavy first year mortality in those birds, or else most immature Peregrines do not return to the breeding area until adult. Breeding population census results are given in Table 2. A total of at least 43 breeding pairs is indicated.

Well documented declines in Peregrine populations in Europe and eastern North America occurred primarily in the mid-1950's. By 1962 the British Peregrine population had declined to one half of the pre-1955 level and the number of successful nestings to 13% of the pre-1955 level (Ratcliffe, 1963). More recent surveys suggest the population there has stabilized since 1963 (Ratcliffe, 1967). Whether such a decline took place in the Queen Charlottes is not known because former breeding densities were not well documented. However Beebe (1960) found 12 occupied eyries on Langara Island in 1952 and did not visit a part of the Island where three breeding pairs were located in 1966 and 1967. Thus it is likely that the 1952 population stood at 15 or more occupied eyries. In 1966 and 1967 only 7 adult pairs could be located at Langara. Most of the now vacant territories are in the Cloak Bay area which Beebe found to be very densely populated during the 1952-1958 period. He stated: "Here in a linear distance of somewhat over a mile, but in less than two square miles of land and sea surface, are concentrated never less than five, usually six and sometimes eight breeding pairs of peregrines". Only one pair could be located in the Cloak Bay area in each of 1966 and 1967. The samples discussed are small, however they suggest there has been a significant decline since 1952 in the breeding status of Peregrines in at least one region of the Queen Charlottes and that the decline was primarily in an area (Cloak Bay of Langara Island) where breeding densities were formerly the highest known on the Coast of British Columbia.

TABLE 2.—Approximate breeding population status of Peregrine Falcons in the Queen Charlotte Islands, 1965–1967

Region	Known breeding pairs	Possible breeding pairs[1]
E. Coast Moresby Isl. (Sandspit – Cape St. James)	19	28
W. Coast Moresby Isl. (Skidegate Chan. – Cape St. James)	4	7
W. Coast Graham Island	13	15
Langara Island	7	10
Total	43	60

[1]If apparently lone adults actually represent a pair.

REPRODUCTIVE SUCCESS

Reproductive success in Queen Charlotte Peregrines is based on numbers of nestlings observed in eyries. Nearly all observations were confined to the first two weeks of June, thus year-to-year figures are roughly comparable. A few eyries contained eggs at that time but were usually visited only once, thus it is not possible to determine if the clutches were complete. For that reason figures for egg clutches were not included in Table 3. Some early mortality would undoubtedly have taken place before certain eyries were visited. Thus figures in Table 3 represent neither true clutch size nor fledging success, but indicate survival to a fairly advanced nestling stage.

Reproductive success was virtually identical at Langara Island in the mid-1950's and for the entire Charlotte complex in the mid-1960's. The presence of an average of 2.5 young per eyrie late in the nestling stage would appear to indicate good survival. If the average clutch of eggs is similar to that of 3.7 found by Hickey (1942) for Peregrines in eastern North America, then about 32% of the potential young would be lost between egg and late nestling stages.

TABLE 3. Number of nestlings observed in Peregrine eyries in the Queen Charlotte Islands

Number of Nestlings	Number of Broods		Percent of total broods	
	1952–58[1]	1962–67[2]	1952–58[1]	1962–67[2]
1	3	12	8.8	15.8
2	15	24	44.1	31.6
3	13	27	38.2	35.5
4	3	13	8.8	17.1
Totals	34	76		
Mean no. of nestlings	2.5	2.5		

[1]Data for Langara Island (Beebe 1960).
[2]1962–1964 observations by permittees only.
1963–1965 observations by permittees and Wildlife personnel.

TABLE 4.—Comparative observations of the average number of Peregrine nestlings per eyrie

Source	Location	Years data collected	No. eyries examined	Mean No. nestlings
This report	Queen Charlotte Islands, B.C.	1962 – 1967	76	2.5
Beebe, 1960	Langara Island, B.C.	1952 – 1958	34	2.5
Cade, et al 1967	Yukon R., Alaska	1966	12	2.25
Enderson, 1965	Alberta	1964	6	2.3
Hickey, 1942	Eastern North America	?	?	2.5
Ratcliffe, 1965	British Isles	1914 – 1949	28	2.25
ibid.	N. England and S. Scotland	1922 – 1949	18	2.5
ibid.	S. and E. Highlands, Scotland	1963 – 1964	19	2.3
ibid.	Britain except S. & E. Highlands	1963 – 1964	43	1.9

Little is known of early losses in Peregrines, but some young evidently fall from the nest ledge and die. During the 1967 government survey, two of 21 nestlings observed had fallen or otherwise left the eyrie. One was dead and the other was alive but undoubtedly would have perished in a short time.

Numbers of Peregrine nestlings per eyrie reported by other authors are compared in Table 4. Despite the fact that observations were likely made at various stages between hatching and fledging, the mean number of nestlings is strikingly similar in most areas. The low figure for Britain exclusive of the south and east Highlands is evidently a result of egg breakage, egg infertility and death of embryos or hatched chicks as a result of exposure of adults to organo-chlorine pesticides (Ratcliffe, 1965).

NESTLING HARVEST

The harvest of eyas Peregrines from the Queen Charlotte Islands is restricted to legitimate permittees. A reliable measure of permittee success and thus of the annual harvest has only been obtained since 1963, but some harvest figures are available back to 1952 (Table 5). At least 211 nestlings have been taken since 1952, 133 of those during the period 1963-1967 (Table 5). The maximum harvest of 41 birds in 1967 may represent about 33% of the available nestlings, if we accept an estimate of 50 eyries with an average of 2.5 young each. The cumulative removal to date appears to have had no adverse effect on the population status of Peregrines in the Queen Charlotte Islands.

SUMMARY

1. The distribution of Peregrine eyries in the Queen Charlotte Islands is closely correlated with that of breeding colonies of alcid birds which in turn are apparently restricted to islands free of certain mammalian predators.
2. A total of at least 43 Peregrine breeding territories was present in the Queen Charlottes during the period 1965-1967. There is evidence that the number of active eyries has declined significantly in at least one area where former breeding densities were very high.

TABLE 5.—Approximate numbers of eyas Peregrines removed from the Queen Charlotte Islands for recreational and scientific purposes

Year	Birds taken	Year	Birds taken
1952	5	1960	2+ (incomplete)
1953	?	1961	?
1954	?	1962	10+ (incomplete)
1955	18	1963	23
1956	11	1964	33
1957	3	1965	11
1958	5	1966	25
1959	14	1967	41

3. The average number of nestlings observed in 76 eyries during the period 1962-1967 was 2.5. This is the same average as determined from data of another author for part of the same area during the period 1952-1958, and suggests there has been no decline in reproductivity of the Queen Charlotte Peregrine population between the mid 1950's and mid 1960's.
4. At least 211 nestling Peregrines have been removed from the Queen Charlottes during the period 1952-1967. An average removal of 27 nestlings per year has been maintained over the past 5 years.

ACKNOWLEDGEMENTS

I am particularly indebted to W. R. Hourston, Victor Giraud, Frank Wheeler, and Ken Harley of the Federal Department of Fisheries for accommodations and transportation during the field surveys. Considerable field information and background data were supplied by Charles Guiguet and Frank Beebe of the B.C. Provincial Museum; Bryan Gates of the B.C. Fish and Wildlife Branch; and David Hancock of Saanichton, B.C. Many falconry permittees also kept records and kindly supplied them to me. For critical review of the manuscript I am indebted to Rory P. Finegan and Richard Fyfe. Finally, I owe much to W. Glen Smith, Chief of Wildlife Management, B.C. Fish and Wildlife Branch, for his supervision, advice, and encouragement.

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THE FOOD OF THREE SPECIES OF GULLS IN NEWFOUNDLAND

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INTRODUCTION

MANY PAPERS have been written about the food of gulls primarily because many people believe that these birds have a deleterious effect on farming and fishing activities, the fears usually proving groundless. Harris (1965) summarized many of the more important works. Pimlott (1952) worked on the economic status of the Herring Gulls of the Grand Manan Archipelago, New Brunswick, and concluded that they have little or no real effect on agriculture or economic fish in the area.

The material on which this paper is based was collected during a survey of the helminth parasites of marine birds in Newfoundland during the years 1966 and 1967.

MATERIALS AND METHODS

The stomach contents of 502 birds of three species (401 Herring Gulls (*Larus argentatus* Pont.), 32 Great Black-backed Gulls (*Larus marinus* L.), and 69 Black-legged Kittiwakes (*Rissa tridactyla* (L.)) were analysed, during the periods June-August 1966 and May-September 1967. A record was made of any food items found, and the numbers of each food item present, the proportion of stomachs with each type of food item then being calculated.

Three methods of studying the food of the birds were utilised, namely analysis of stomach contents, examination of pellets, and direct observation. The last method was suitable for only qualitative studies as it was possible to identify only large prey such as fishes, smaller organisms such as insects being neglected. Hartley (1948) discusses the different methods used in the analysis of the food of birds, and notes the relative value of each method. In the present work a qualitative, rather than a quantitative, approach was used.

All the birds examined, except for one Great Black-backed Gull, were obtained on three islands (Gull, Green, and Great) that lie approximately 19 miles south of St. John's, Newfoundland. The lone Great Black-backed Gull was obtained from Marystown on the Burin Peninsula, Newfoundland. Pellets that were analysed were picked up on the above islands.

RESULTS AND DISCUSSION

The most commonly found foodstuff in the Herring Gull stomachs was vegetation and fibrous plant material, followed closely by fish. In the case of the Great Black-backed Gulls and Black-legged Kittiwakes fish was the most commonly found food item. Table 1 shows the relative percentage of stomachs containing the various food items found in the study (Ratio of the number of occurences of a particular item to the total number of food items found, expressed as a percentage).

Due to the short sampling season it is not possible to state with any certainty that seasonal variations exist in the diet of these three species of gulls. However, it was noted that Blue Mussels (*Mytilus edule*) were eaten in greatest quantity, by Herring Gulls, during May and June, before caplin (*Mallotus villosus*) were available as a food source. Caplin were then eaten through most of the summer, as was fish offal. Independent fledgling gulls were seen to eat large quantities of mussels during the late summer and fall. It is of interest to note that although many of the adult Herring Gulls were living on caplin and fish offal many of the chicks of these birds were fed mussels. The nests of some gulls were surrounded by pellets composed entirely of mussel shells or fish bones which would suggest that some of the birds have definite food preferences. The mussel shells found were from 7 to 23 mm in length.

In May 1967, 165 pellets composed entirely of small pieces of Green Sea Urchins (*Strongylocentrotus drobachiensis*) were found on Gull Island, and in one case two whole sea urchins (3.7 cm and 3.6 cm in diameter) were recovered from the crop of an adult Herring Gull. Few sea urchins were eaten during the summer months (June-August), when other food was readily available. Many pellets were found that were composed of a mixture of mussel shell fragments and pieces of sea urchin shells. The Great Black-backed Gulls and Kittiwakes ate less molluscs than the Herring Gulls and only in the stomachs of chicks of the latter species were land molluscs (slugs and snails) found in any numbers. The Kittiwakes ate more marine crustaceans than either of the other two species.

The lack of annelids and other materials associated with agricultural practices in the diet of the Herring Gull is quite noticeable, this probably being due to the fact that few agricultural activities are performed in the area of the study. Harris (1965) found that 64 per cent of Herring Gulls from Anglesey, and 53 per cent from Skomer Island, West Wales had food in their stomachs that had been collected from arable land. Threlfall (1965) found that food materials from arable land and garbage dumps formed the bulk of the diet of birds obtained in Northern Caernarvonshire and Anglesey.

Over 450 pellets composed entirely of bones and feathers of Leach's Petrels (*Oceanodroma leucorhoa*) were found on Gull and Great Islands, particularly the latter. It would appear that large numbers of this species of bird are killed each year by Herring and Great Black-backed Gulls on the islands in question, 1,000 deaths per year probably being an extremely conservative estimate. Buxton and Lockley (1950), Davis (1958), Mylne (1960) and Harris (1965) showed that large numbers of Manx Shearwaters (*Procellaria puffinus*) and Common Puffins (*Fratercula arctica*) are killed each year on Skomer Island, West Wales, by Great Black-backed gulls.

Pellets composed almost entirely of murre egg shells were seen in large numbers on Green Island, where there is a breeding population of at least 50,000 pairs of Common Murres (*Uria aalge aalge*) (Tuck, 1960). These pellets were seen only in June and July, and no such pellets were found on Gull and Great Islands. One adult Kittiwake was found to have murre egg shells and membranes in its stomach. Krasovski (1937) and Uspenski (1956) noted that Kittiwakes, in Novaya Zemlya, frequently feed on murre nesting ledges, picking up egg shells and membranes, as well as fishes that have not been eaten by the murre chicks. This type of food may be important in the diet of the Kittiwake.

Berries and seeds were generally eaten in late summer and early fall, when juvenal Herring Gulls wander away from their nest and hide in areas where berries and seeds are found and where they may readily be picked up.

Direct observations on the three species of gulls revealed that the Herring Gulls and Kittiwakes would gather near the wharves in the outports, particularly in the vicinity of the splitting tables where they could pick up fish offal. Herring Gulls generally picked up dead caplin along the shore or caught them when they were in shallow water, while the Kittiwakes hovered for a second over the shoals of caplin in deeper water, before momentarily plunging partly below the water surface to catch live caplin with a sharp downward movement of the head. Sand Launces (*Ammodytes americanus*) were caught in a similar way.

On several occasions Herring Gull chicks were found that had extensive head lacerations and in one instance, late in the breeding season, adult Herring Gulls were seen to attack a chick, laying the creature's skull bare and fracturing it with repeated blows with their beaks.

Great Black-backed Gulls were seen eating salmon (*Salmo salar*) that had been caught in gill nets and which lay just below the water surface on several occasions. Gill netting for salmon and cod (*Gadus morrhua*), as well as the use of codtraps, is practiced around the bird islands every year, many murres perishing in the nets (Tuck, 1960). Great Black-backed Gulls were often seen eating murres that had become entangled in the nets and had drowned. One Great Black-backed Gull regurgitated two almost fully fledged Common Puffiin chicks when it was shot, while another had a Tomcod (*Microgadus tomcod*) over ten inches in length in its proventriculus and oesophagus.

The miscellaneous category in Table 1 includes a wide variety of objects, from chicken and seal bones to sanitary napkins, which seem to be a common item in the Herring Gulls diet. Other items found and included in this category may be seen listed in the appendix, which also lists other food items that were identified.

TABLE 1.—Showing the relative percentage of food items recovered from the stomachs of *Larus argentatus*, *Larus marinus*, and *Rissa tridactyla*

Food Items	*Larus argentatus*	*Larus marinus*	*Rissa tridactyla*
Seeds/Berries	3.24	3.77	00.00
Vegetation	32.64	20.75	14.29
Annelids	0.23	1.89	00.00
Arthropods			
(i) Insects	7.41	1.89	00.00
(ii) Crustacea	0.11	00.00	1.79
Molluscs	9.84	3.77	4.46
Echinoderms	0.58	1.89	0.89
Fish	22.80	33.96	41.08
Birds			
(i) Pieces	3.36	5.66	00.00
(ii) Eggs	0.93	00.00	0.89
Miscellaneous	14.00	16.98	25.89
Empty	4.86	9.44	10.71

It is of interest to note that the Herring Gulls have a diet that is mainly land and littoral in nature, while the Kittiwakes have an almost completely marine diet. The Great Black-backed Gull are intermediate, with regard to diet, between the other two species.

It would appear that the species of birds examined are of no economic importance to man in Newfoundland with regard to damage they may do to agriculture or fishing, probably due to the fact that Newfoundland has a tremendously rich marine fauna (particularly fishes) which is well able to supply the food needs of the birds.

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APPENDIX

A list of food items previously recovered from Herring Gulls was compiled by Harris (1965). The following list records some of the food items found during the analysis of Herring Gull stomach contents and pellets.

ANIMALS

ANNELIDA

Oligochaeta: — *Allolobophora sp.; Eisenia foetida.*

ARTHROPODA

Crustacea: — *Gamarellus angulosus; Cancer sp.; Hyas araneus.*

Isopoda: — *Oniscus sp..*

Insecta: — *Coleoptera,* many small pieces of both adults and larvae, including Elaterids, Curculionids, Staphylinids, and Coccinellids.
Diptera, Tipulids (adults, larvae and eggs); Cyclorrhaphans, blow-fly maggots, and rat-tailed maggots.
Hymenoptera, Campanotus herculeanus; Ichneumon wasps.

MOLLUSCA

Gasteropoda: — *Thais lapillus; Littorina littorea;*

Pelecypoda: — *Mytilus edule; Cyrotodaria siliqua; Mya arenaria; Arctica islandica.*

Cephalopoda: — *Illex illecebrosus.*

ECHINODERMATA

Asteroidea: — *Asterias rubens.*

Echinoidea: — *Strongylocentrotus drobachiensis.*

CHORDATA

Actinopterygii: — *Clupea harengus; Microgadus tomcod; Gadus morrhua; Mallotus villosus; Ammodytes americanus.*

Amphibia: — *Rana clamitans.*

Aves: — Eggs and young, *Uria aalge; Larus argentatus.* Adults, *Oceanodroma leucorhoa.*

Mammalia: — Bones of *Lepus americanus,* and *Phoca sp..*

PLANTS

RHODOPHYTA

Lithothamnium sp.

GYMNOSPERMAE

Picea mariana.

ANGIOSPERMAE

Several species of grasses; *Cerastium sp.; Stellaria media; Vaccinium angustifolium.*

MISCELLANEOUS

Chicken heads and feet; silver paper; remains of household foods; polythene bags; pieces of coal; sanitary napkins; paper wrappings from around food; string and pieces of nylon rope; plastic toys; grit and stones (aid in digestion).

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OBSERVATIONS ON THE HYBRID CORD-GRASS, *SPARTINA* × *CAESPITOSA* IN THE MARITIME PROVINCES

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THE RARE CORD-GRASS, *Spartina caespitosa*, was originally described by A. A. Eaton in 1898 from the coast of New Hampshire. Later it was considered to be a hybrid between two ubiquitous species, *S. pectinata* and *S. patens*, and the hybrid symbol (×) was inserted in its name.

In 1953, David Erskine (1960) collected this hybrid for the first time in Canada, at Charlottetown, P.E.I. In August 1967 we made it a point to inspect the plant at the same site and to look for it at other places in the Maritime Provinces.

At Charlottetown, the plants of *S.* × *caespitosa* were readily located in a band of wasteland at the railway station, between the tracks and the harbour wall along Hillsborough Bay. During high tides and storms a certain amount of sea water laps over the wall and floods the area temporarily, maintaining a saline habitat. Repeated disturbance of the soil by ditching, grading up the tracks, and building the shore dyke, however, has disrupted the natural zonation of the marsh species and opened the habitat for more ready establishment of seedlings. Consequently, there has been much better opportunity for hybrid progeny to develop in this particular site than elsewhere along the coasts where the marshes are stabilized.

The chart (Fig. 3) shows the disposition of the hybrid plants relative to the other vegetal units. In all, 81 plants were found. In the field, the hybrids could be spotted quite easily by their tufted habit and dense upright growth of stems and leaves intermediate in size between the two reputed parents. *Spartina patens*, one of the parents, produces expansive, low and almost pure mats of foliage due to its prostrate stems, slender culms, and intricate mass of deep-penetrating, thin, white rhizomes; *S. pectinata* forms tall, rather loose stands composed of coarse flowering stems which arise from the tips of a few, very hard, stout and brown-scaly rhizomes, essentially superficial. The hybrid plants, although described fairly as 'caespitose', also produce rhizomes, but these are very short and congested, only about an inch long and much shorter than in either species, and usually of a bright red color.

In other morphological features, size and number of spikes and spikelets, size of leaves, etc., the hybrids were intermediate and would conform with the detailed findings of Mobberley (1956) who analysed populations occurring along the coast of the mid-Atlantic States. The numerous hybrid clumps at the Charlottetown site, however, showed considerable diversity indicating individual inheritance, and some could be picked out as resembling more one parent than the other. Frequently they were congregated more around the

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FIGURE 1. General view across the marsh at the Charlottetown site. (Camera position indicated in chart).

FIGURE 2. A clump of *Spartina* × *caespitosa*. The tall plants in the background are *S. pectinata*; the low plants in the foreground are *S. patens*.

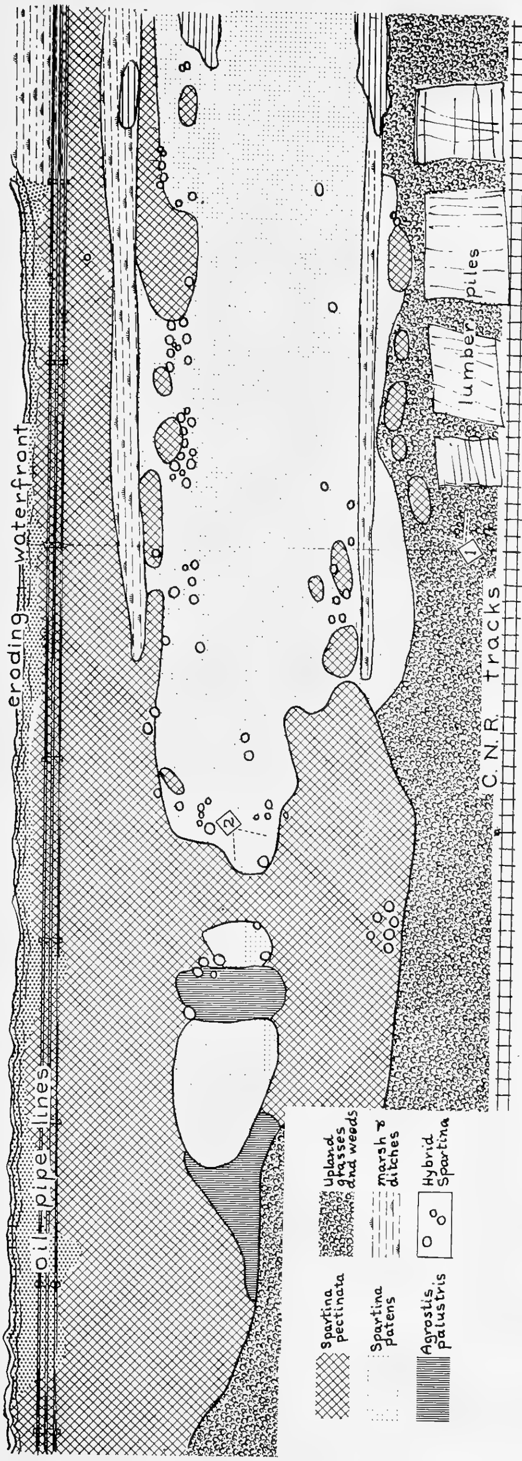

FIGURE 3. Chart of the *Spartina* population at the Charlottetown railway yards, 15 August, 1967.

S. pectinata clones which suggested that it was the female parent and produced the seeds.

At Lower Onslow, Colchester County, N.S., plants of *S.* × *caespitosa* were scattered here and there among a mixed population of *S. patens* and *S. pectinata* which occupied a high marsh area along the bank of Chiganois River near its entrance to Minas Basin. The disturbance resulting from aboideau construction a few years earlier had left the marsh soil greatly mixed and in some places completely free of vegetation. The occasional flood-tide had washed debris and surface soil around and left loose deposits in which young seedlings could establish. Both *S. pectinata* and *S. patens* were re-colonizing from sod fragments and seedlings. The largest clump of the hybrid *S.* × *caespitosa* at this site was 18 inches across and would probably represent about 10 year's growth.

At Sackville, New Brunswick, a porion of Tantramar Marsh was disturbed a few years ago by the construction of a new highway bridge over Tantramar River. On this disturbed soil five small clumps of *S.* × *caespitosa* were found to be already established.

Many other natural stands of *Spartina* were surveyed along the maritime shores during the summer but at no other site was the establishment of hybrids detected. It is expected that the study of the meiotic material obtained at the above sites will clarify the hybrid status of the caespitose cord-grass.

General observations: (1) The hybrid, *Spartina* × *caespitosa*, occurs only where *S. patens* and *S. pectinata* grow in close proximity. (2) The establishment of hybrid seedlings is favoured by a disturbed condition of the soil. (3) The hybrids arise locally, grow slowly, and being non-aggressive, show no indication of becoming widely distributed geographically in contrast to the wellknown amphidiploid *Spartina* × *townsendii* of Europe.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. VII. *B. PAPYRIFERA* AND *B. RESINIFERA* FROM NORTHWESTERN CANADA

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The following paper records cytological and morphological observations on collections of white birch, *Betula papyrifera* Marsh., and the Alaska birch, *B. resinifera* Britt., from 1) the northern prairies, 2) the Mackenzie River Basin and 3) the Yukon Territory, together with observations on the seedlings grown from these specimens which are now established in the Morgan Arboretum at Macdonald College. This living collection supplies the basic material for studies on juvenile characters, inter- and intra-specific variation, and growth and development which are now underway.

Materials and Methods

The collections were made during the late summer and autumn of 1961, 1962 and 1963 by the senior author. The 1961 collecting trip began at Jasper and proceeded westward along the Edmonton Highway to Piers Junction, then northward passing through Whitecourt and Valleyview, eastward along the southern border of the Lesser Slave Lake and then southward to Westlock. At Westlock a side trip was made to the Swan Hills. From Westlock the route continued southward through Edmonton and ended at Lacombe.

The 1962 Saskatchewan field trip started at Kamsack near the western Manitoba border, proceeded through Hudson Bay Junction and along the Otosquen Road to Carrot River. Returning to Hudson Bay Junction the route continued westward to Peesan, north to Nipawin, through Prince Albert and ended at Lac La Rouge. These collections have been supplemented by additional ones made on our behalf by officers of the Canada Department of Forestry mainly from the neighbourhood of the northern lakes lying between the settled area of Saskatchewan and Manitoba and the Northwest Territories.

Collections in the Mackenzie River area and the Yukon were carried out in 1963. The Mackenzie River collection includes specimens from Wood Buffalo Park, situated within Alberta just south of the territorial border, from Hay River, Yellowknife, and the environs of the Great Slave Lake. In addition, collections were made at various points on the Mackenzie River and on its tributaries, the Liard and Peel rivers, and were continued down to Reindeer Station on the delta. In the Yukon, collecting began at Whitehorse and proceeded along the highway to Dawson and its environs. From Dawson the route continued to Toc Junction in Alaska, then south along the Alaska Highway to Haines Junction, Yukon, then westward to Haines City, Alaska, and back to Whitehorse.

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In general, the nomenclature and interpretation provided by Dugle (1966) in her biosystematic study of the birches of this general region have been followed. The morphological and cytological techniques used in our study have been given previously (Brittain and Grant, 1965). All stomatal guard cell measurements were made on herbarium specimens from mature trees.

OBSERVATIONS

Excluding dwarf birches, the birch flora of the entire vast area covered by this study consisted mainly of *B. papyrifera* and *B. resinifera* (Figs. 1-6). The former species diminished in frequency as one proceeded northward, whereas the latter increased in frequency. Along the length of the Mackenzie River *B. papyrifera* was encountered only twice. Although a longer search would undoubtedly have uncovered additional trees, it seems clear that the characteristic species of this particular area is *B. resinifera*. However, in the Yukon, open as it is to intrusions from the west, *B. kenaica* Evans makes its appearance, as will be discussed later.

As in eastern Canada, B. *papyrifera* displayed considerable variation in minor characters, though the occurrence of resinous glands on the branchlets of mature specimens and still more often on seedlings, was observed more frequently on northwestern specimens. The dense pubescence of the stems and undersides of the leaves which characterize young seedlings of *B. papyrifera* was similar to that found in young seedlings grown from eastern collections of this species. In mature specimens, the pubescence on the leaves is reduced to mere patches located at the base of the leaves and in the axils of the larger veins.

The somatic chromosome number of 84 was predominant in the seedlings of the northwestern *B. papyrifera* (Table 1) in contrast to eastern populations where the somatic chromosome numbers of 70 and 56 were represented in higher frequencies. In fact, the herbarium specimen for each of the *B. papyrifera* accessions in these northwestern collections, in which seedlings from the accession had a somatic chromosome number of 56, possess characteristics of *B. resinifera* and are apparently hybrids between these two species (Table 1).

The presence of resiniferous glands in *B. resinifera*, which has been widely cited as characteristic of the species, could not be detected in many of our specimens, especially those from the prairie provinces and, to a lesser extent, from the Yukon. In comparison, the seedlings were invariably strongly resiniferous. The leaves, in general, are triangular or trullate but, more rarely, a portion of them may be rounded or even cordate at the base. In contrast to *B. papyrifera*, the leaves are glabrous, or nearly so, on the underside. Some individuals of *B. resinifera*, but by no means all, possess drooping branches producing a definite "weeping" effect, but from our pressed specimens, no significant morphological differences could be detected between these individuals and the upright ones.

A reliable distinguishing character between *B. resinifera* and *B. papyrifera* is that of the achene. In the case of *B. resinifera*, the achene is almost glabrous

TABLE 1. — Northern prairie birches. *Betula resinifera* except as noted.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seedling height (cm)	Remarks
47	McLeod River Bridge, Alberta	84	37.88	105	*B. papyrifera*, but resembling *B. resinifera* in form of leaves and resinous stem of seedling.
43	3 mi. north of Piers Junction, Alta.	28	28.50		Bark greyish-white; lateral lobes of bract strongly recurved as in Nos. 47 and 112.
46	10 miles west of Whitecourt, Alta.		28.97		Trees with drooping branches, greyish bark, 16 cm. diameter at breast height (d.b.h.).
57	3 mi west of Piers Junction, Alta.	28[2]			Bark pinkish in color, very thin and papery. Branchlets slightly glandular.
100	7 miles north of Whitecourt, Alta.	28		82	Tree form as in No. 46, rather close bark, 23 cm. d.b.h.
101	Fox Creek, Alta.	56	38.81	76	*B.* × *winteri*. White, pinkish bark freely exfoliating. Samara and bract largest of series. 44 cm. d.b.h.
102	At highway junctions 34-36 near Valleyview, Alta.	28[2]	28.10	76	Bark thin, papery.
103	High Prairie, Alta.	28	28.31	76	Bark thin, papery and pinkish. Altitude 610 m. 25 cm. d.b.h.
104	Joussard, Alta.	84		100	*B. papyrifera*. Branchlets slightly glandular. Bark dull bronzy. 5 cm. d.b.h.
105	6 miles east of Kinuso, Alta.	28	29.06	95	Bark dull white; 4 cm. d.b.h.
106	Near Slave Lake, Alta.	84		84	*B. papyrifera*. Bark white, rather thick. 42 cm. d.b.h.
107	Remples Road, 10 miles north of highway No. 2, Alta.	28[3]	28.13	95	Leaves very thin and papery; bark thicker than average, 28 cm. d.b.h.
108	Swan Hills, Alta.	28			Young twigs glandular. Altitude 991 m. Bark grey to brownish. 18 cm. d.b.h.
109	9 miles east of Swan Hills, Alta.	28			Bark as in No. 108. Young shoots glandular. 17 cm. d.b.h.
110	Swan Hills, Alta.	28[3]	26.33		Similar to No. 109.
111	Swan Hills, Alta.	28		120	Bark creamy white, exfoliating. 8 cm. d.b.h.
169	Swan Hills, Alta.	70			*B. papyrifera*.
112	Smith, Alta.	28	26.44		Bark white to gray; twigs smooth.
113	10 miles south of Fawcett, Alta.	28[2]	25.31	56	Branches drooping, pinkish bark, young twigs glandular 23 cm. d.b.h.
114	Legal, Alta.	28	30.34	100	Bark white.
219	Gull Lake, near Lacombe, Alta.		34.13	62	50 yr. old tree; achene wider than average.

TABLE 1. — (*Continued*)

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seedling height (cm)	Remarks
327	Gull Lake, near Lacombe, Alta.	28	30.38	68	Achene more hispidulous than average.
324	Edmonton, Alta.		28.97		Achene broader than average.
326	Edmonton, Alta.		35.44	88	Leaves large and coarser than average.
200	Porcupine Hills, Saskatchewan	28		97	
201	Peepaw Lake, Sask.	28[2]		77	
202	Route 9, Sask.	28[3]	37.31	77	
203	Pasquia Hills, Sask.	84[2]	41.53	57	*B. papyrifera.*
204	Hudson Bay Junction, Sask.	56	31.45	46	*B.* × *winteri.*
205	11 miles west of Veillardville, Sask.			56	*B. papyrifera.*
206	5 miles north of Veillardville, Sask.	28	25.69		
207	6.5 miles east of Prairie River, Sask.	28	40.41	25	
208	2 miles west of Peesan, Sask.	28[3]	33.44	58	
210	Otosquen Road, Sask.	56:70[4]	39.84	51	*B.* × *winteri.*
211	White Fox, Sask.	70:84[5]	40.41	64	*B. papyrifera.* One seedling slightly glandular.
212	Emma Lake, Sask.		40.78		
213	Waskesieu, Sask.	28	32.72	70	Branchlets smooth.
214	At mile 32, Lac La Ronge Rd., Saskatchewan.		30.09	67	Branchlets smooth.
215	At mile 62, Lac La Ronge Rd., Saskatchewan.	28		27	Very long bract.
216	Lac La Ronge shore, Saskatchewan.		31.41		
217	At mile 89, Lac La Ronge Rd., Sask.		29.16		
218	Prince Albert, Sask.		31.13		
244	Amisk Lake, Sask.	28	29.81		
376	Ena Lake, Sask.	28	36.66		
377	Cree Lake, Sask.	28	37.31		
378	Stone Rapids, Sask.	28	36.23		
379	Birch Point, Reindeer Lake, Sask.	28	31.73		
380	Wapawekka Lake, Sask.	28	32.80		
381	Nevins Lake, Sask.	28	38.19		
242	2 miles north of Root Lake, Manitoba	84	40.78		*B. papyrifera.*
243	4 miles north of Root Lake, Manitoba	56	29.06		*B.* × *winteri.*
245	6 miles south of Flin Flon, Manitoba.	28	30.09		
246	Simonhouse Lake, Man.		44.58		*B. papyrifera.* Glandular stem, but young seedling pubescent.

TABLE 1. — (*Continued*)

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seedling height (cm)	Remarks
283	Chocolate Lake, Man.	84			*B. papyrifera.*
335	Burntwood, Man.		24.75		
337	God's Lake, Man.	28			
370	Burntwood River, Man.	28	31.31		
371	Eganolf Lake, Man.	56	44.40		*B.* × *winteri.*
372	God's Lake, Man.	84			*B. papyrifera.*
374	Granville Lake, Man.	28	33.66		
375	Tadoule Lake, Man.	84	48.75		*B. papyrifera.*

[1]Average of 20 measurements.
[2]Determination from two seedlings.
[3]Determination from three seedlings.
[4]Two seedlings with different chromosome numbers.
[5]Four seedlings examined; three with 70.

except for a few hairs at the tip, whereas in *B. papyrifera*, the achene is densely hispidulous on the upper half. An even more striking contrast may be found in the length-width ratio of the achene: characteristically 2:1 in *B. resinifera*, and up to 1:1 in *B. papyrifera*. On the other hand, the general shape of the bract is no help in identification since it varies widely in form, especially in *B. papyrifera*.

A less reliable character but still a useful one in separating *B. resinifera* from *B. papyrifera* is the comparative length of the stomatal guard cells (Tables 1, 2, 3). Although overlapping of measurements occurs in approximately one-tenth of the specimens, the averages for *B. papyrifera* ($2n = 84$) and *B. resinifera* ($2n = 28$) are 43.53 μ and 32.01 μ, respectively. Measurements for the guard cells of the hybrids ($2n = 56$) overlapped with both *B. papyrifera* and *B. resinifera* but averaged 35.66 μ.

There is a definite difference in growth rate in our nursery between seedlings of *B. resinifera* from the far north, from such places as Fort Macpherson and Aklavik, as compared with those from the southern range. The far northern plants do not produce any, or very little, linear growth during their first year but form a rosette of leaves close to the ground. In contrast, plants grown from seed from the prairie region show little difference in growth rate from those of *B. papyrifera* from the same area. It has been noted, however, that growth actually starts first with the arctic plants and this has been the case for the three years during which these individuals have been under observation.

We have observed that environmental conditions of temperature and light have a considerable influence on the growth of birch seedlings and birch seedlings might be useful material for investigating such interactions. For example, *B. resinifera* flourished at a lower temperature than that found to be

TABLE 2. — The MacKenzie river area birches. *Betula resinifera* except as noted.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seed-ling height (cm)	Remarks
294	Pine Lake, Alberta	70	46.59		*B. papyrifera*. Leaves coriaceous, some shoots slightly glandular.
295	Fort Fitzgerald, Alta.	28	31.78	48	Leaves varying from trullate to suborbicular, abruptly narrowing at tip.
296	Hay Camp, Alta.	28	32.63		Stem warty.
220	Fort Smith, Northwest Territories	84[2]	44.72		*B. papyrifera*. Leaves pubescent beneath, to 6-2 cm. long and 3 cm. wide. Serrations 24-29, 7 veins, singly-doubly serrate, tip long-acuminate.
254	Yellowknife, N.W.T.	28	32.98		Stem warty, minor differences, resembles Nos. 255 and 273 from same area and also with $2n = 28$.
247	Hay River Settlement, N.W.T.	28	34.82		Very warty stem.
248	Hay River Settlement, N.W.T.	28			Very warty stem.
331	Fort Simpson, N.W.T.	28	30.38	33	
332	Fort Simpson, N.W.T.	28			
343	Fort Liard, N.W.T.	28	30.28		Large leaves to 5.5 cm. long and 4.5 cm. wide.
298	Norman Wells, N.W.T.	28	32.00		
298A	Norman Wells, N.W.T.	28	32.16		
382	Norman Wells, N.W.T.	28[2]			
383	Head of Sans Sault Rapids, N.W.T.	84[2]	46.88		*B. papyrifera*.
410	Fort Good Hope, N.W.T.	28[2]			Seed only.
384	Travaillant River, N.W.T.	28[2]			
385	Fort Norman, N.W.T.	28[2]	37.88		Height 18 m., 3.5 cm. diameter at breast height (d.b.h.).
301	Fort MacPherson, N.W.T.	28[2]	40.13		Slowest growing seedlings from this area including 301A.
301A	Fort MacPherson, N.W.T.	28			As above.
299	Inuvik, N.W.T.	28	32.25		
299A	Inuvik, N.W.T.	28			
300	Inuvik, N.W.T.				
386	Inuvik, N.W.T.	28[2]			
411	Inuvik, N.W.T.	28			
616	Inuvik, N.W.T.				
617	Inuvik, N.W.T.				

TABLE 2. — (*Continued*)

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seed-ling height (cm)	Remarks
302	Aklavik, N.W.T.	84[2]	32.72		Hybrid, see text. Stem warty, with wing proportionately narrower and achene wider than average of *B. resinifera* specimens.
302A	Aklavik, N.W.T.	28			Seed from same site as No. 302; seed and seedlings characteristic of *B. resinifera*.
344	Reindeer Depot, N.W.T.	28[2]			Seed only obtained; seedlings characteristic of *B. resinifera*.

[1]Average of 20 measurements.
[2]Determination from two seedlings.

ideal for *B. papyrifera.* Again, seed of *B. resinifera* from the northern areas when placed under continuous artificial light responded promptly and growth was greatly accelerated. However, in the case of those which originated from the very farthest north, that is, Aklavik and Fort Macpherson, while growth was accelerated it was definitely less so in these individuals.

DISCUSSION

The Prairie Provinces

The collections of *B. papyrifera* and *B. resinifera* from the central and northern portions of the three midwestern provinces show the two species thoroughly intermixed with occasional hybrids between them. The proportion of *B. resinifera* increases towards the north, but individuals of *B. papyrifera* were, nevertheless, well in evidence up to the northern limit of the area in which the collections were made. Individuals from the different accessions of this area are now well established in the arboretum.

Dugle (1966) has named hybrids between these two species as *B.* $\times$ *winteri.* She has determined the somatic chromosome numbers of different hybrid plants as 28-84, whereas those specimens which we have considered to be hybrids all have a chromosome number of $2n = 56$ for this area. Specimens of our accession number 101 are typical of the description given for *B.* $\times$ *winteri* by Dugle (1966).

The Mackenzie River Area

For convenience this region is taken to include Wood Buffalo Park situated just south of the territorial boundary. In this transition zone both species were still noted in considerable numbers and, although no hybrids were actually collected, a number of non-fruiting trees having intermediate characters were observed. Within the territory itself, *B. papyrifera* was encountered

TABLE 3. — Yukon Territory birches. *Betula resinifera* except as noted.

Acc. no.	Locality	Somatic chromosome number	Stomatal size (μ)[1]	Seed-ling height (cm)	Remarks
167	Mile 1019, Alaska Highway	28[3]	31.22	8.4	Age 63 years; branches very warty; bark white exfoliating, 17 cm. diameter at breast height (d.b.h.).
303	Dawson City	28[2]	31.50	42	Branchlets glabrous; dark brown bark, 18 cm. d.b.h.
304	Dawson City	28[2]	31.31	40	Pendulous branches; leaves glabrous, branchlets non-glandular; petiole pubescent.
305	Dawson City	28[2]	31.97	50	Height 12 m., stem warty, pinkish bark, 20 cm. d.b.h.
306	Dome Mountain, near Dawson	28		35	Height 12m., brown bark, 10 cm. d.b.h.
307	Bonanza Creek	84[3]	43.13	100	*B. kenaica*. Leaf almost as broad as long, lacking long acuminate tip. Stem glabrous; seedling stem and underside of leaves densely pubescent.
307A	Bonanza Creek	28[2]	30.30	52	*B. resinifera*. Same site as No. 307.
307B	Bonanza Creek	28	30.28		As above.
629	Sunrise		27.30		
308	Carmacks	28:42[4]	30.30	48	Hybrid. Leaves resemble No. 307, with sparse marginal fringe of long colorless hairs which are well developed in seedlings (see text).
309	Crooked Creek	28	33.94	28	Stem glabrous, non-glandular. Leaves with long acuminate tips.
311	Dawson Highway	28	29.02		Branchlets glabrous. No seedlings.
312	Klondike River	28[2]	37.13	30	Height 12 m., pendulous branches; leaf long acuminate.
316	Mile 1298, Alaska Highway	28		48	
388	Dawson City	28	33.13		Branchlets non-glandular, glabrous.
389	Dawson City	28[3]	33.31		Similar to No. 388.
390	Dawson City	28	33.38		Similar to No. 388.

[1]Average of 20 measurements.
[2]Determination from two seedlings.
[3]Determination from three seedlings.
[4]Two seedlings with different chromosome numbers.

only twice. The first was at Fort Smith (Acc. No. 220) and the specimens from this tree are typical *B. papyrifera* judging from its adult characters. The seedlings grown from this tree, however, are thickly beset with resinous glands, although a somatic chromosome number of 84 has been determined for them. The other specimen was from the Sans Sault Rapids (Acc. No. 383) between Norman Wells and Port Good Hope at 65° 40′ north latitude and 120° 60′ west longitude. In contrast to the foregoing collection, the stems of these seedlings are densely hispidulous and typical of *B. papyrifera.*

One specimen was tentatively classified as *B. resinifera* (Acc. No. 302) since it superficially resembled that species. This plant was found growing on a very damp, mossy site on Eonoch Lake near Aklavik. It was one of a group of spindly trees with a height of six to seven meters and was the only catkin bearing tree in the group. It appeared to represent an atypical specimen of *B. resinifera* growing on a poor site. On closer examination slight differences were noted; for example, the achene wing was narrower and the body relatively wider than the average for *B. resinifera* (302-b, Fig. 5). Somatic chromosome number determinations on seedling root tips for this accession were 84, and the seedlings themselves (S-302, Fig. 5) were different in form and appearance from the parent plant. Seed collected for us from the same site (Acc. No. 302A) the following year was typical of *B. resinifera* and seedlings were also typical of that species both in growth habits and in appearance.

Dr. Eric Hultén, who has kindly examined this material, states that in his opinion such specimens are "the result of introgression between *B. glandulosa* Michx. and *B. resinifera*" and "from Alaska-Yukon they have been described as *B. commixta* Sargent, *B. Eastwoodae* Sargent and *B. Beeniana* A. Nelson", each individual of the complex differing slightly from the next. This particular specimen (Acc. No. 302), however, has a somatic chromosome number of 84, whereas, *B. glandulosa* and *B. resinifera* both have $2n = 28$. Consequently, this tree (based on chromosome numbers of its progeny) has most likely been derived through hybridization with a species with 56 chromosomes. Hybridization might be expected with *B. glandulifera* (Reg.) Butler which has this somatic chromosome number, however, further studies are required to determine this relationship. Such specimens with high polyploidy, derived from species with lower ploidy, all of which have received various taxonomic recognitions, clearly illustrate the nomenclatural complexities involved in this group. A brief description of this specimen (Acc. No. 302) is as follows:

Habitat: Eonoch or Hudson Bay Lake, Aklavik, Northwest Territories, collected by W. H. Brittain, August 9, 1963. Parent tree 15.6 meters in height 3.5 cm. in diameter at breast high.

Foliage: Leaves angular-ovate, glabrous, singly-doubly serrate, yellowish green on fertile shoots to 3.3 cm. long and to 2.4 cm. wide. Petioles red in color. Serrations 9-18; up to 20 on nursery grown seedlings, which are dark green in color.

Twigs: very glandular.

Male ament: 2 in cluster in this specimen.

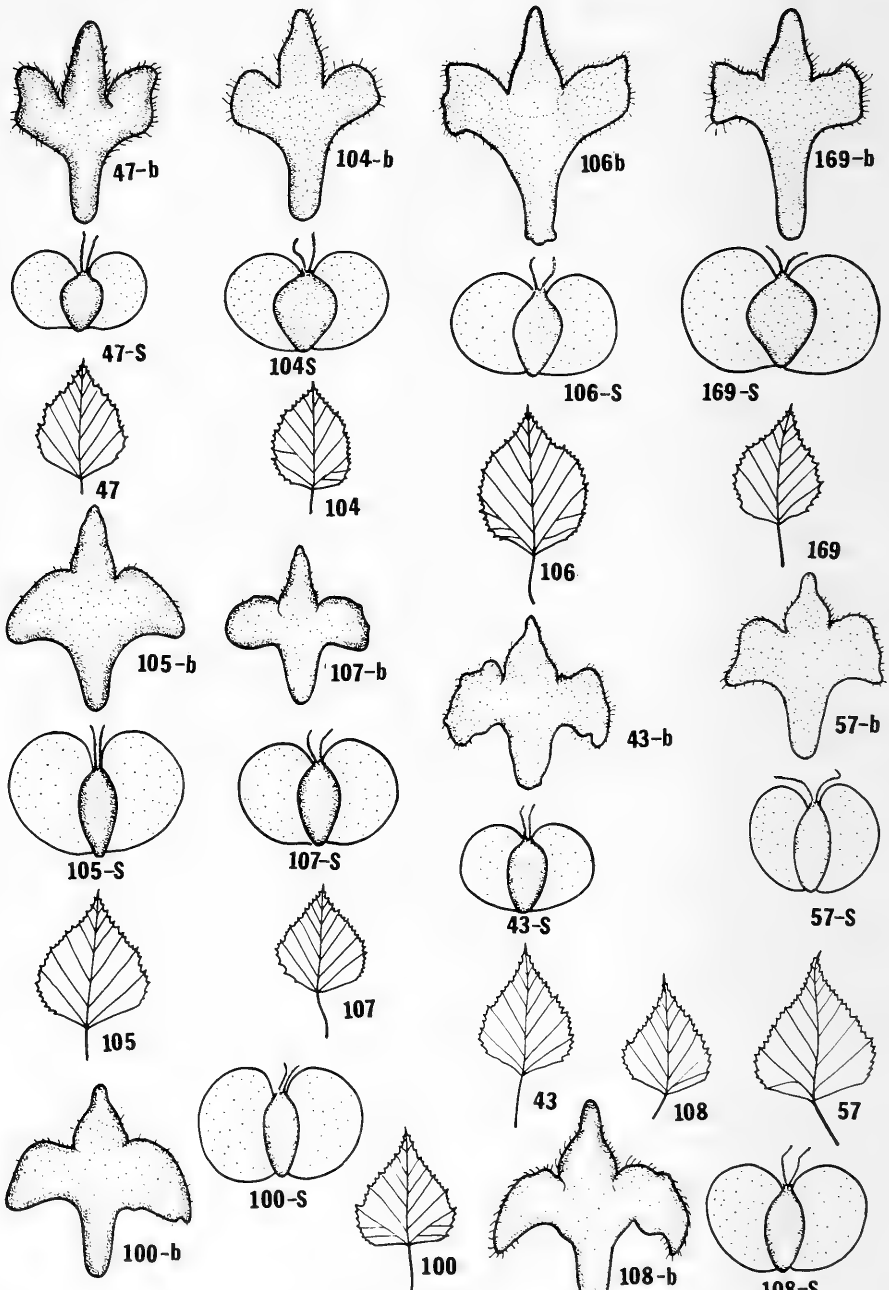

FIGURE 1. Bracts and samaras (× ca. 6) and leaves (reduced ca. $\frac{3}{5}$) of representative specimens from the Northern Prairies. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara. *Betula resinifera*, except Nos. 47, 104, 106 and 169, *B. papyrifera*.

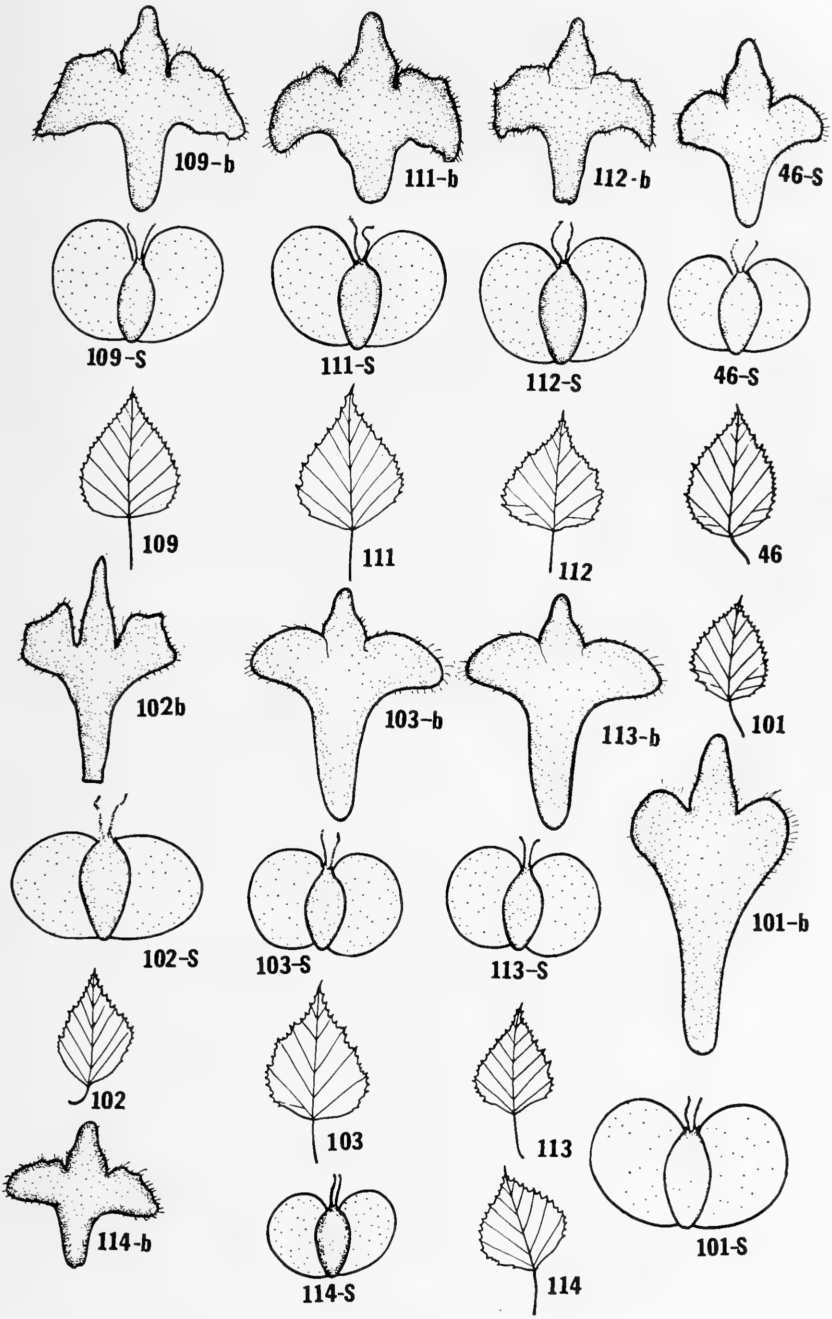

FIGURE 2. Bracts and samaras (× ca. 6) and leaves (reduced ca. ⅗) of representative specimens from the Northern Prairies. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara. *Betula resinifera*, except No. 101, *B.* × *winteri*.

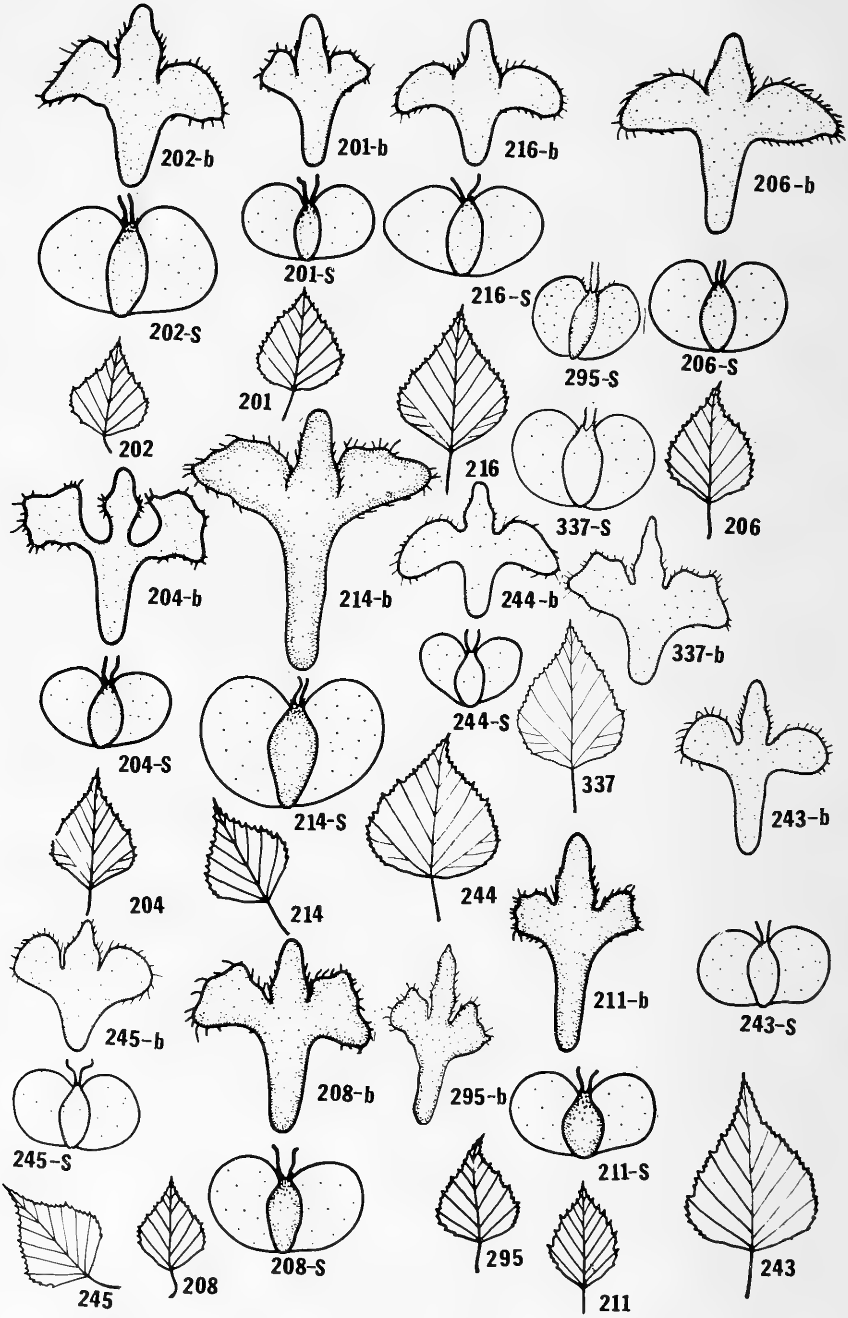

FIGURE 3. Bracts and samaras (× ca. 6) and leaves (reduced ca. $\frac{3}{5}$) of representative specimens from the Northern Prairies, except No. 295 from the MacKenzie River area. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara. *Betula resinifera*, except Nos. 204 and 243, *B.* × *winteri* and 211, *B. papyrifera*.

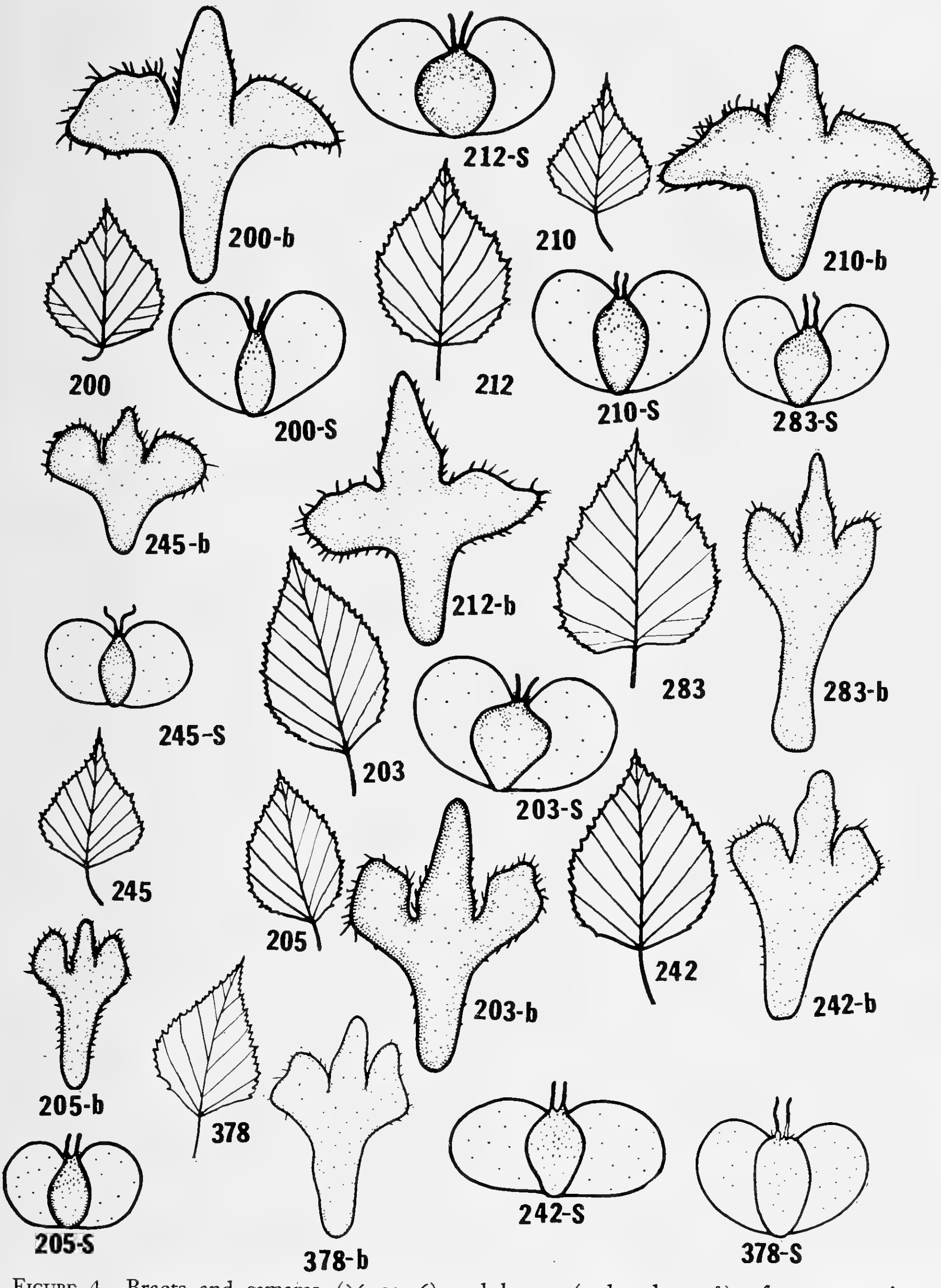

FIGURE 4. Bracts and samaras (× ca. 6) and leaves (reduced ca. ⅗) of representative specimens from the Northern Prairies. The numbers refer to accession numbers as given in Table 1. b = bract; S = samara. *Betula papyrifera,* except Nos. 200, 212, 245 and 378, *B. resinifera.*

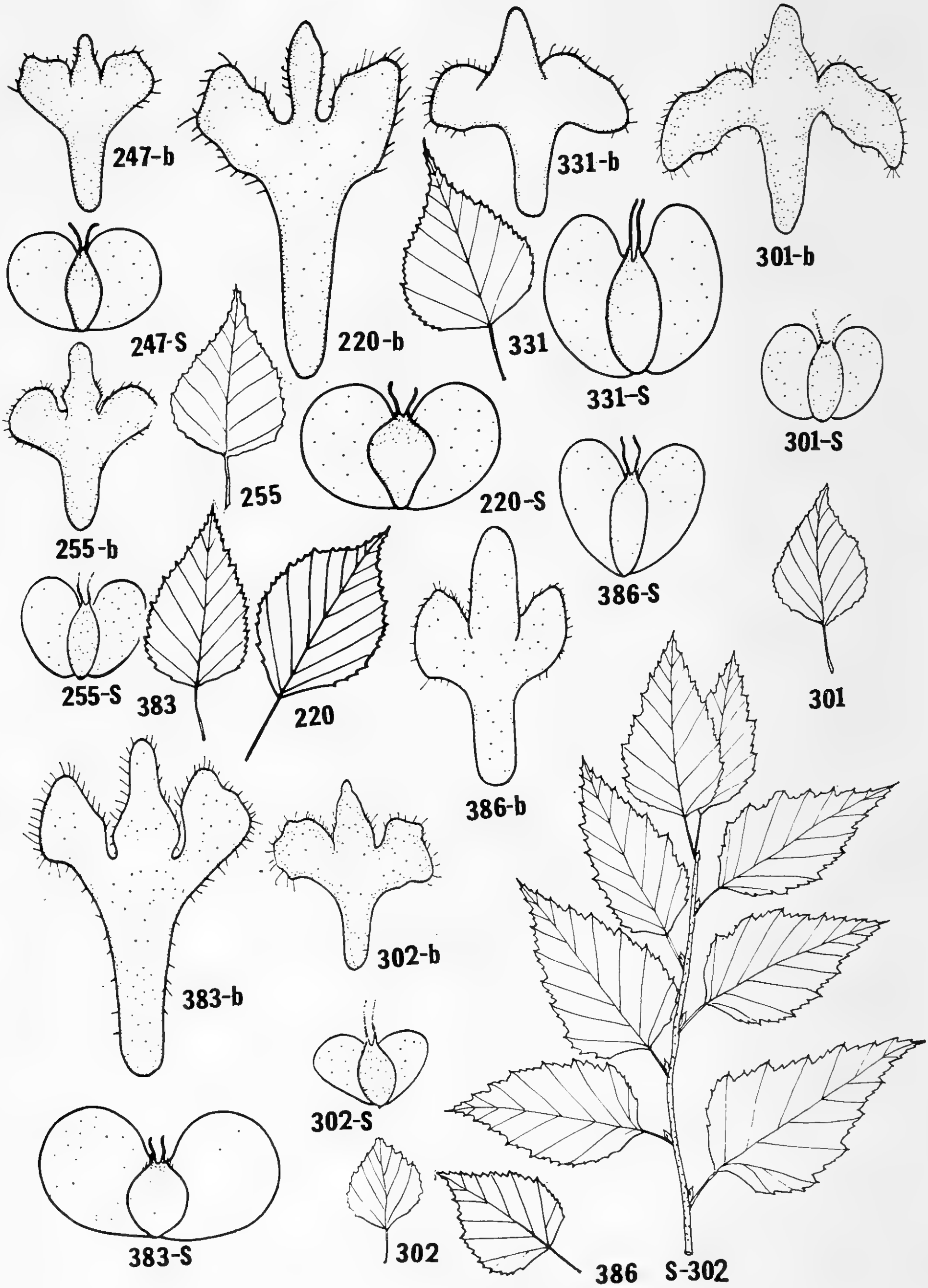

FIGURE 5. Bracts and samaras (× ca. 6) and leaves (reduced ca. ⅗) of representative specimens from the MacKenzie River area. S-302, seedling stem. The numbers refer to accession numbers as given in Table 2. b = bract; S = samara. *Betula resinifera,* except Nos. 220 and 383, *B. papyrifera* and No. 302, see text.

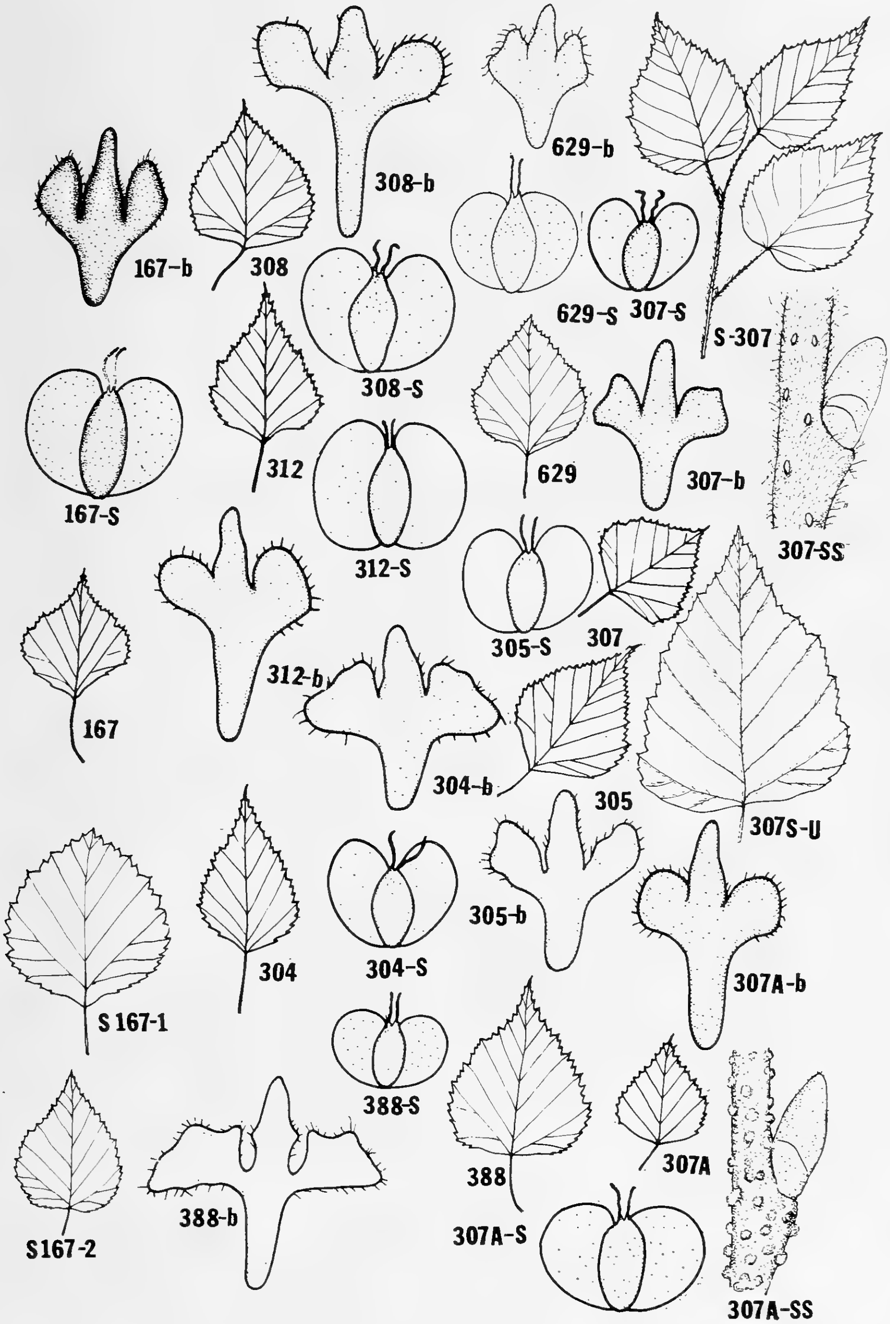

FIGURE 6. Bracts and samaras (× ca. 6) and leaves (reduced ca. ⅗) of representative specimens from the Yukon Territory. S-307, seedling stem; 307-SS, seedling stem showing lenticles; 307A-SS, seedling stem showing glands; 307-SU, seedling leaf, underside; S-167-1, and S-167-2, seedling leaves. The numbers refer to accession numbers as given in Table 3. b = bract; S = samara. *Betula resinifera*, except Nos. 307, *B. kenaica* and No. 308, hybrid, see text.

Female ament: 1.35-2.5 cm. long.

Samara: Achene and wing subequal in width; sparsely hispidulous on upper half: length 1.61-1.75 mm., width 1-2.5 mm., styles 1.25-1.4 mm.

Bark: Creamy white, exfoliating.

The Yukon Territory

Most of the individuals collected in this area were *B. resinifera* and exhibited a greater morphological variability than those from the Northwest Territories. Evidence of hybridization was noted in several collections and will be commented on briefly. The Yukon Territory is open to intrusions from the west as the Northwest Territories are from the south. As in the latter area, *B. glandulosa* Michx. is everywhere and *B. glandulifera* (Reg.) Butler is also known to occur. Specimens of *B. resinifera* (Acc. No. 167) collected at mile 1019 Alaska Highway were taken from a lone tree apparently remote from other trees of this species. Approximately 90% of the seedlings from this tree proved to be quite different from the parent, consisting of multistemmed types, and even slower growing than seedlings from other accessions of *B. resinifera* from this area. The leaves (Fig. 6, 167-1) from these specimens resembled those of one of the dwarf species, and seedlings from this accession are now under observation in the arboretum.

Specimens collected from a tree at Carmacks indicate this tree may be of hybrid origin (Acc. No. 308). The leaves lack the long acuminate tip characteristic of *B. resinifera.* In other characters they are typical of *B. resinifera.* One seedling grown from this collection is triploid ($2n = 3x = 42$).

Growing among a group of trees of *B. resinifera* on Bonanza Creek and resembling them in general appearance was a specimen (Acc. No. 307) which differed from the others in a number of characters including 1) the absence of glandular twigs, 2) the ciliate leaves, lacking the characteristic long acuminate tip and 3) an achene with a narrower wing than is typical in *B. resinifera.* Still wider differences appeared in the seedlings grown from seed collected from this tree. The stems proved to be densely pubescent, as in seedlings of *B. papyrifera* and they lacked the abundant glands characteristic of *B. resinifera* seedlings. The young leaves, including the petiole are densely pubescent beneath and the marginal fringe of long colorless hairs is more pronounced than in the parent tree. The leaves themselves are simple — doubly serrate. Growth of the seedlings is more rapid and the leaves remain on the seedlings longer in the autumn than on those of *B. resinifera* (Acc. No. 307A). By September 20, 1966, leaves of the latter accession had all fallen, whereas on October 8, those on this accession (Acc. No. 307) were still fresh and green.

This specimen (Acc. No. 307) conforms to the description of *B. kenaica* Evans as given by Hultén (1944), who has confirmed this identification (personal communication). For the record a description of this specimen is as follows:

Habitat: Tree, 6.5 m. high growing on rubble left by gold dredge operations, near tree of *B. resinifera* (No. 307A). Collector, W. H. Brittain.

Foliage: Leaves trullate lacking the long pointed tip of *B. resinifera*, glabrous or nearly so (though sometimes with slight pubescence in lower portion of larger veins; simply serrate.

Twigs: Glabrous, with a few or no glands visible.

Male ament: Two or three in a cluster; *Female ament*: 2.4-3.0 cm. long.

Fertile bract: Lateral lobes ascending, 5.5-5.7 mm. long.

Samara: Achene hispidulous at apex; length 1.5-1.7 mm., width 1 mm., style length 0.7-0.8 mm.

Bark: Pinkish, exfoliating.

It would appear that hybridization of *B. kenaica* with *B. resinifera* [as Hultén (1944) noted to occur extensively between these two species in Alaska] and backcrosses of the hybrids with *B. kenaica* [as might be deduced from the chromosome numbers reported for this species by Dugle (1964) and Woodworth (1931)] could readily occur between these two species when they grow together. Since Dugle (1964) reported that some of her specimens of *B. kenaica* had characteristics of *B. papyrifera*, hybridization involving this species is most likely also to occur and might be expected since these two species have chromosome numbers in common.

The extensive evidence of hybridization in western birch reported by Dugle (1966) and the new evidence presented here indicates the difficulty of separating the different hybrids and the species themselves. Further controlled experimental data are needed to resolve this difficulty.

Clausen (1966) has recently shown that for *Betula* interspecific crosses between species of dissimilar ploidy seem to be more successful when the male parent has the higher chromosome number. Although his results may elucidate the problems of interspecific compatibility and hybridization in *Betula*, they cannot be applied generally since in some other genera, for example wheat, more successful crosses have been produced when the female plant has had the higher chromosome number. Further information on this aspect may be forthcoming from the reciprocal crosses which we are carrying out between *Betula* species with different ploidy.

SUMMARY

A morphological and cytological study has been carried out on collections and seedlings of *Betula papyrifera* Marsh. and *B. resinifera* Britt. from the northern prairies, the Mackenzie River Basin and the Yukon Territory. Achenes and stomatal guard cells were useful as distinguishing morpohological characters between the two species. As in eastern Canada, *B. papyrifera* displayed considerable variation in minor characters. The somatic chromosome number of 84 was the predominant number found in the seedlings, in contrast to Eastern populations where somatic chromosome numbers of 70 and 56 were more frequent. A triploid seedling ($2n = 3x = 42$) was found in the diploid progeny of one *B. resinifera* collection, whereas all other accessions of *B. resinifera* had a chromosome number of $2n = 28$. Accessions with a chromosome number of $2n = 56$ possessed chracateristics of both *B. papyrifera* and *B. resinifera* and were considered hybrids between these two species

(*B.* × *winteri* Dugle). A somatic chromosome number of 84 was determined for a collection of *B. kenaica* W. H. Evans. The extensive introgressive hybridization makes it difficult to dissociate between the different hybrids and the species themselves for certain collections.

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UNUSUAL RECORDS OF SUMMER BIRDS ON KENT ISLAND, NEW BRUNSWICK[1]

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Introduction

From June 29 to September 3, 1964, while I was studying bird populations at the Bowdoin Scientific Station, a number of unusual birds were recorded on Kent Island, New Brunswick. These observations provide the main basis for this paper. Kent Island, located about six miles southeast of Seal Cove, Grand Manan, New Brunswick, is part of a group of three islands, including Hay and Sheep Islands. The northern and western parts of Kent Island are characteristic Canadian Zone Forest, with balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*) being the most common species of trees. American mountain-ash (*Sorbus americana*) and birch (*Betula*) are also present as smaller trees (Gleason, 1937). The central part of the island contains mainly open fields of grasses such as timothy grass (*Phleum pratense*), red-top (*Agrostis alba*), brown bent grass (*Agrostis borealis*), and blue-joint grass (*Calamagrostis canadensis*) (Potter, 1937).

The bird life of Kent Island has been extensively studied, especially since the establishment of the Bowdoin Scientific Station on the island in 1935. Pettingill's paper (1939) on the birds of the Grand Manan Archipelago included many sightings from Kent Island and summarized the status of all species found in the archipelago at that time. Various lists of birds observed on the island have also appeared in the Bulletins of the Bowdoin Scientific Station (Valencourt, 1938; Spear, 1939; Winn, 1949). Huntington (1959) recorded over 80 species on Kent Island during the summer of 1958.

The annotated list below contains the more unusual recent records of birds obtained on Kent Island, New Brunswick. To clarify the status of certain species, sighting in other years have also been included. The nomenclature and arrangement is that of the fifth edition (1957) of the A.O.U. Check-List of North American Birds, while the plant names follow Gray's Manual of Botany (Fernald, 1950).

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[1]Contribution No. 34 of the Bowdoin Scientific Station, Kent Island, Grand Manan, New Brunswick, Canada.

ANNOTATED LIST

Green-winged Teal, *Anas carolinensis* — This species was especially common during the first two or three weeks of June (1964). Preston located a nest containing three eggs on June 8, 1964; this nest was found to be empty on June 15. The Green-winged Teal also nested on the island about 1960 (Huntington, pers. cor.). Pettingill (1939) reported no nesting records in the archipelago.

Red-breasted Merganser, *Mergus serrator* — Only two sightings in 1964; July 5 (1) and July 17 (6). This species nested on the island during the summer of 1962 (Huntington, pers. cor.). Pettingill (1939) indicated that it was very unlikely that the Red-breasted Merganser nested in the archipelago, even though it was "probably a summer resident at one time." At present, this species appears to breed in small numbers in the archipelago (see Gobeil [1966] for other nesting records).

Peregrine Falcon, *Falco peregrinus* — One seen by Preston flying along the eastern shore of the island on May 24, 1965. The Peregrine Falcon is a "rare transient and very rare summer resident" in New Brunswick (Squires, 1952).

Killdeer, *Charadrius vociferus* — Four definite sightings in the summer of 1964: July 21 (3), July 22 (2), August 1 (1), and August 7 (1). In 1965, single birds were noted on July 7 and August 16. Pettingill (1939) recorded the Killdeer as "generally a rare transient."

Upland Plover, *Bartramia longicauda* — One bird was observed at close range by Preston on May 19, 1965. Pettingill (1939) regarded this species as a "rare transient and summer visitant"; he gives two records of single birds on Kent Island (August 29, 1932 and October 1, 1935).

Solitary Sandpiper, *Tringa solitaria* — The status of this species has changed as it is no longer a rare transient as indicated by Pettingill (1939). In 1964, the first bird was sighted on August 20; two were present on August 24. Huntington (1959) noted a single bird on August 14, 1958. During the summer of 1964, the Solitary Sandpiper was not uncommon on Grand Manan also (Gobeil, 1966).

Willet, *Catoptrophorus semipalmatus* — An unusual number of sightings were obtained in 1965: these included May 13; June 13; June 22; June 30; and July 18. These records were mainly of single birds seen on the rocky, western shore of the island. The Willet is a "rare summer visitant" in New Brunswick (Squires, 1952). The species has also been recently found summering in certain areas of Maine (Gobeil, 1963).

White-rumped Sandpiper, *Erolia fuscicollis* — Data obtained on Kent Island further substantiate a late migration for the White-rumped Sandpiper; the height of migration in New Brunswick appears to be around mid-October (see Gobeil, 1963). In 1964, no migrants were noted before August 6 (5); thereafter, the number of birds gradually continued to increase, being highest in late August and early September when I left the island. Twenty were present on August 27. Terrill (1951), studying shorebird migrations at Montreal, Quebec, also noticed a late migration in this species. He stated that the White-rumped Sandpiper was ". . . generally one of the latest shore birds to arrive and one of the last to leave." Peak numbers at Montreal were recorded during the last two weeks of October.

Laughing Gull, *Larus atricilla* — Two birds observed on July 5, 1965. In 1958, Huntington (1959) noted one on the island on July 20. On June 30, 1965, a single bird was also seen on Machias Seal Island where the species has been reported as nesting (Palmer, 1949). The Laughing Gull is considered as a "very rare summer resident" in New Brunswick (Squires, 1952).

Mourning Dove, *Zenaidura macroura* — Preston saw two doves on the island on May 16, 1965. Pettingill (1939) recorded this species as a "rare transient and summer resident". Since 1940, the Mourning Dove has shown significant increases in New Brunswick and Nova Scotia (Squires, 1960).

Yellow-billed Cuckoo, *Coccyzus americanus* — One bird seen at close range by many observers from August 30 to September 3, 1964. This bird may have been part of a flight of these cuckoos which occurred in the Northeastern Maritime Region at this time; about 200 Yellow-billed Cuckoos were recorded over an area extending from Block Island, Rhode Island, to Prince Edward Island (Bagg and Emery, 1965).

Ruby-throated Hummingbird, *Archilochus colubris* — At present, apparently not a "rare transient and summer resident" as indicated by Pettingill (1939). In 1964, first seen on July 19 (1), then a few sighted regularly for the rest of the summer, three being the highest count on any one day. A few were also present on the island around mid-May, 1965. This species was regularly seen on Grand Manan in the summer of 1964 (Gobeil, 1966).

Black-backed Three-Toed Woodpecker, *Picoides arcticus* — At least one present on September 11, 1965. This woodpecker is an "uncommon resident" in New Brunswick (Squires, 1952).

Great-crested Flycatcher, *Myiarchus crinitus* — Single birds were observed on May 25 and July 2, 1965. Squires (1952) reported that this species was a "rare summer resident" in New Brunswick.

Eastern Wood Pewee, *Contopus virens* — Seen almost daily during the first two weeks of June (1964), then none recorded until August 19 (1); a few sighted thereafter. Pettingill (1939) recorded the species as a rare summer resident and transient.

Horned Lark, *Eremophila alpestris* — One was observed almost daily during the second week of July (1964). On the Bay of Fundy side of the Isthmus of Chignecto, Boyer (1966) found the Horned Lark "fairly common at all seasons of the year." Pettingill (1939) reported no summer occurrences of the species in the archipelago.

Blue Jay, *Cyanocitta cristata* — A few seen or heard calling through the summer of 1964. In 1958, the species was also "seen occasionally through the summer" (Huntington, 1959). In the late 1930's, the Blue Jay was a rare resident and transient in the archipelago (Pettingill, 1939).

Mockingbird, *Mimus polyglottos* — Preston located a single Mockingbird on the island on July 17, 1964. The bird was watched for at least twenty minutes during which time it was constantly harassed by both Barn and Tree Swallows. Other occurrences of Mockingbirds on the island include one bird observed in late May, 1953, and another in 1955 (Huntington, 1956). In 1965 a lone bird was noted on July 1. Pettingill (1939) gives records of three specimens taken on Grand Manan.

Brown Thrasher, *Toxostoma rufum* — At least one bird seen between June 4-7, 1964. More common during the summer of 1965 when a few birds were sighted almost daily. The Brown Thrasher is a "very rare summer resident" in New Brunswick (Squires, 1952).

Wood Thrush, *Hylocichla mustelina* — A lone Wood Thrush was observed by Preston on May 16, 1965. Squires (1952) also considered this species as a "very rare summer resident" in New Brunswick.

Blue-gray Gnatcatcher, *Polioptila caerulea* — One was sighed on September 11, 1965. This species appears to be a casual visitor to the archipelago. In late September of 1952, Moses (1953) noted two individuals of this species on Grand Manan.

Prothonotary Warbler, *Protonotaria citrea* — A Prothonotary Warbler was sighted by Rothstein on August 22, 1964. This single bird was watched with field glasses from a distance of about 30 feet. The bright yellowish-orange breast and head were clearly seen. The bluish-gray wings, without wing-bars, were also apparent. Squires (1952) recorded this species as "accidental" in New Brunswick.

Golden-winged Warbler, *Vermivora chrysoptera* — Rothstein observed a single bird on the island on August 15, 1964. The yellowish wing-patch, white belly, black bib and cheek were seen at close range. The A.O.U. Check-List (1957) lists the species as "casual north to . . . central New Hampshire (Hanover), and Maine (York and Cumberland counties, Mount Desert Island)." Squires (1952) gives one doubtful record for New Brunswick.

Blue-winged Warbler, *Vermivora pinus* — Two sightings of Blue-winged Warblers were obtained in 1964: the first bird was seen by Huntington and Rothstein on August 22. The black eye-line, yellowish underparts, and white wing-bars were clearly evident. Another or perhaps the same bird was observed by Huntington on August 31. Again the individual was seen at close range and its identity positively determined. The A.O.U. Check-List (1957) records the species as "casual north to . . . southern New Hampshire (Manchester) . . .". The first sight record for New Brunswick was obtained on August 20, 1951, when Woolfenden (1952) saw two on Machias Seal Island.

Tennessee Warbler, *Vermivora peregrina* — Pettingill (1939) treated the Tennessee Warbler as a hypothetical species, indicating that it probably was a "rare transient and summer resident". It now appears to be quite common in the archipelago; in 1964, the first bird was seen on August 5. A total of 17 Tennessees were banded in 1964, while 5 were banded in 1960.

Cape May Warbler, *Dendroica tigrina* — A warbler considered as a "rare transient and apparently very rare summer resident" by Pettingill (1939). This species now appears to be the most common warbler during the fall migration; a total of 49 birds were banded in 1964, the largest number being 25 on August 22. In 1960, 86 Cape May Warblers were banded on the island. The species is also now commonly found on Grand Manan (Gobeil, 1966). The peak migration seems to be quite early (mid to late August). Such an early migration is also substantiated by Cruickshank's (1952) observation of an unusual concentration of Cape Mays on Little Green Island on August 20, 1952; this island is located off West Penobscot Bay, Knox County, Maine.

Squires (1952) regarded the Cape May as an "uncommon summer resident and transient", while Huntington (1959) did not include it on his list of birds found on Kent Island. In the Cumberland Basin region of New Brunswick and Nova Scotia, the Cape May is considered as a "rare irregular transient" (Boyer, 1966). Tufts (1961) also recorded this species as "regularly uncommon . . ." in Nova Scotia. As judged from the number of Cape May Warblers banded on Kent Island, the species may not be as uncommon as believed in surrounding areas.

Bay-breasted Warbler, *Dendroica castanea* — Appears to be a common migrant on the island. First sighted on August 1, 1964; 25 were banded during the summer (7 on August 22). Huntington (1959) did not mention this species in his list of birds on Kent Island.

Prairie Warbler, *Dendroica discolor* — On August 25, 1967, a single male Prairie Warbler was collected on Kent Island. This specimen represents the second definite record of the Prairie Warbler in New Brunswick. The first specimen, an immature bird collected on Machias Seal Island, was obtained by G. E. Woolfenden on August 19, 1951 (Woolfenden, 1952). Details of this second record have been presented elsewhere (Gobeil, 1968).

Northern Waterthrush, *Seiurus noveboracensis* — This species is now a common fall migrant on Kent Island. Two were observed on August 30, 1964 and three on August 31. In 1965, small numbers were commonly seen in August. Twenty-six were banded in 1960 (13 on September 3). Pettingill (1939) recorded the species as an "apparently rare transient and very rare summer visitant."

Eastern Meadowlark, *Sturnella magna* — Five sightings in 1965, most of them between May 13-19. None recorded in 1964. This species has been increasing in New Brunswick (Squires, 1960). Bond and Ross (1953) give several early July records of Meadowlarks in New Brunswick. In the early

1950's, this species was a "very rare summer resident" in the region (Squires, 1952).

Brown-headed Cowbird, *Molothrus ater* — Small numbers seen throughout the summer of 1964; more common in August. On July 22, 1964, an adult Magnolia Warbler (*Dendroica magnolia*) was observed feeding a young Cowbird capable of flight. Cowbirds being fed by Myrtle Warblers (*Dendroica coronata*) and American Redstarts (*Setophaga ruticilla*) were recorded in 1965. In 1958, Huntington (1959) suggested that Cowbirds probably bred on the island as young birds were commonly seen in August. Pettingill (1939) recorded the status of this species in the archipelago as a "rare summer resident; no eggs have ever been noticed."

Rose-breasted Grosbeak, *Pheucticus ludovicianus* — The only sighting for 1964 was a bird banded on August 7. Other records include three males on May 16, 1965 and one bird on September 11, 1965. Pettingill (1939) reported this species as a "rare transient and summer resident."

Lark Sparrow, *Chondestes grammacus* — One bird was present on the island on August 23-24, 1965. In 1958, Huntington (1959) also saw a Lark Sparrow on September 9. This species appears to be a casual fall visitor to the island.

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ISLAND NESTING OF DUCKS IN NORTHERN ONTARIO

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THE LAKES of northern Ontario are not particularly noted as producers of waterfowl; indeed, the general consensus is that the Pre-Cambrian Shield, which occupies much of northern Ontario, actually supports a very low duck population (Addy *et al.*, 1952; Hanson *et al.*, 1949; Wellein and Lumsden, 1964). One of the few exceptions to this general rule is the situation that prevails in the Sudbury area, where there is a thriving population of several hundred birds. I believe that this unusual situation is due to a favorable combination of predator-free nesting sites in the larger lakes and choice brooding areas in neighboring beaver ponds (Young, 1967).

Neither the extent nor the importance of island nesting of ducks in Ontario has been fully appreciated. In the few duck-producing areas in this province, island nesting appears to be the rule rather than the exception. Cringan (pers. comm.), in a study of waterfowl productivity in Prince Edward County, found that the majority of Mallards (*Anas platyrhynchos* Linnaeus) nested on islands. In central southern Ontario, Toronto Island is renowned as a duck nesting area. Munroe (1965), working at Long Point in Lake Erie, found that nearly all of the waterfowl territories in his area ". . . were closely associated with dry land, especially, with islands and wooded ridges." At Luther Marsh, sixty miles northwest of Toronto, Cringan *et al.* (1962) recorded nesting densities of 1 nest per acre on floating leatherleaf bog and 1 nest per 2.5 acres on grassland islands. They noted, significantly, that nesting densities in mainland habitats were much lower. Boyer and Devitt (1961), also working at Luther Marsh, found that Mallards, Black Ducks (*Anas rubripes* Brewster) and Blue-winged Teal (*Anas discors* Linnaeus) all showed a decided preference for island sites.

In a study of duck nesting in the Sudbury area, 81 percent of Mallard and Black Duck nests were found on islands. Table 1 gives the location of each Mallard and Black Duck nest found during the four years of the study, the immediate nesting cover in each case, and the eventual outcome of the clutch. It should be pointed out that the upland areas were searched as thoroughly as were the islands. Because so few nests were actually found on the mainland, it is difficult to compare the hatching success of the two kinds of sites. It is perhaps significant, though, that only one upland clutch in four years hatched successfully, whereas 25 of the 34 island clutches (74 percent) hatched without interference. This compares very favorably with hatching success in other duck breeding areas. Keith (1961) found that the hatching success for all duck species in his southeastern Alberta study area was 33 percent. Kalmbach (1939) recorded 36 per cent hatching success for the Lower Souris Refuge and Sowls (1948), in predation studies at Delta, found that only 35 per cent of his clutches hatched successfully.

Experiments have been carried out in the Sudbury area in order to establish the degree of preference of ducks for island nesting sites. In the summers of 1965, 1966, and 1967, artificial islands in the form of cedar rafts were set out on a lake near Sudbury and a record was kept of how readily these rafts were accepted by nesting ducks. The rafts were made of 6 foot long cedar logs held together by two-by-fours. A nest box, 18 inches square by 6 inches deep, was placed near the center of each raft. It was filled with leaf litter and screened on three sides with brush. The whole raft was then covered over with cedar boughs to protect it from crows and owls and was anchored several hundred feet from shore by means of a large rock and a length of aluminum clothesline wire. It was found that mink, which are common in this area, would not swim out to the rafts if they were placed well out in the lake.

In 1965, six rafts were tested. They were put in place on the third of May and within three days three of the rafts were occupied. The attractiveness of at least one of the artificial islands was demonstrated by the fact that three different ducks used it during the same season. First a Black Duck laid a full clutch of 12 eggs in the nest box, then a Mallard added another 11 eggs, and finally a second Mallard arrived and shared in the incubation of the huge clutch after having added a few eggs of its own. In 1966, twelve rafts were set out and six were used, three by Mallards and three by Black Ducks. In 1967, fourteen of the eighteen available rafts were occupied. Again in 1967, one of the rafts was used by two different birds, in this case one after the other, and both brought off broods successfully. In all three years the ducks took possession of the rafts almost as soon as they were made available. In the majority of cases the first egg was laid within three to four days of the raft being set out; in four instances the first egg was laid on the same day.

It appears that the ducks which are now using nest rafts are birds that in previous years attempted to nest on the mainland, since the total number of potential breeders has remained constant throughout the four years of the study. Even so, the total production of ducks is probably greater now than it

TABLE 1. — The location, cover, and outcome of all Mallard and Black Duck nests found in the Sudbury Study Area 1964-1967

Nest #	Location of Nest	Cover	Outcome
Mallard			
65–9	island	leatherleaf	hatched
–12	island	leatherleaf	destroyed by crows
–13	island	leatherleaf	hatched
–17	peninsula	leatherleaf	destroyed
–23	hay meadow	dry grass	unknown
66–5	island	blueberry bushes	hatched
–7	island	small red pine	hatched
–12	shore	grass	destroyed by mink
67–13	island	leatherleaf	hatched
–15	island	base of birch tree	hatched
–21	island	shrubs	hatched
–24	island	leatherleaf	hatched
–27	island	under birch tree	hatched
Mallard or Black Duck			
67–22	island	shrub	hatched
–29	island	leatherleaf	destroyed by crow
Black Duck			
64–1	floating bog	leatherleaf	destroyed by mink
–2	floating bog	sedge and grass	hatched
–3	floating bog	sedge and grass	hatched
65–1	upland woods	dead bracken	hatched
–6	upland woods	dead bracken	destroyed by mammal
–7	lake shore	jackpine windfall	destroyed
–8	island	old boat	hatched
–10	island	brush pile	hatched
–11	island	small cedar	hatched
–14	island	juniper bush	hatched
–15	peninsula	leatherleaf	destroyed by crow
–18	island	small spruce	hatched
–19	island	leatherleaf	destroyed by crow
–20	island	under spruce tree	hatched
–22	peninsula	grass	destroyed by mink
–25	island	leatherleaf	destroyed
–26	island	grass	unknown
66–3	island	cedar	hatched
–4	island	cedar	destroyed by mink
–6	island	small red pine	destroyed
–10	island	juniper and blueberry	hatched
67–9	upland woods	blueberry bush	destroyed by crow
–12	island	base of birch tree	hatched
–14	island	juniper	hatched
–16	island	fir	hatched
–17	island	small red pine	hatched
–19	island	red pine	hatched
–20	island	black spruce	destroyed by crow
–31	island	blueberry	destroyed?

has ever been, now that the problem of nest predation has largely been overcome.

SUMMARY

In the Sudbury district of northern Ontario the majority of Mallards and Black Ducks nest on islands, apparently to escape from mammalian predators. Far from being unusual, island nesting appears to be more common than mainland nesting in most of the duck-producing areas of Ontario. It was demonstrated that these two species will readily accept artificial nesting rafts in situations where natural islands do not exist.

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ON THE OCCURRENCE OF *POLYCELIS* (TURBELLARIA, TRICLADIDA) IN WESTERN CANADA

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The freshwater triclad genus *Polycelis* Ehrenberg, 1831, as defined by Kenk (1930), is probably of Eurasian origin and contains about 25 known species which, with one exception, *P. oculimarginata* (Palombi, 1931), occur only in the northern hemisphere. The American fauna is represented by two species, *P. coronata* (Girard, 1891) from Wyoming, South Dakota, and Colorado, and *P. borealis* Kenk, 1953 known only from Alaska. Kenk (1953) has shown that in general the freshwater triclads of Alaska show no close relationships with the present North American (U.S.A.) triclad fauna but two species, one being *P. borealis*, are very closely related to Asian species of the same genera. He postulates that the present Alaskan fauna is of Asian origin and that a south-eastern migration along the Rockies has occurred in post-glacial times, leading to the occurrence of a species of *Polycelis* in the north-western United States. Kenk (op. cit.) drew attention to the lack of supporting data from intermediate areas, and therefore the finding of specimens of *Polycelis* in western Canada is of considerable interest.

The specimens under discussion were collected by Dr. G. O. Mackie at two adjacent sites on the Snaring River, Jasper National Park, Alberta (53°N, 118°W) on 2nd September, 1967. The river, fed from glacial streams, is fairly large and swift, and the triclads were found under rocks around the edge of the river in regions where the water was not so swift as to prevent sediment being deposited. The collecting site is 4500 feet above sea level and the water temperature was 10-11°C.

The largest of the specimens measured 12 mm long and 3 mm wide. In contour the specimens resemble the other North American species of the genus with the exception that the auricles are somewhat stouter and more rounded. In this respect the specimens resembled some Asian *Polycelis* species. The colour varied from dark reddish brown to light brown, pale grey, and green. The green colour of some specimens was seen to be due to plant material in the gut but it is not known if this had been ingested purposely or accidentally. The eyes are arranged in two irregular linear groups a little distant from the anterior and latero-anterior margins of the animals. The pharynx represents about one quarter of the body length and the pharyngeal pore opens about three quarters of the way down the body.

The specimens were fixed in Bouin's fluid and preserved in 70% alcohol. This unfortunately resulted in coiling of the specimens and so they were relaxed and cleared in ACS medium (E. Gurr Ltd.) and then re-hardened, in alcohol, in a flattened condition. During the processes of relaxing and clearing the specimens were examined for the presence of reproductive organs but unfortunately none of them were sexually mature, which makes specific identification impossible. The two largest specimens were serially sectioned and the absence of reproductive organs confirmed. The sections did, however, demonstrate that the musculature of the pharynx is typical of that of the family Planariidae, and this, together with the distinctive arrangement of the eyes, makes the generic assignment of the specimens reliable. Several whole mounts, in ACS, were made to demonstrate the form of the gut (Fig. 1A) and the variations in the arrangement and number of the eyes (Fig. 1A-C). The complexity of the gut and the frequent anastamoses of its branches are particularly noteworthy.

Although sexual specimens were not found it is almost certain that these specimens, in common with the other North American *Polycelis* species, belong to Kenk's subgenus *Polycelis* (see Kenk, 1953). This subgenus is found in Europe, Asia and North America and is distinguished from the predominantly European *Ijimia* by the absence of adenodactyls or muscular gland organs, and from the Asian *Seidlia* by the lack of a well developed muscular atrial sheath. Kenk's division of the genus is, however, open to criticism since the Euopean species *P. tenuis* Ijima, 1884, occurs with or without adenodactyls, and under laboratory conditions it will interbreed with *P. nigra* (Müller, 1774) (see Benazzi, 1963), a species unequivocally belonging to the subgenus *Polycelis*.

While eye arrangement and number is a generic character the taxonomic significance of variation within the genus seems to have been little studied. In the common European species of the genus *Polycelis* there is usually a single row of eyes closely applied to the frontal and lateral margins of the anterior end of the animal (Fig. 1D). Usually the lateral part of the rows extend to about one fifth or one quarter of the body length. In at least one species, *P. felina* (Dalyell, 1814) multiple rows may occur, but even so they are still situated extremely close to the margins (e.g. Dahm, 1958). In contrast, most, if not all, Asian and American forms have two groups of eyes irregularly arranged and usually not so closely situated to the margins of the animals. If this difference is real it suggests that there are two large sub-groups of the genus, one primarily European and the other primarily central and east Asian in origin. The American forms would have been derived from the latter group. However, further speculation along these lines is unprofitable until a much needed revision of the Planariidae is forthcoming.

Kenk (1943) has suggested that the triclad fauna of southern Canada came by immigration from the North Eastern United States, and current work on a variety of species is confirming this. The finding of *Polycelis* in Alberta also supports his later contention (Kenk, 1953) that at least part of the fauna of western Canada may be derived originally from Asian forms which crossed into Alaska and later migrated southwards along the Canadian Rockies. Projected studies of the triclad fauna of British Columbia and Alberta may, therefore, be expected to yield very interesting results.

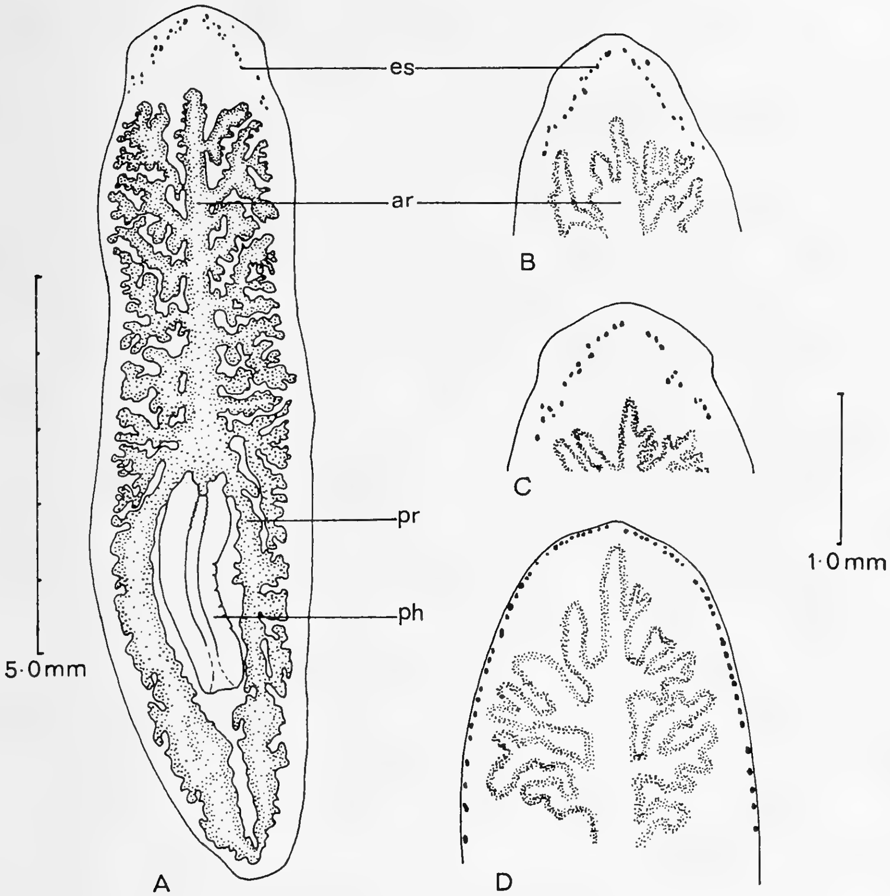

FIGURE 1. Whole mounts of *Polycelis* species to show arrangement and number of eyes, and the form of the gut. A-C. *Polycelis* sp. from Snaring River, Alberta. D. *Polycelis tenuis* from Bassingbourn, Cambs, England. ar, anterior ramus of gut; es, eyespot; ph, pharynx; pr, posterior ramus of gut.

For reference a single wholemount of the present *Polycelis* will be deposited in the National Museum of Canada.

ACKNOWLEDGEMENTS

We would like to thank Dr. G. O. Mackie and Mrs. Violet Scott of the Department of Zoology, The University of Alberta, Edmonton for sending the preserved specimens to us and for providing notes on the living animals and their habitat. Our current work on triclad systematics is being supported by the National Museum of Canada, Ottawa.

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NOTES

Status of Breeding Herring Gulls at Bridge Lake, British Columbia from 1933 to 1963

THE most southerly colony of breeding Herring Gulls (*Larus argentatus*) in British Columbia was reported at Bridge Lake by J. A. Munro (1935) in 1933. This colony was revisited by Munro (1937) in 1935. Since this date several ornithologists and oologists have visited the Bridge Lake area and the Herring Gull colony but their records, as far as I know, have not been published. The purpose of this paper is to report recent data compiled from 1948 through 1963. For comparative reasons I have included briefly early nest counts by Munro.

I would like to thank Mrs. A. L. Meugens, wife of the late A. L. Meugens, and John K. Cooper of New Westminster for permission to use their records. David Stirling, Victoria, has critically read this manuscript.

DESCRIPTION

Bridge Lake lies in the Cariboo District of south-central British Columbia about 215 air miles northeast of Vancouver. The lake is deep, about four and one-half miles long and a mile and a half wide at its widest point. From the air numerous islets can be seen dotting the lake's surface. All islets, with the exception of the one described below, are forested. The lake shore is irregular with dominant stands of Douglas fir (*Pseudotsuga menziesii*), White spruce (*Picea glauca* var. *engelmanni*) and lodge-pole pine (*Pinus contorta* var. *latifolia*). Patches of black cottonwood (*Populus trichocarpa*) and trembling aspen (*Populus tremuloides*) are also evident.

The Herring Gulls nest on a small rocky islet, locally known as Stack Rocks, near the east end of the lake. The islet is bare rock and devoid of vegetation. The water level at Bridge Lake fluctuates slightly and as a result the size of the colony islet changes. On July 1, 1962 the islet was about six feet in height and 70 feet long by 36 feet wide.

VISITS AND NOTES

July 26, 1933—Munro (1935) reported fifteen pairs nesting. Twelve young, about one-quarter to one-half grown, left the islet and swam in the water as he approached the colony.

May 15, 1934—A visit by F. M. Bell, a local rancher, to the colony was reported by Munro in his original paper. Fifteen nests and 33 adults were counted. Six nests contained a single egg, six had three eggs and three were empty.

June 24, 1935—On his return visit Munro (1937) reported 17 nests and 38 adults. Nest contents as follows: 2-empty, 4-1 egg, 3-2 eggs, 3-3 eggs, 3-1 egg 1 young and2-2 eggs 1 young.

May 25, 1948—A. L. Meugens and Walter Maguire, both late of New Westminster, visited the colony for collecting purposes. Twenty-two nests were counted. Most nests had three eggs, but a few had two.

Meugens reported the eggs were uniform in color and size, being about 3.00 x 2.05 inches.

June 3, 1962—Nineteen nests and an estimated 40 adults were counted by John K. Cooper. Seventeen nests contained 3 eggs and 2-2 eggs. Incubation was advanced.

July 1, 1962—Ken Kennedy and the writer counted twenty nests: 15 empty, 2-1 egg, 2-2 eggs, and 1-1 egg 1 young. As well, three half-grown young were noticed on the islet and one swimming nearby. Incubation was well advanced in most eggs.

Nests were messy structures placed anywhere room permitted, in crevices or atop flat rocks. Materials consisted of Douglas fir cones and branches, mosses, lichens, bark, water weeds, feathers, small pine branches, aspen leaves, and large twigs.

FIGURE 1. Stack Rocks, Bridge Lake, British Columbia.

FIGURE 2. Nest of Herring Gull.

May 22, 1963—A count by Ken Kennedy and the writer showed twenty-five nests: 2-1 egg, 6-2 eggs, 16-3 eggs and 1-4 eggs. Three sets of two eggs were laid on bare rock, no nesting materials used. Two fresh, but cracked, eggs were found in the water near the colony. The eggs in the clutch of four averaged (in inches) 2.80 x 1.95.

Fifty-six adult birds were counted this trip.

June 17, 1963—Colony visited by Ken Kennedy and the writer for banding purposes.

Nest count showed 25 nests; 18 empty, 1-2 eggs, 3-3 eggs and 3-1 egg 1 young. An adult was observed carrying nesting materials to the islet, probably for replacement nesting.

Two dead young were found and eleven were banded, numbers 626-32801 through 626-32811.

Summary

During the 28-year interval between published records there has been a gradual increase in numbers of breeding Herring Gulls at the Bridge Lake colony. The increase has been ten pairs, which works out to an increase of about 0.36 pairs annually.

The earliest recorded arrival for Herring Gulls at Bridge Lake is April 15 (Munro, 1935). The birds probably establish territories in late April as the ice leaves the lake. Nest building would take place in early May and the first eggs laid about May 10 with most egg-laying completed by mid-May. Hatching commences late in the first week of June. By the fourth week in June most young gulls are ready for banding. Banding return data from a colony this size is not, however, sufficient to warrant disturbances to the colony.

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The Effect of an Underwater Explosion on the Fish of Wentzel Lake, Alberta

During the summer of 1966 the Department of Mines and Technical Surveys of the Government of Canada detonated a series of underwater explosions in various lakes in the northern part of Canada as part of certain seismic research projects.

On August 14th, 1966, 4,000 pounds of 60 percent carbonitronitrate explosive were detonated on the bottom at a depth of 90 feet in Wentzel Lake, Alberta (59°N - 115°W). The charge used is approximaetly equal to 2,400 pounds of high explosive in strength but is much less in rate of detonation. The slower the rate of detonation, the slower the increases in hydrostatic pressure within a fish gas bladder, thus resulting in a decrease in the possibility of damage or rupture. Wentzel Lake is a large lake of some 18 square miles situated at an altitude of 2,000 feet in the Caribou Mountains of Northern Alberta, approximately 375 miles N.N.W. of Edmonton.

At the time of the explosion there was a light breeze which resulted in some wave action on the lake. The blast did not result in any noticeable change in this action and no blast-initiated waves were observed to reach the shore, some 850 meters from the blast site.

Within ten minutes of the detonation the area was patrolled using a float-equipped Cessna 185. Two observers remained in the plane while another was stationed on each float. Two hours after the blast the area was examined from the air by flying parallel lines at an altitude of 300 feet. All dead or injured fish were floating on their backs and the exposed white ventral surfaces made it possible to count all fish over 15 centimeters in length.

The maximum distance from the blast centre at which dead or injured fish were found immediately after the explosion was 400 meters. This is in keeping with the findings of Puke (1949, Inst. Freshwater Research, Drottningholm. Report 29: 71-75) that a 250 kilogram charge had an effect on the fish at a maximum distance of 90 meters. Coker and Hollis (1950, J. Wildl. Mgmt., 14: 435-444) found that explosions of 1,200 pounds of H.B.X. (an explosive slightly stronger than T.N.T.) in Chesapeake Bay ordinarily damaged fish only within a 100 to 200 yard radius although on occasions as far as 500 yards from the blast centre.

Fish that were killed in Wentzel Lake were burbot (*Lota lota*), lake whitefish (*Coregonus clupeaformis*), trout-perch (*Percopsis omiscomaycus*) and cisco (*Coregonus artedii*). Lake trout (*Salvelinus namaycush*) are also present in the lake but were not injured by the blast or did not rise to the surface. Many fish were dead when examined while others were still alive but unable to right themselves. Some of the injured fish subsequently recovered but most succumbed within a two hour period.

When the area was surveyed from the air two hours after the blast there were an estimated 35 to 40 burbot and 20 to 30 lake whitefish floating at the surface. The ciscoes, which were all less than 15 centimeters in total length, and the trout-perch were too small to be counted from the air but observations at lake level suggested that one to two hundred of each species were destroyed. These estimates exclude any specimens which may have sank to the bottom.

Damage to the fish was caused by rupture of the heart and associated vessels or by equilibrium imbalance resulting from damaged or ruptured gas bladders. In several dead individuals the gas bladder was found to protrude from the mouth. It may be noted that all killed species possess gas bladders.

Although the damage to the fish population was reasonably severe within a 200 meter radius of the blast site the overall effect on the sport or commercial fishing potential of Wentzel Lake is thought to be negligible.

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Two Records of the Ruddy Duck Nesting at Vancouver, British Columbia

WHILE conducting a breeding bird survey of Burnaby Lake, central Burnaby, 10 miles east of Vancouver, B.C. on June 3, 1962 I located a nest with four eggs of the Ruddy Duck (*Erismatura jamaicensis*). The nest was well concealed and built among a patch of wild iris (*Iris pseudacorus*). Materials consisted of a low pile of mixed fresh and dead bulrushes (*Scirpus acutus*) and cat-tails (*Typha latifolia*). The nest depression was deep and sparsely lined with down. The eggs were large, dull white, and incubation was not advanced.

Like the secretive Pied-billed Grebe, the Ruddy Duck slips into the water at the approach of disturbance and as a result the bird was not seen on the nest. A female Ruddy Duck was observed, however, about 30 yards from the nest site a few minutes later.

Water levels at Burnaby Lake are controlled by a small dam at its eastern end and, unfortunately, the following day the level had risen and the Ruddy Duck nest was found to be half submerged. Only three eggs remained in the nest; these were collected and averaged 2.41 x 1.80 inches.

Burnaby Lake, about two and one-half miles long and three-eighths mile wide, is an eutrophic lake, which is characterized by abundant shore-line vegetation, dense planktonic populations with seasonal 'blooms' and shallow waters. It is one of the few remaining inland marsh lakes in southwestern British Columbia valuable as waterfowl habitat.

On July 15, 1966 Errol Anderson and George Sirk, Vancouver Natural History Society, observed a female Ruddy Duck with a brood of ten, recently hatched young, on a settling pond at the Iona Island Sewage Treatment Plant, just north of the Vancouver International Airport. The area was revisited on July 20 and only nine young were observed. From this date through September 4, 1966 Iona Island was visited by several naturalists, many of whom recorded and observed the nine young. These birds probably wintered in the area with other Ruddy Ducks.

Munro and Cowan in their Review of the Bird Fauna of British Columbia (Victoria, B.C. Provincial Museum, 1947) mention small numbers of Ruddy Ducks are present, both summer and winter, on southern Vancouver Island but report no summer records for the Lower Mainland of B.C. According to the Check-List of Vancouver Birds, 1962 Edition, the Ruddy Duck is a frequent winter visitant.

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Long Distance Dispersal of Seeds by Pant Cuffs[1]

PLANTS have been widely distributed by man throughout history, but documented cases of transport by means of pant cuffs are apparently lacking.

In 1966, I had the opportunity of visiting Israel for but one day while returning from a scientific congress held in Japan. On the morning of September 15 I spent a few hours in the Nature Reserve about seven kilometers south of Netanya near the mouth of the Poleg River with Dr. B. R. Baum. The slacks that I wore had previously been cleaned by a reputable firm in Japan and not worn until that morning. We traversed the dry hillsides looking at the fall vegetation which was in a general state of senescence. Many of the plants were in fruit and a few seed samples were collected. The next morning I left to continue my trip home to Canada.

After arrival in Canada, I happened to notice that many different types of seeds were present in the cuffs of the slacks that I had worn in Israel. As I had not worn them again after leaving Israel, I thought it would be interesting to find out what species I had inadvertently obtained during the course of my visit to the coastal hills of Israel. The seeds were planted in the fall of 1967 in the Plant Research Institute greenhouse. Nine species belonging to five families were successfully grown. These taxa are known to occur in Israel (Dinsmore 1932, 1933; and Zohary 1966). The number in parentheses preceding the name of each taxon in the following list indicates the number of plants that grew to maturity.

GRAMINEAE

(3) *Trisetum lineare* (Forsk.) Boiss.; Collection No. 67C-10.

(1) *Cutandia philistea* (Boiss.) Benth.; Collection No. 67C-7.

[1]Contribution No. 661 from the Plant Research Institute.

RANUNCULACEAE

(1) *Nigella arvensis* L.; Collection No. 67C-5.

LEGUMINOSAE

(1) *Trifolium* sp.; Collection No. 67C-9.

UMBELLIFERAE

(1) *Daucus littoralis* Sibth. & Sm. var. *forskahlei* Boiss.; Collection No. 67C-4.

PLANTAGINACEAE

(1) *Plantago lanceolata* L.; Collection No. 67C-11.

COMPOSITAE

(1) *Carthamnus tenuis* (Boiss. & Bl.) Bornm. ssp. *foliosus* (Boiss.) Hanelt; Collection No. 67C-3.
(1) *Crepis aspera* L.; Collection No. 67C-2.
(3) *Picris radicata* (Forsk.) Less.; Collection No. 67C-1.

Voucher specimens are available for all taxa except *Trifolium*, which was unfortunately disposed of while growing in the greenhouse. All collection numbers are those of the author. Dr. Bernard R. Baum kindly assisted in the identification of the taxa.

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A Polar Bear and Porcupine Encounter

THOUGH one does not generally associate polar bears (*Ursus maritimus*) with porcupines (*Erethizon dorsatum*) in a natural environment, their ranges do overlap along the Hudson Bay coast of central Canada. During my studies of polar bears in that area I found evidence that interaction between the species does take place. On October 27, 1967, I captured a 345-pound sub-adult male polar bear in a cable foot snare near Churchill, Manitoba. I immobilized the bear with drugs (Sernylan, Parke, Davis, and Co. Detroit, Michigan) and tagged and tattooed him with identifying numbers. After recording a series of measurements and removing a premolar for use in age determination I released the bear. He was recaptured three days later about 10 miles to the west. In the interim the bear had acquired 15 to 20 quills in the nose and upper and lower lips. Some of the quills were broken and difficult to count, but lumps could be felt beneath the skin. Since there were no quills inside the mouth, the bear evidently had sniffed the porcupine but had not bitten him. This suggests that mere curiosity rather than predation may have been the motive. The bear may have been partially under the influence of the drug when the encounter occurred. Twenty-nine other bears captured in that area did not have any quills in them. While the quills were certainly an inconvenience to the bear, they probably would not have harmed him permanently. I removed as many quills as possible before again releasing the bear.

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Flying Duck Transports Young on its Back

THE OBSERVATION of a duck transporting young on its back while in flight is rarely reported. In the early summer of 1964 while working in the Chapleau District of northern Ontario, two friends and I saw a low-flying duck pass directly in front of us with what appeared to be a duckling on its back. We identified the duck as either a Black Duck (*Anas rubripes*) or female Mallard (*A. platyrhynchos*). The duck flew to a small lake near by and landed out of our view. Several minutes later it returned alone and flew directly to a small pond just below us. This time, the duck came flying back with what was unmistakably a duckling on its back, only about 25 feet from us. The duck made four trips in all, each time transporting one individual. After the fourth trip it remained on the small lake with its brood. The area encompassing the lakes was burned over 15 years before. Thus, the duck could fly low with its passenger since the new trees were no more than 20 feet high. I estimated the duck's travelling distance to be about 250 yards from the pond to the lake.

The reason that prompted this duck to transfer its family from the pond to the lake is not known but perhaps deteriorating water conditions or low food supply were involved. It is fairly clear why the duck moved its brood in this way instead of leading them overland as most do. A forest fire leaves a maze of tangled, fallen trees, and dense, regenerating brush. With a ground cover such as this walking any distance would have been extremely hazardous.

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Note: A similar observation made in Australia was reported in a review while this paper was in press. (P. A. Johnsgard and J. Kear 1968. A review of parental carrying of young by waterfowl. The Living Bird [7th Annual]: 89-102.)

An Early Colonial Duck Decoy

THE USE OF duck decoys in North America appears to have been quite limited. The operation of a recent one at Delta, Manitoba, has been described by McCabe and Mulder (1961). It is of interest that a 'duck coy" was installed at Salem, Massachusetts, in 1638 by Emanuel Downing who brought the equipment from England at great expense. On September 6 of that year the general court gave him permission to place the decoy at any convenient place in the town of Salem, being desirous of encouraging "such designs as tend to public good." Shooting by any person within one-half mile of the decoy was made unlawful. The grant of John Humphrey on Forest River contained two ponds, still known as Coy Ponds, and Downing obtained the right to operate the decoy on one of them (Perley 1926:25). Downing wrote on October 22, 1638, to his brother-in-law Governor John Winthrop that if he would come to Salem he would acquaint him with the "secrets of ye decoye" (Simmons 1958:53). Presumably he used the decoy until his return to England in 1652.

The extent of the use of decoys is not known. Wood (1865:47) wrote in 1634 that Rumny Marsh, near Lynn, Massachusetts, had "great store of geese and ducks. There be convenient ponds for the planting of Duckcoys." A court order dated April 3, 1632, prohibited the shooting of waterfowl on Pullen Point (Point Shirley) and Noddles Island as they were reserved for John Perkins to take fowls with nets (Noble 1904:21). It is not clear if this refers to decoys or to submerged nets as sometimes used by the Indians.

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A Note on Magpies and Rocky Mountain Bighorn Sheep

A BAND of approximately 60 bighorn sheep (*Ovis canadensis*) occupy a restricted range bordering the trans-Canada highway about 1 mile west of the townsite of Banff, Alberta, Canada. Since the area is a national park, and since the animals have become used to man and to road traffic, close range observation of the herd is relatively easy.

At 6:00 p.m. on the warm spring afternoon of April 25, 1967, the following observations were made. A bighorn ewe and a year-old lamb were standing quietly by the side of the highway, while a Black-billed Magpie (*Pica pica hudsonia*) perched on the ewe's back. The magpie appeared to be busily engaged in investigating an area at the base of the hair over the ewe's withers. Several times the magpie pecked and swallowed, and at such times several tufts of hair were loosened and carried away in the breeze. The magpie continued feeding while the ewe stood in an attitude similar to that frequently exhibited by horses while being combed or scratched about the ears. Her head was raised and and stretched forward. The magpie concentrated its attention on a small area about 12 inches in length at the top of the withers. In several instances the bird was observed to raise its head fully and proceed to swallow pencil-sized tufts of hair which appeared to be somewhat matted at the base. An 8 x 35 pair of binoculars were used to observe these actions from a distance of approximately 30 feet .

During the period of observation which lasted 20 minutes, a second magpie landed on the back of the yearling which also stood docilely and received similar treatment. The hair on the lamb appeared to be less easily removed, and was not noticeably hanging in loose tufts on the sides of the animal as in the case of the ewe. Both magpies frequently buried their heads out of sight in the hair with a side-to-side motion while pecking close to the hide. Once the ewe was seen to swing her head over her shoulder dislodging the magpie which then settled on her rump. The bird quickly returned to the shoulder region and resumed feeding. Both birds were still feeding and both animals remained standing still, during this period and when observations concluded.

The Rocky Mountain wood tick or spotted fever tick (*Dermacentor andersoni*) is prevalent in the Banff area of the Rocky Mountains (Cowan, 1951) and is known to infest bighorn sheep. Magpie feeding on the withers suggests the possibility of tick concentrations in this area of the body. During removal of ticks, hair of the host is frequently dislodged because of its tendency to be matted around the location of the tick.

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DAVID STELFOX

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Accepted May 1, 1968

Transplant Experiments and Toxicity Tests in *Peltandra*

Peltandra virginica (L.) Kunth., a species of the Aroid Family (Araceae), occurs in shallow water of muddy ditches, ponds, rivers or swamps along the coast from southern Maine to northeast Texas, locally from southwest Quebec to Niagara Falls through to central Indiana, south of Lake Erie and south close to the Mississippi River (Fernald 1950, Steyermark 1962, Jones and Fuller 1955, Braun 1967). Its Ontario distribution is given by Laking (1953). This plant, commonly known as Green Arrow Arum, is regarded as an interesting primitive food Aroid (Fernald and Kinsey 1943). One objective of this paper is to report on my attempts to extend its range in Ontario by artificial plantings. A second objective is to report on personal tests on the toxicity of this and other Aroids.

Transplant Experiments

Seeds of *Peltandra* were obtained from a colony at the mouth of Ussher's Creek, Chippewa, Ontario in the Fall of 1958. These seeds were planted in 3 inches of water in a polyethylene dishpan containing dark clay-loam. They were kept cool (minimum air temperature of 25 F. occasionally) all winter in a cool pit greenhouse. There was good germination the following Spring. Between June 6 and 20, 1959, the bulk of the seedlings (each seedling weighed about ½ ounce) were planted in water at 32 different wet shore sites, mostly North to East of Toronto, including some creeks around Lake Simcoe. The seedlings were either hand-planted, or weighed down with a stone, thrown into place.

A few of these plantings were checked about three months after planting, at which time there was no sign of *Peltandra*. All but 6 or so were checked August 13-14, 1966 when there was no sign of *Peltandra*.

About September 12, 1966, after hunting vainly for *Peltandra* on the Chateauguay and Richelieu Rivers, the stand at Gananoque was reconnoitered. This stand was discussed by Garwood (1965). A calculated million plants or 100,000 clones here show considerable habitat variation. Another supply of seed was obtained as well as a few roots.

In September-Ocotber 1966, plantings were made at two localities, one at the Southwest corner of the bridge over the Severn River, North of Washago, Ontario and the other East of the man-made oxbow of the Don River, South of Pottery Road, Toronto. These plantings, seen the Fall of 1967, were unsuccessful.

It is of interest that, so far as I could determine, not a single one of my transplant experiments was successful. Therefore some combination of environmental factors, as yet not fully clear, determines the northern limits of range and the cultural requirements of this species. Evidently all or nearly all potentially suitable habitats in southern Ontario are already occupied by this species and, apparently, horticultural treatment is needed to grow the plant.

Toxicity Tests

The earliest inhabitants used the giant rhizomes of *Peltandra virginica* as food but only after the abundant calcium-raphide-druse, and intercalary crystals, so common in the rhizome, were altered by heat and desiccation. A food rating for *Peltandra* was obtained when, during September, 1966, all our Aroids native to eastern Canada were *carefully* chewed. Using a centrally located 3 mm square from a 1 mm thick sector of fresh rhizome, except where noted, a block was placed at tip of tongue, masticated at that position and progressive reaction noted. The blocks were taken as: (a) Raw, (b) Cooked—5 minutes steam pressure 15 pounds, and (c) Sonic cooked —5-6 minutes at 110 F. with 11 kilocycles (courtesy of Mr. Last of Ontario Research Foundation Sonic Lab.). To avoid prolonged discomfort which each Aroid would certainly cause, water, then Bayer

Aspirin were used after each test to cut short the toxicity. The results for raw and cooked Aroids are as follows:

Raw (a)—natural acidity, crisp or stiff pithy textured.

(1) Increasing ability to sting—*Arisaema dracontium, Calla palustris, Symplocarpus foetidus, Acorus calamus, Arisaema triphyllum, Peltandra virginica, Dieffenbachia seguine.*

(2) Those with a rather obnoxious initial taste in the same order—*Dieffenbachia seguine, Acorus calamus, Symplocarpus foetidus.*

Cooked (b)—greatly reduced acridity, usually melting-soft.

Increasing ability to sting (the first almost nil)—*Arisaema triphyllum, Arisaema dracontium, Symplocarpus foetidus, Peltandra virginica, Calla palustris, Acorus calamus.*

Cooked (c)—varying translucence, retaining the raw texture, grealty reduced acrid, irritant taste.

Increasing ability to sting (the first almost nil) — *Symplocarpus foetidus* (seed), *Arisaema triphyllum, Peltandra virginica* (seed), *Peltandra virginica.*

Of all these species *Peltandra* had abundant and the biggest most perfect looking starch grains.

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Accepted January 20, 1968

An Additional Observation of the Leatherback Turtle off Newfoundland

BLEAKNEY (1965. Canadian Field-Naturalist 79 (2): 120-128) has recently summarized the known records of the leatherback turtle for New England and eastern Canada. In this paper he cited only two records of this species from Newfoundland. Therefore, the following additional observation is of interest.

On September 26, 1967 about 3:00 p.m. on a pleasant sunny afternoon with just a trace of high cloud, I was on board the Pascal Annie, which is a small ferry operating between Fortune, Newfoundland, and St. Pierre, the French Island off Newfoundland, when a large leatherback turtle was sighted. We were just over halfway back to Fortune when the turtle was sighted. The turtle was under observation for 5 to 10 minutes and was just floating on top of the relatively calm water as we passed within 50 feet of it. The turtle seemed to be languidly observing the ship and showed no sign of alarm. The carapace was about four feet long with the frontal half and head riding fairly high out of the water, the head being clear of the water. The only sign of movement was a turning of the head in our direction. It did not seem to be swimming, but just floating or resting.

MICHAEL D. MILLER

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Accepted June 24, 1968

Mockingbird at Vancouver, British Columbia

ON THE morning of February 26, 1968 W. J. Anderson sighted a Mockingbird (*Mimus polyglottos*) associating with Oregon Juncos (*Junco oreganus*) and House Finches (*Carpodacus mexicanus*) at his feeding station. All were feeding on peanuts and bread squares on the ground beneath the feeder. That afternoon the senior writer was notified and about 4:00 p.m. several black and white as well as color photographs were secured. From that date to March 22, 1968 the Mockingbird was recorded daily by Anderson and was observed or photographed by at least twenty local birders, including Dr. Kenneth C. Boyce, Mr. and Mrs. J. Hustead, and Miss Gwen Wright.

During the bird's twenty-six day visit a few interesting notes on habits and behavior were recorded.

The Mockingbird was quite tame and was easily approached to within thirty feet. Its plumage, according to that described by W. Earl Godfrey in *The Birds of Canada* ages the bird as an adult. The bird was seldom seen during the day but frequented the area near the feeding station from about 7:00 a.m. to 9:00 a.m. and 3:00 p.m. to 5:00 p.m.

The bird was recorded feeding on bread, buds of trees (notably ornamental plum and cherry), and it showed a decided preference for the small red berries of the garden shrub *Cotoneaster*. It was also seen eating an unidentified butterfly (probably *Vanessa* sp.)

The Mockingbird is casual in southern British Columbia. Munro and Cowan in their *Review of the Bird Fauna of British Columbia* (Victoria, B.C. Provincial Museum, 1947) list the Mockingbird as extralimital on the basis of two early records (1933 and 1940) from southern Vancouver Island. There are three recent published records for southern British Columbia. David Stirling (Canadian Field-Naturalist 74:176, 1960) reports two records (both 1959); one sighted near Miracle Beach Provincial Park on Vancouver Island and a female collected at Murtle Lake in Wells Gray Provincial Park. Enid K. Lemon (Victoria Naturalist, 24:13, 1967) reports a female Mockingbird, nest and eggs at Victoria, southern Vancouver Island, in June 1967.

Also two unpublished records have recently come to our attention. Mrs. Kline (pers. comm.) banded a Mockingbird at Blaine, State of Washington in December, 1963 and Robert E. Luscher (pers. comm.) recorded a Mockingbird in a holly tree near 67th Avenue and Granville Street in southern Vancouver, B.C. on June 8 and 9, 1967.

R. WAYNE CAMPBELL
WILLIAM J. ANDERSON

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Accepted May 29, 1968

First Record of the Southern Flying Squirrel, *Glaucomys volans volans*, from Quebec

ON OCTOBER 2, 1967, Mr. Morley Mackenzie collected a male and two female *Glaucomys volans volans* (Linnaeus) from 6 mi. NW Hull, Gatineau Co., (Lat. 45° 28′ N; long. 75° 49′ W), Quebec. On November 9, 1967, Mr. Martin Berger collected a male from Fortune Lake, Gatineau Co. (45° 30′ N; 75° 51′ W).

These specimens, now in the Museum of Natural Sciences, National Museums of Canada, (NMC 36100-02, 36279) represent the first known records of occurrence of *Glaucomys volans* in Quebec. An additional record of the Southern Flying Squirrel is documented by a photograph (fig. 1) taken by Mr.

H. A. Thompson, National Collection of Nature Photographs

FIGURE 1. Southern Flying Squirrel at Meach Lake, Quebec.

H. A. Thomson during the winter of 1963 at Meach Lake, Gatineau County, Quebec.

The external measurements of the four specimens are, (in mm): 230, 235, 230, 229; 105, 114, 104, 103; 30, 30, 31, 30; 21, 20, 20, 19; weights (of 3): 46.5 grams, 46.5 grams, 67.3 grams. Cranial measurements are: greatest length, 33.7, 33.6, 33.5, 34.1; zygomatic breadth, 18.8, 20.6, 18.7, 21.1; mastoidal breadth, 17.4, 17.6, 17.0, 17.5; least inter-orbital breadth, 6.2, 6.8, 6.6, 6.6; length of nasals, 8.8, 8.7, 8.7, 8.9; maxillary tooth-row, 6.0, 6.3, 6.0, 6.2.

The previous northernmost record for Canada is a specimen (NMC 11330), collected in 1931 by Mr. Clyde L. Patch from Clayton, Lanark Co., (45° 11′ N; 76° 20′ W), Ontario, and reported by Anderson (1947: 123).

Since the above was written our attention has been called to a specimen (R 121) in the Redpath Museum, McGill University, Montreal, collected by Amy Clark, December 10, 1951, at Hudson, Vaudreuil Co. (45° 27′ N; 74° 09′ W), Quebec. The external measurements of this female are: 230, 87, 30.

REFERENCE

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PHILLIP M. YOUNGMAN
DAVID A. GILL

Museum of Natural Sciences
National Museums of Canada
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Accepted April 3, 1968

Reaction of a Semipalmated Plover to Covering of its Eggs with Sand and Seaweed Respectively

H. LAVEN (1949 Vögel aus Augentiere. Festschift Streseman, Verhaltensforschung 3:147-152) published the results of some experiments with Ringed Plovers

(*Charadrius hiaticula*) which showed that when the eggs of incubating individuals were moved a few centimeters out of the nest and completely buried in the sand the birds returned to the empty nest and searched for the eggs with the bill and by foot scratching.

In June 1967 I repeated this experiment in modified form on a pair of semipalmated Plovers (*Charadrius semipalmatus*) which had a three egg nest on a sandy beach with sparse vegetation and pieces of dead sea weed lying about, near the settlement of Chesterfield Inlet, N.W.T. The nest was found on June 23. One bird rose from it injury feigning. Its partner was close by "on guard". There was an empty nest cup about three feet from the nest. I covered the eggs *in situ* with sand, so that about ½ of each projected above the sand, and withdrew to watch the bird through binoculars. It returned and after some hesitation made not more than two pecking movements at or near the eggs, sat down on them and, within a five minute period, rotated its body about on the eggs two or three times. After it had remained still for some time I checked the nest and found that the eggs had been almost completely uncovered, but instead of lying as originally with their long axis in the horizontal with the blunt poles toward the nest center, they now lay with their pointed poles lightly buried and the blunt poles exposed.

On June 24, I covered the eggs in the nest completely with sand and watched the birds from a distance. One returned to the nest almost immediately, made at the most 3-4 pecking movements with the bill, but cleared the eggs by shuffling about over them with its body somewhat lowered. Within a minute it had arranged things to its apparent satisfaction and remained still, apparently incubating. After observing for a further nine minutes I checked the nest and found the eggs completely exposed and as far as I could tell in their original position.

On June 26 there were four eggs in the nest. I disturbed the incubating bird and completely covered the eggs *in situ* with a piece of dead seaweed, which as a physical obstacle the bird could easily have pushed out of the way with its bill or feet. This situation the bird could not solve. On returning to the nest site it sat down for a moment, got up again, walked to the empty nest cup, sham brooded there for some seconds, then got up and walked several times to the nest site, then a few feet away, back to the nest site again, and continued to behave thus until ten minutes had elapsed from the time I had covered the eggs. I then removed the seaweed and withdrew once more. The bird at once returned to the nest and without showing any surprise at the changed situation there sat down and resumed incubation.

The eggs hatched on July 19.

These experiments first of all confirm Laven's finding that the bird can recognize and find its nest site even if no eggs are visible in it: I had also earlier (Höhn, E.O. The Auk 74 P. 208, 1957) observed this in a Black-bellied Plover (*Squatarola squatarola*) the eggs of which I covered lightly with grass in the nest. Secondly the results show that the Semipalmated Plover while it could expose eggs buried in sand (surprisingly enough not with the bill or feet but mainly by body movements), it was like the Black-bellied Plover psychologically unable to uncover eggs lightly covered with vegetation. When I wrote of my Black-bellied Plover experiment (Höhn *loc. cit.*) I believe that Laven had seen Ringed Plovers uncovering sand buried eggs. However as he buried the eggs near but not in the nest site he only observed attempts of the birds to uncover them in the site. I infer that had the eggs been buried in the nest-floor "his" birds too, like my Semipalmated Plover, could have uncovered them.

In explanation of these findings one may speculate that plover nests on sandy beaches or sand dunes may get sand covered by wind action often enough for natural selection to have favoured the development of a response to deal with this situation. Covering of the eggs with objects other than sand is presumably so rare that there has been no selection favouring the evolution of a response to cope with such an event.

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Accepted May 30, 1968

Swarming and Mating in the Ant, *Lasius sitkaensis* Pergande

ON AUGUST 24, 1967, during the late afternoon and evening, widespread swarming of flying ants was witnessed along Highway 401 in eastern Ontario. As the observer (P.S.C.) travelled southwestwards on Highway 401, large and very numerous swarms were first noticed at 1645 hrs. E.S.T. (1745 hrs. local summer time) near Lunenburg (*ca* 45°N, 75°W); from there to just west of Prescott (44°40′N, 75°35′W) they were seen more or less continuously until darkness fell about two hours later. It can therefore be assumed that the swarms extended for at least, and probably very much more than 35 miles along the highway.

As described by Wheeler (1910) for European species of *Myrmica* and *Lasius*, the swarms were columnar and occurred as discrete clouds, resembling puffs of smoke. Individual clouds occurred in aggregates of about 10-15 to make composite swarms. A composite swarm was usually 6-12 m. wide and high, and came to within about 6 m. (occasionally as little as 3 m.) of the ground. Most swarms occurred above the asphalt of the highway, though others were seen over trees and bushes up to 100 m. or more from the road on either side. Ants seen or caught beneath swarms at about 1700 hrs. E.S.T. were all mating pairs. Two such pairs, in fresh condition, were identified (by G.L.A.) as *Lasius sitkaensis* Pergande. It is likely, though not certain, that the whole swarm comprised this species. No aerial predators were seen feeding amongst the swarms.

The swarming and associated mating of newly-emerged males and females (i.e. winged ants) is a well-known phenomenon in some species of this genus, and one to which the term "nuptial flight" has appropriately been applied. The event described here is probably the first authentic record of a nuptial flight for this species and is further noteworthy because of the synchronization of swarming over such a large area. Wilson (1955) in his revision of the genus *Lasius*, cites two records of pairs *in copula* (Marblehead, Massachusetts and Towner, North Dakota) and one record of a nuptial flight for *L. americanus* Emery in 1933 (Matamek region of Quebec) which, in his revision, he considers is "probably" *L. sitkaensis*. None of these swarm records can be considered as referring beyond doubt to *L. sitkaensis*. The synchronization of the flights probably occurred because conditions for swarming became suitable after a relatively long period during which the weather, though permitting emergence and maturation of the sexuals, prevented flight. Relevant weather records (for which we are indebted to Mr. G. D. V. Williams, Plant Research Institute, Ottawa and Mr. D. H. Parkinson, Canadian Forces Base, Trenton) support this view. In both localities the weather on August 19-22 was rainy and unseasonably cool. In Ottawa the last rain fell on 22nd; 23rd was sunny but still cool; and 24th, the day of the swarms, was the first "really warm" day, and the first when the maximum temperature at Trenton reached the seasonal normal.

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PHILIP S. CORBET
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Accepted April 28, 1968

REVIEWS

The Shorebirds of North America

Edited by Gardner D. Stout, text by Peter Matthiessen, species accounts by Ralph S. Palmer, illustrations by Robert Verity Clem. The Macmillan Company of Canada, Toronto. 27 pp., 32 color plates. $24.95.

"The Shorebirds of North America" is in every way an outstanding book. It has superbly beautiful illustrations, vivid writing, and authentic detail. Moreover, the shorebirds are an exciting and fascinating group.

Peter Matthiessen's informative text (pp. 19-135) ranges over countless aspects of the shorebirds. He has a magic with words that catches and retains the interest of the reader. His vivid imagery instantly transports us to the beaches, mud flats, and salt marshes where shorebirds teem. This lively compendium of shorebird lore closes with a selected bibliography of 97 literature references.

An appendix of over 120 pages, by Ralph S. Palmer, contains good accounts of the shorebird species known to occur, or to have occurred, on this continent. Unusual attention is devoted to the various plumages. Also, for each species there is generally an account of field identification, voice, habitat, migration, breeding, and habits. At the end of each account useful sources of additional information are cited.

Robert Verity Clem's 32 full-page paintings were a source of pleasant astonishment to this reviewer. This young painter's early mature treatment of the shorebirds is one of the best of the book's many fine features. Not only are his bird portraits beautiful, they are extremely accurate in plumage and posture as well. Moreover, each painting is an ecological record with apparently the same meticulous care lavished on the ecological details as on the bird portraits themselves. The artist, engravers, and printers have combined to produce illustrations that are truly superb.

Needless to say, this is the finest single volume that has yet appeared on the shorebirds of this or any other continent.

W. Earl Godfrey

National Museum of Natural Sciences
National Museums of Canada
Ottawa, Ontario

Conservation Directory 1968

The National Wildlife Federation, 1412 16th Street, N.W., Washington, D.C. 20036. 149 pp. $1.50 U.S.

This is the 13th annual edition, with 50 more entries and 28 more pages than the 1967 edition. It briefly lists the aims, officers, personnel, addresses and publications of a wide variety of government and private citizens' organizations and agencies at the international, national, provincial or state, and regional levels for North America — all of which are interested in certain broad or narrow aspects of natural history and conservation of natural resources.

Birds in Our Lives

Edited by Alfred Stefferud and Arnold L. Nelson. 1966. United States Department of the Interior, Washington, D.C. 561 pp. Profusely illustrated. $9.00 (U.S.) (For sale by Superintendent of Documents, Washington, D.C. 20402).

"Birds in Our Lives" is a different kind of bird book. It treats informally, at a non-technical level, various aspects of birds, primarily those occurring in the United States, in their manifold relationships with man.

Some of the subjects discussed are birds in connection with the outdoor recreation of millions of people; birds as a resource and how we use them; bird protection laws and other means of furthering birdlife protection; the controversial and generally misunderstood hawks and owls; birds and pesticides; problems with birds at airports; birds on coins, paper currency, postage stamps, and in fine arts and the Bible.

The book examines the role of birds in the development of the airplane; looks at birds as insect destroyers; outlines the extensive research on how birds are able to find their way over vast distances during migration and in homing; describes refuges and sanctuaries in the United States of America; and deals with many other avian aspects.

No fewer than 61 authors combined to produce the 54 interesting and authentic chapters contained in this large volume. In addition, it is profusely illustrated by 372 photographs (some of them full page) and some 80 wash drawings by Bob Hines. A colored frontispiece attractively depicts the Bald Eagle.

W. EARL GODFREY

Museum of Natural Sciences
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NEWS AND COMMENT

Valuable Ontario Waterfowl Marsh Saved from Drainage

The Minister of Indian Affairs and Northern Development Arthur Laing announced today a major extension of his department's program for maintaining wetland habitat for migratory birds. Some 1,300 acres of prime marsh on the south shore of Lake St. Clair near Chatham, Ontario, which is valued by naturalists and hunters for its waterfowl production and as an important staging area for birds on migration, has been preserved from drainage for agriculture through a two-year agreement with the owners, Bradley Farms Limited, of Chatham.

In announcing the agreement Mr. Laing said, "As I outlined in the National Wildlife Policy and Program, it is the intention of the government to prevent the loss of important habitat for ducks and other migratory birds across the country. The preservation of this marsh will maintain the opportunity for thousands of recreation days for naturalists and hunters, and bring revenue to the surrounding communities. The program of leasing prairie potholes is well under way, but this is the first time that a large marsh in Eastern Canada has been the subject of this sort of agreement."

"The Canadian Wildlife Service will use the marsh to investigate the economic aspects of wetlands use in the area," the Minister said. "Following a two-year study, the agreement will be extended if a favourable cost/benefit ratio is determined. The Service will also be producing a management plan aimed at increasing the potential of the marsh for waterfowl use – both for production and during migration."

The agreement will make it possible to continue to provide access to the area for school groups and naturalists, and to demonstrate techniques of improving marshes for increased revenue. The Service will be conducting research on waterfowl and marsh ecology. Preservation of the marsh will permit continuance of the University of Guelph's major investigation of Red-winged Blackbird ecology, which is now in its third year. It is estimated that 100,000 ducks use the area during migration periods each year.

Press Release
Department of Indian Affairs and Northern Development,
Ottawa

Proposed Amendments to the Constitution of THE OTTAWA FIELD-NATURALISTS' CLUB[1]

The Secretary
The Ottawa Field-Naturalists' Club

Dear Mr. Secretary:

I hereby give notice to the Council of The Ottawa Field-Naturalists' Club that at the next Annual Meeting of the Club it shall be moved by Mr. W. J. Cody acting on my behalf that the Constitution be amended by the deletion of all the present text and the substitution of the following revised text arrived at by the Council. I append hereto a copy of the revised text.

(Signed) Theodore Mosquin
Chairman,
Constitution Committee,
Plant Research Institute,
Canada Department of Agriculture,
Ottawa 3, Ontario
July 17, 1968

CONSTITUTION OF THE OTTAWA FIELD-NATURALISTS' CLUB

Articles of the Constitution

1. Name
2. Objectives
3. Membership
4. Institutions
5. Affiliated Societies
6. Benefactors
7. Patrons
8. Special Funds
9. Officers
10. The Council
11. Standing Committees
12. Auditors
13. Business Meetings
14. Elections and Appointments
15. Term of Office
16. Quorum
17. Duties of the President
18. Duties of the Vice-Presidents
19. Duties of the Secretary
20. Duties of the Treasurer
21. Publications of the Club
22. Expulsion from the Club
23. Amendments
24. By-laws

Article 1. NAME

This Club shall be known as THE OTTAWA FIELD-NATURALISTS' CLUB.

Article 2. OBJECTIVES

The Objectives of this Club shall be to promote the appreciation, preservation and conservation of Canada's natural heritage; to encourage investigation and publish the results of research in all fields of natural history and to diffuse information on these fields as widely as possible; to support and co-operate with organizations engaged in preserving, maintaining or restoring quality environments for living things.

Article 3. MEMBERSHIP

Any persons or family shall, upon application and payment of dues, become a member of the Club. Payment of the Annual Dues as set out in the By-laws will be a necessary condition for the continuance of Membership.

1. *Individual Members.* Persons holding Individual Membership may hold office and vote at the Annual Business Meeting. The annual fee shall be set out in the By-laws.
2. *Family Members.* A family shall consist of husband and wife (or either) and their dependent children. Adult Family Members may vote at the Annual Business Meeting and hold office. Families wishing to receive more than one copy of any of the publications of the Club can do so by applying for an Individual Membership in addition to their Family Membership. The annual fee for Family Membership shall be set out in the By-laws.

[1]The present Constitution of the Ottawa Field-Naturalists' Club was published in The Canadian Field-Naturalist 63(4):242-244. 1949.

3. *Sustaining Members.* Upon payment of the annual fee of $25 a person may hold Sustaining Membership in the Club. Individuals or families holding Sustaining Membership shall be entitled to all the privileges of Individual or Family Membership.
4. *Life Members.* Life Members shall be those persons from whom the Club has accepted the sum of $200 in one payment for such membership. Such persons shall be entitled to hold office and to vote at the Annual Business Meeting.
5. *Honorary Members.* Any person who has, to a marked degree, assisted toward the successful working of the Club, or who has made an outstanding contribution to Canadian natural history may be elected by the Council an Honorary Member of the Club. Individuals previously elected by the Council as Corresponding Members shall hereafter be called Honorary Members. Honorary Members shall be entitled to hold office and to vote at the Annual Business Meeting.
6. *Privileges of Members.* Members may participate in the activities of the Club, will receive the publications of the Club and will be provided with a copy of the Constitution and By-laws.

Article 4 INSTITUTIONS

Institutions cannot hold Membership in the Club but may subscribe to the publications of the Club and make donations to the Club.

Article 5. AFFILIATED SOCIETIES

Affiliated Societies are those organizations which have been accepted for affiliation by the Council. The annual affiliation fee shall be set out in the By-laws. A list of Affiliated Societies shall be published in *The Canadian Field-Naturalist.* Affiliated Societies shall receive one copy of the regular publications of the Club.

Article 6. BENEFACTORS

Benefactors shall be those persons from whom the Club shall accept the sum of $500 or more. A list of Benefactors shall be published in *The Canadian Field-Naturalist.*

Article 7. PATRONS

The Council shall have power to elect a Patron or Patrons, not to exceed two in number at any time, after his or their consent has been obtained.

Article 8. SPECIAL FUNDS

The Club shall maintain two permanent funds to be known as the Current Fund and the Reserve Fund.

(1) *Current Fund.* This fund shall contain the working moneys of the Club for current operations. It shall receive all normal income such as regular membership fees and any other moneys not specifically allocated to other purposes.

(2) *Reserve Fund.* This fund shall contain moneys invested so as to maximize long-term capital growth while maintaining sufficient flexibility to provide money on short notice for special requirements as needed.

Article 9. OFFICERS

The officers of the Club shall be a President, a First and a Second Vice-President, a Secretary and a Treasurer.

Article 10. THE COUNCIL

The Council shall consist of the Officers of the Club and such additional members as the Club may elect. Upon retirement of any President of the Club from office, he shall continue as a member of the Council for the ensuing club year. The Editors, the Business Manager and the Presidents of Affiliated Societies shall be ex-officio members of the Council.

The Council shall meet from time to time at the call of the President or of any two other of its members; it shall manage all matters affecting the welfare and activities of the Club; it shall have control of the funds of the Club; it shall present at the Annual Business Meeting a report on the year's work. This report shall be published in *The Canadian Field-Naturalist.*

Article 11.
STANDING COMMITTEES

Three standing committees of at least five members each shall be appointed by the Council, namely: a Publications Committee, an Excursions and Lectures Committee, and a Finance Committee. The majority, including the chairman in each committee, shall be members of the Council. The Chairman of the Excursions and Lectures Committee shall have power to add to the Committee, provided that the majority of the Committee shall at all times be members of the Council.

Article 12. AUDITORS

Two Auditors shall be elected by open vote at the Annual Business Meeting. They shall examine the Treasurer's accounts and certify as to their correctness.

Article 13. BUSINESS MEETINGS

The Annual Business Meeting of the Club shall be held in December.

A Special Business Meeting of the Club may be called by the Secretary on the request of ten voting members. At this meeting no business other than that for which the meeting was called shall be transacted except by unanimous decision of those present.

Artcile 14.
ELECTIONS AND APPOINTMENTS

The President, the two Vice-Presidents, the Secretary, the Treasurer, and the additional members of the Council, shall be elected by ballot at the Annual Business Meeting or at a Special Business Meeting.

The Council shall, at the earliest possible date, appoint:

(1) Editors and Associate Editors (as required) for *The Canadian Field-Naturalist*, and for other Club publications;
(2) A Business Manager; and
(3) Chairmen and members of Standing and Special Committees.

The Council shall have power to accept any resignations and to appoint any member of the Club to fill any vacancies occurring during the club year.

Article 15. TERM OF OFFICE

All persons elected or appointed pursuant to Articles 10, 12 and 14 shall commence their duties at the close of the meeting at which they are elected or appointed, and shall serve until the end or the next Annual Business Meeting or until their successors are appointed.

Article 16. QUORUM

Twenty members shall constitute a Quorum at the Annual Business Meeting or at any Special Business Meeting of the Club, and seven members shall constitute a Quorum of the Council.

Article 17.
DUTIES OF THE PRESIDENT

The President shall arrange, and preside at, Business Meetings of the Club and at meetings of the Council. He shall be, ex-officio, a member of all Committees of the Club.

Article 18.
DUTIES OF THE VICE-PRESIDENTS

In the absence of the President, or, at his request, a Vice-President shall, in order of rank, act in his stead.

Article 19.
DUTIES OF THE SECRETARY

The Secretary shall keep minutes of the proceedings of the Council, the Annual Business Meeting and Special Business Meetings. He shall give previous notice to each member of the Council of its meeting and to the general membership of the Annual Business and Special Business Meetings. He shall be the custodian of the Constitution and the By-laws and of the records of the Club. He shall be the compiler of the Annual Report of the Council and shall make it available to the General Membership at the Annual Business Meeting.

Article 20.
DUTIES OF THE TREASURER

The Treasurer shall be charged with the collection and custody of the moneys of the Club and shall keep a systematic account thereof which shall at any time be open to the inspection of the Council or of the auditors. He shall make disbursements only when authorized by the By-laws or by decision of the Council. He shall submit at each Annual Business Meeting a statement showing the financial standing of the Club.

Article 21.
PUBLICATIONS OF THE CLUB

(1) *The Canadian Field-Naturalist* shall be issued as directed by the Publications Committee.
(2) Other publications shall be issued as directed by the Council.

Article 22.
EXPULSION FROM THE CLUB

Any individual may be expelled from the Club for conduct or activities prejudicial to the well-being of the Club. The procedure shall be as specified in the By-laws.

Article 23. AMENDMENTS

An Amendment to this constitution may be made at an Annual Business Meeting of the Club by a two-thirds vote of the members present, notice having been sent to the Secretary, who shall present it at a meeting of the Council at least two months previous to such Annual Business Meeting, or to the Club at a previous Annual Business Meeting. Notification of a proposed Amendment shall be published in *The Canadian Field-Naturalist* at least one month before the Annual Business Meeting at which a vote on the Amendment is to be taken.

Article 24. BY-LAWS

The Council may make By-laws that are consistent with the provisions of the Articles of this Constitution. The By-laws and any amendments thereto shall be published in *The Canadian Field-Naturalist.*

MEETINGS

CANADIAN SOCIETY OF WILDLIFE AND FISHERY BIOLOGISTS

The annual meeting of the CSWFB will be held at Winnipeg, Manitoba on January 9 and 10, 1969. Additional information may be obtained by writing to:

W. G. Leitch,
Secretary-Treasurer,
CSWFB,
145 Mossdale Avenue,
East Kildonan,
Winnipeg, Manitoba.

ERRATA

Because of the recent postal strike and the temporary curtailment of regular mail service, the Editorial in the last issue of this journal 82(2):75 was transmitted from Banff to Ottawa by telephone. The following noteworthy errors thus made their way into the final text:

1. Paragraph 4, line 1: "flows"' should read "loads".
2. Paragraph 4, line 4: should read "extinct in eastern North America –".
3. Paragraph 4, line 6: should read "Migratory hawk populations –".

The CANADIAN FIELD-NATURALIST

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THE OTTAWA FIELD-NATURALISTS' CLUB

FOUNDED IN 1879

— *Patrons* —

THEIR EXCELLENCIES THE GOVERNOR GENERAL AND MRS. ROLAND MICHENER

The objectives 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

The Canadian Field-Naturalist is published quarterly with the assistance of affiliated societies and of a contribution from the Canadian National Sportsmen's Show. Manuscripts representing observations or the results of original research in any branch of natural history are invited. Contributions to the Letters and to the News and Comment sections are welcome. All material intended for publication should be addressed to the editor. Opinions and views expressed in this journal are private and do not necessarily reflect those of The Ottawa Field-Naturalists' Club nor of any other agency.

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The Canadian Field-Naturalist

VOLUME 82 OCTOBER-DECEMBER 1968 NUMBER 4

POLLUTION, WILDLIFE AND SCIENCE

A RECENT editorial in this journal discussed the threat to many species of wildlife which results from the continued use of the chlorinated hydrocarbon biocides (April-June, 1968). It was pointed out that the danger does not derive from the toxicity of these compounds, but from their capacity to become environmental pollutants which exert sublethal but harmful physiological effects.

In discussing the potential effects of pollutants, a very useful reference point is the total amount of carbon fixed yearly into organic material by the plants of both land and sea, since it provides some measure of the capacity of the global ecosystem to absorb new components. This figure is of the order of 10^{16} grams. Professor Goldberg of the Scripps Institution of Oceanography has calculated that the yearly total of civilization's waste materials which are injected into the atmosphere is already of this order of magnitude. It is clear, therefore, that as civilization expands the balances which have slowly evolved over the past two billion years will be swamped by the sheer bulk of the waste materials produced. At that point, however distasteful the prospect may be to all but the most utopian of planners, our environment will have to be "managed" and the input of all persistent chemicals strictly controlled.

United States production of DDT in 1965 was approximately 140 million pounds or 5×10^{10} grams. World production in that year was therefore roughly 0.001% of the amount of carbon fixed by plants. Since DDT is chemically very stable and since it readily vapourizes to become a gas and thereby leaves the areas where it is applied, almost all of this DDT becomes both a waste product and a pollutant in the global environment. Of all the pollutants of synthetic origin the DDT compounds appear to be the most abundant. Their distribution is totally unexpected. In California the highest DDT residues are found not in the Robins of the cities or the Kestrels of the farmlands, but in petrels, oceanic birds which never approach land except to breed on the off-shore islands[1]. Sooty Shearwaters and Wilson's Petrels, which may be the first and second most abundant bird species in the world, now contain approximately 10 parts per million of DDT residues, a level considerably higher than those in almost all land birds. A comparable situation exists among fish. Fresh-water fishes in California, because of the high usage of all kinds of biocides in that state, contain higher concentrations of the chlorinated hydrocarbons than most fresh-water fishes elsewhere in North America. But the marine fishes in the adjacent areas of the Pacific Ocean now contain residues which are just as high and in some cases higher. The long term trend is clear. By fallout from the air and adsorbed to silt particles suspended in rivers, the chlorinated hydrocarbons are transferred from the land to the sea, where their concentrations are no longer negligible. Their non-polar nature, which makes them insoluble in water but highly soluble in fat, causes them to enter biological systems and to accumulate in those species at the top of the food chains.

Only within the past year has it become apparent that other persistent pollutants are already almost as wide-spread in the global environment. The polychlorinated biphenyls (PCB) are, like the DDT compounds, chlorinated hydrocarbons, but they are industrial products used in the manufacture of some plastics, paints and resins. Their virtual indestructibility ensures that the total production figures of the PCB used in industry will approximate the amount eventually released into the environment, since manufactured products inevitably become waste products. In some industrial outfalls such as San Francisco Bay the amount of PCB in fish and

Mailing date of this number: 5th February, 1969

birds may exceed the amount of DDT. PCB has not yet been measured in Canadian wildlife, but it is likely that fish and birds in the ecosystems of the lower Great Lakes contain physiologically significant amounts of this pollutant. Fulmars from Alaska, Short-Billed Shearwaters from Australia, Sooty Shearwaters from New Zealand and Pink-footed Shearwaters from Chile are now accumulating PCB in their tissues, frequently in concentrations greater than one part per million[1].

Biologists are now confronted with a challenge of enormous dimensions and immediate urgency. What are the effects of these and other persistent pollutants upon the physiology and behaviour of the species which concentrate them? Only "laboratory" biologists can provide the answers which, however, are without any relevance unless they are interpreted and correlated with detailed field studies. Without these we would never know what is actually happening in the environment. Only sound technical data, compiled from many scientific fields which until now have had little in common, can provide the basis for informed public opinion and the implementation of effective political action. What projects in non-human biology should now have greater priority than the determination of the causes of the extinction of the Bald Eagle and the Peregrine Falcon?

The Peregrine Falcons which once nested on the building of the Sun Life Assurance Company in Montreal appear to have been the first recorded victims of environmental pollution in Canada. In 1949 the female was observed eating one of her eggs. The other eggs disappeared one by one and presumably also were eaten. Other abnormalities were observed through 1952 which was the last year Peregrines nested in Montreal[2]. At the time such aberrant behaviour was probably attributed to the old age of one individual bird. Only 15 years later did it become apparent that the same pattern of abnormal behaviour and reproductive failure was occurring simultaneously among Peregrines elsewhere in North America and Europe[3]. Peregrines now no longer breed anywhere in eastern North America and individuals of the surviving populations may contain high concentrations of both DDT and PCB[1].

The same process is now being repeated in other species. In areas of Wisconsin the Marsh Hawks are no longer able to reproduce. The males no longer perfom their spectacular aerial flights in the spring and the reproductive cycle therefore stops at this point. On the Gulf Coast and in California the Brown Pelicans have, within the past ten years, gone from their nesting colonies. The Fork-tailed Petrels have just as suddenly disappeared from the coastal waters of California. Everywhere, contaminated populations of raptorial and fish-eating birds are now laying abnormal eggs with thin shells[4,5]. This discovery, by D. A. Ratcliffe in Great Britain[4] has provided dramatic proof that a widespread change in the chemical environment has occurred which affects the physiology of many species. While studying the reproductive failures of the Peregrine Falcons in Britain, Ratcliffe noted a high incidence of broken eggs. Eggs of Peregrines had been collected for many years and were preserved in museums. By measuring the thickness and weight of the shells, Ratcliffe was able to show that peregrine eggs laid after the Second World War, when chlorinated hydrocarbons came into widespread use, were significantly thinner[4]. Many species of North American birds are now producing thin-shelled eggs[5]. They include all of the fish-eating and raptorial species so far examined which accumulate chlorinated hydrocarbons. The thin shells alone are sufficient to cause breeding failure, but they also indicate other abnormalities in the reproductive physiology of the contaminated birds.

We, the vertebrates, have evolved in a chemical environment where our ancestors might occasionally ingest a foreign poisonous compound or non-polar substances like waxes and resins which would be absorbed by the intestine but could not pass unaltered through the kidney. To rid the body of these foreign substances a mechanism therefore evolved which would make them water-soluble so that they might be excreted. Non-specific but short-lived enzymes which accomplish this are synthesized in the liver. One of the side-effects, however, appears to be the temporary destruction of some of the body's steroids, including the sex hormones. No permanent harm to the individual or to the reproductive capacity of the population would result since the enzymes appear to be short-lived. What appears to be happening now in many species of birds is the continued synthesis of these enzymes as a result of the continuous ingestion of chlorinated hydrocarbons with the food supply. The sex hormones as well as other steroids would therefore be continually broken down.

Will government agencies be able to combat environmental pollution without becoming lost in a bureaucratic superstructure? In the United States several of the governmental "environmental" programs are without any ecological relevance. The Department of Agriculture is about to embark on a massive four year monitoring program to determine whether there is any long-term buildup of the chlorinated hydrocarbons in the environment. It has long been known that chlorinated hydrocarbons applied to soil eventually become vapours and enter the atmosphere. It is also common knowledge that they are virtually insoluble in water. The Department of Agriculture, however, is now monitoring both soil and water to determine whether there is a long term buildup. It would be much more relevant to follow the residue levels in tuna from year to year, since the sea is the link in which these compounds are eventually deposited.

The greatest challenge, however, falls upon the scientific community since only it can provide the data and the conclusions which are needed to formulate public policy. Most scientists working with the development and toxicology of biocides are employed by industry, agriculture or the military, as well as related branches of governments and universities. Their public pronouncements almost invariably reflect the views of their employers and almost never admit a wider responsibility. Independent scientists too frequently are not concerned with environmental and other "practical" problems. Having solved the genetic code, molecular biology is now constructing the Brave New World. Yet only molecular biologists are able to study the enzyme induction phenomenon and to determine whether the induction of these enzymes by chlorinated hydrocarbons has contributed to the extinction of the Peregrine Falcon. Only endocrinologists are able to determine whether hormonal changes are caused by the persistent pollutants and why the male Marsh Hawk no longer performs its aerial display. Only physiologists can find out what has happened to the calcium physiology of the Cooper's Hawks which causes them to lay thin-shelled eggs. But only field naturalists can tell us what is actually going on in the environment. Amateur naturalists especially have an unprecedented opportunity – and an obligation – to compile meaningful and invaluable data.

Industry has so far denied its responsibility in finding out what effect pollutants will have upon our environment. The responsibility falls therefore by default upon the scientific community.

ROBERT W. RISEBROUGH, INSTITUTE OF MARINE RESOURCES
DEPARTMENT OF NUTRITIONAL SCIENCES, UNIV. OF CALIFORNIA, BERKELEY

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THE BIRDS OF THE CHESTERFIELD INLET, DISTRICT OF KEEWATIN, N.W.T., CANADA

E. Otto Höhn
Department of Physiology, The University of Alberta, Edmonton, Alberta

Introduction

The settlement of Chesterfield Inlet (population about 170 in 1967) at 63° 20′N 90° 42′W lies on a bay (which forms a good harbour) on the headland which stands at the southern entrance into the inlet of the same name. Ornithological observations carried out here over a period of eleven days in August 1930 were published by Sutton (1931) and from May 6 to September 2, 1950 by D.B.O. Savile (1951) who was supported by three other observers and who also collected a small number of birds. I arrived at Chesterfield on May 27, 1967 and left there on July 22 travelling by boat to Rankin Inlet. My observations, which were supplemented by some collecting, add sixteen species to the local list as it was known from the above two publications (this figure excludes Thayer's Gull which I saw and collected only at Rankin Inlet) and furnish the first proof of local breeding of four species. The subspecific status of all but one of the proved breeding species is now known on the basis of specimens collected either by Savile or myself. It seems probable that further work will only modify the avifaunal list presented below by the addition, most probably in a high lemming year, of the Rough-legged Hawk, Pomarine and Long-tailed Jaegers, Short-eared and Snowy Owls to the category of locally breeding species. Further observations will almost certainly also establish the local breeding of the Red-breasted Merganser, Peregrine Falcon, the Common and Hoary Redpolls; and perhaps of the White-fronted Goose, Willow Ptarmigan, Golden Plover, Whimbrel, and Pectoral Sandpiper. A number of additional species from more southern areas are likely to be recorded as vagrants.

The term Chesterfield Inlet district is to be understood as the area about the settlement rather than about the inlet as a whole, which extends for a considerable distance inland. While Sutton and Savile's party operated only within a few miles of the settlement; though the latter made a visit to Fairway Island on July 1, I was able to operate somewhat farther afield since unlike Savile and his coworkers I had no other duties to perform during my visit.

On my arrival on May 27 local conditions, apart from the temperature, were essentially still those of winter. All land was snow covered except where the tops of rocky ridges had been freed of snow by wind action, the sea was frozen, the nearest open water was two and one-half miles off shore due east of the village. Nevertheless Snow Buntings, Horned Larks and some Herring Gulls which found food among the garbage dumped on the frozen harbour had already arrived and at the floe edge there were more Gulls, the odd Parasitic Jaeger and some Common Eiders and Black Guillemots while Rough-legged Hawks were migrating through the area in very small numbers.

FIGURE 1. Sketch map of Chesterfield Inlet to show the localities more remote from the settlement referred to in the text.

My itinerary was as follows (the localities visited are indicated on sketch maps 1 and 2): June 2 by skidoo-drawn sled to Rankin Inlet along the coast, June 3 return to Chesterfield by the same route. June 8 by skidoo over the sea ice to Wag and Promise Islands. June 10 accompanied a group of natives seal hunting by canoe from the floe edge off Chesterfield to a point about five miles south of Fairway Island with a brief landing on this island. June 11 by skidoo-drawn sled along the landfast sea ice to the Lake Ikalukarjuk and back. June 13 by canoe to Promise Island where I stayed for seven hours. June 18 by skidoo-drawn sled to Ayaratulik lake and back. June 19 on foot over the sea ice to Sachpik Island, all parts of which were visited. June 25 by canoe to Promise and Fairway Islands, four hours were spent on the first, but only one and one-half hours on the second of these islands. June 27 midnight to midnight June 29, camped on Promise Island. July 2 on foot to the hill Akwa southeast of the village returning next day. July 7, 9 p.m. to 11 a.m. July 11 camped on Promise Island. July 13, 9 a.m. to 5 p.m. stay on Rockhouse Island which was reached by helicopter. July 17 by canoe to Cape Silumiut with a stopover of about one-half hour on Wag Island, stayed the night in the temporary Eskimo hunting camp at Cape Silumiut. July 18 returned by canoe from the Cape to Chesterfield with a stop of about one-half hour on an islet northeast of Out Island. July 21 by canoe to Promise Island. July 22 by Peterhead boat to Rankin Inlet.

The local topography has been ably described by Savile (1951) whose account is followed here with the addition of some remarks about areas he did not visit. The country consists of low barren hills or ridges of severely glaciated granite gneiss. There is a cliff about 90 feet high at Goose point, and there are several long escarpments with cliff faces about thirty feet high on Rockhouse Island. Apart from solid rock there are also extensive areas of rock and boulder debris on the mainland and on Promise Island where they form a coastal zone round most of the island. These rock fields provide nesting areas for Snow Buntings and on the islands for Black Guillemots. Between the rocky ridges there are valleys containing many lakes often with small islets, these latter being sparingly used as nesting places by Canada Geese. There are also many ponds. While most ponds and lakes are rather deep there is a shallow lagoon southeast of the Chesterfield Department of Transport radio station referred to below as the D.O.T. lagoon. Savile describes the low ground as largely Carex marsh with small amounts of sphagnum bog. There are however drier areas of heath-lichen tundra on Promise Island and about Ayaratulik Lake and the smaller Lake Ikalukarjuk. Sizeable stands dwarf birch and willow scrub are very scarce in all areas visited; in fact I found only one such patch on the mainland and one on Rockhouse Island. These areas of shrubby growth are apparently the only nesting areas of Redpolls and of Savannah Sparrows though the latter also breed in stands of a tall coarse grass in sandy areas found near the shore in the Finger Point area and on Promise and Fairway Islands. The shores are largely formed of rock slabs or moraines but in part they are sandy. Sandy shores are evidently the major nesting site of Semipalmated Plovers. Where there are sandy beaches heaps of dead seaweed piled in ridges up to two feet high are frequent. These harbour larvae and pupae and are extensively used by Dunlins, Semipalmated and White-rumped Sandpipers and in some years migrant Baird's Sandpipers, as well as by Ruddy Turnstones and Sanderlings both on the mainland and on Promise Island. Small tide pools on such beaches rich in dead seaweed are also important as feeding places for Northern and Red Phalaropes. The abundance of Black Guillemonts as breeding birds on the offshore islands and of Common Eiders in all coastal areas may be related indirectly to the abundance of *Fucus* in offshore waters.

The activities of the local natives affect birds in a number of ways. Ptarmigan are hunted with firearms and by children, with some success, by stone throwing. Village children rob many eggs of passerines nesting in and about the village. A small toll is taken of the migrating geese, and some loons are inadvertially killed in fish nets. Egg raiding trips are made to the offshore islands and the eggs of Eiders, Loons, Terns and Guillemots are taken in considerable numbers. An unfortunate feature of this egg gathering is that unlike some Alaskan Eskimos I visited in 1965, who set out with tin cans provided with lids in which they can safely transport eggs after padding them with grass or moss, the people of Chesterfield seem to lack the forethought to do

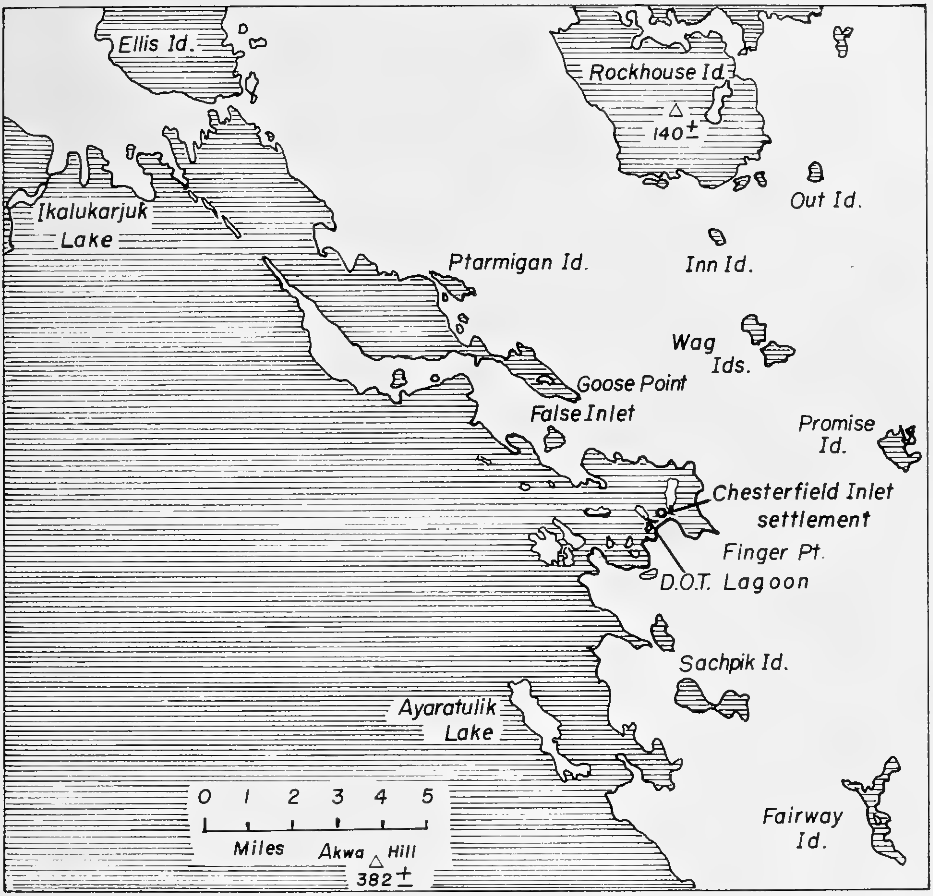

FIGURE 2. Sketch map of the vicinity of Chesterfield Inlet, only those lakes referred to in the text are shown.

this and put the eggs in anything they happen to have handy so that many are broken while the egg hunters scramble about rocks or into and out of their boats.

LOCAL CLIMATE

The following summary is taken from a copy of the town site plan drawn up in 1961 on the basis of local observations by personnel of the Chesterfield Department of Transport Station. Freeze up of the harbour: First week of October, break up first week of July, maximal ice thickness in the harbour 61 inches in early May. Permafrost in August 1960, eleven inches in organic material, fourteen to eighteen inches in coarse sandy material. Mean monthly temperature: January, -25; February, -25; March, -10; April, 0; May, 10 to 22; June 30 to 40; August, 50 to 45; September, 30; October, 20; November, 12 to -7; December, -8 to -12°F. Recorded temperature extremes -60 and 86°F.

TABLE 1.—Estimated number of pairs of breeding birds on Promise Island in 1967, area one square mile approximatley. Proof of breeding on the island was obtained for all species listed except the Semipalmated Plover.

Species	Number of Pairs
Red-throated Loon	5
Pintail	5
Oldsquaw	20
Common Eider	76
King Eider	1–2
Dunlin	1
Semipalmated Plover	2
Semipalmated Sandpiper	10
Northern Phalarope	1
Red Phalarope	6
Parasitic Jaeger	1–2
Arctic Tern	500
Herring Gull	1–2
Black Guillemot	200
Savannah Sparrow	2–4
Lapland Longspur	20
Snow Bunting	15
Total	877

Total annual precipitation 12.1 inches of which snow accounts for 5.7 inches. Snowfall is heaviest in April and again in November. Maximal snow thickness is eight inches. Tides in the harbour from -2 to 3, to 8 feet above intertidal level.

Population density of breeding birds: Saviles paper gives an estimate of the number of breeding pairs in an area of four square miles comprising the eastern portion of the headland on which the village stands. Apart from the fact that in 1967 no phalaropes of either species and fewer Arctic Terns nested in this area his figures appear to me representative of the breeding population there in 1967 as well. If, as he states, the Arctic Tern and Semipalmated Plover are removed from his Table 1, these figures give a picture that would be typical of the breeding population of any area on the mainland in this district, except that in 1967 at least there were no Arctic Loons in most areas. If the sample area included willow scrub, Redpolls and Savannah Sparrows would probably be found breeding too.

For comparison the composition of the breeding bird population of Promise Island is given here in Table 1. Its area is barely one square mile and its avifaunal composition is probably typical of most offshore islands in this segment of the western shore of Hudson Bay.

MIGRATION

Savile felt that Chesterfield was not a good area for the observation of migration and that much of this as far as swans, geese, shorebirds and terns were concerned, probably passed directly between Baker Foreland and Cape Fullerton or even between Cape Churchill and Cape Fullerton. While passing the vicinity Baker Foreland on September 2 he saw a travelling flock of Arctic Terns and one of White-rumped Sandpipers. About Baker Foreland as an observation point for coastwide spring migration I can only add that during about twenty minutes spent here on June 2 only one flock of Snow Geese went past, flying north. The reversed migration observed by Savile in 1950 involving Whistling Swans, Snow and Canada Geese and Pomarine Jaegers was noted in 1967 only in so far as Snow Geese were concerned, a regular south-westerly passage of which was observed for nine days in early June. The local spring arrival dates of the great majority of migrants in 1967 are compared with these for 1950 in the systematic list below. They are in most cases in very good agreement.

SYSTEMATIC LIST

In the list which follows the locale of all observations is the immediate vicinity of the settlement of Chesterfield Inlet, sometimes referred to simply as the settlement or the village, unless some other locality is specified. The local list on the basis of the information presented here and that previously published stands at 22 species of breeding birds, 4 other species which probably breed regularly but have not yet been proved to do so; 24 species of spring and fall transients, post-breeding-season wanderers, or winter visitors; and 11 species of vagrants, making a total of 71 species. Trinomials are used only for those species of which local representatives were collected and examined later at the National Museum of Canada. In the case of Savile's specimens W. Earl Godfrey made the subspecific determinations, for those collected in 1967 this was done by myself with the generous help of Mr. Godfrey.

Savile's paper (Savile 1951) contains a number of valuable observations on behaviour. Information on this topic from my own observations is given below only for the Semipalmated Sandpiper. The only other significant behaviour observations I made were on Rock Ptarmigan, Phalaropes and on a pair of Semipalmated Sandpipers. These are to be published elsewhere.

YELLOW-BILLED LOON. *Gavia adamsii.* Rare spring transient. A single bird was seen in westward i.e. landward flight over Promise Island on June 13. Not observed by Savile's party (Savile 1951).

ARCTIC LOON. *Gavia arctica.* Transient and scarce breeding bird. Observed at sea in pairs or as single birds near Fairway Island June 10 and near Promise Island on June 13. While these were evidently migrants, a pair seen on July 13 in the sound between Rockhouse Island and the adjacent island were probably in their nesting area. Thus no proof of breeding was obtained in 1967 but Savile's party secured two breeding records in 1950 (Savile 1951).

RED-THROATED LOON. *Gavia stellata.* Common breeding bird near the coast and on offshore islands. It was first seen at sea, singly or in pairs on June 10 near Fairway, on the 13 near Promise Island. None were observed on fresh water until June 18. On June 25 there were four pairs on the largest lake on Fairway Island and a nest with two eggs was found. On June 29 there were also four pairs on the largest lake on Promise Island and a nest with one egg was found. Another pair had a nest with two eggs on a small lake on the same island. On the mainland a nest with two eggs was found on July 3 on a lake about three miles east of Chesterfield. Other localities visited where these loons appeared to be nesting and the numbers seen at each are: Ayaratulik Lake, 3-4 pairs, Sachpik Island, 3 pairs, Goose Point: 1 pair, Finger Point: 1 pair, Rockhouse Island: 4-6 pairs, Cape Silumiut, 1-2 pairs. Three were caught in fish nets set by the Chesterfield natives and used as dog food. One of these, a female taken July 18 weighed 1,754 g. Its measurements in mm. were: total length 632, wing 270, bill 50, tarsus 58.

Savile's party first observed this loon on fresh water on June 18 and found one pair with young later.

WHISTLING SWAN. *Olor columbianus*. Rather scarce spring migrant. One breeding record. The first spring observation of Savile's party was on May 27. I saw none until June 3 when a flock of twenty resting by a pool of melt water on the landfast ice about fifteen miles east of Rankin Inlet was observed. Several of those displayed, standing face to face in couples with extended necks and raised bills waving their abducted wings. After this, one was seen in flight over the sea ice toward land at Chesterfield on June 11 and a pair flew over Promise Island on July 8. Savile (1951) cites the report of a prospecting party who found a pair with young twenty miles south of Chesterfield in 1950.

CANADA GOOSE. *Branta canadensis parvipes*. Breeds in small numbers. On May 30 a flock of twelve was seen flying northward along the floe edge of Chesterfield Inlet settlement. On June 3 a flock evidently of resting migrants containing between 600 and 1000 birds with about 30 Snow Geese and a few Blue and White-fronted Geese was observed on the landfast sea ice about fifteen miles east of Rankin Inlet settlement. On June 5, a flock was seen flying in from the south near Chesterfield Inlet settlement. Thereafter pairs or small groups were seen in all areas visited but there was no further evidence of migration. On July 2, one was observed on the nest on an islet in a lake about three to four miles southeast of the settlement and a similar observation was made on a lake on Rockhouse Island on July 13. In both cases while one bird flattened itself out on the nest in an attempt to remain undiscovered, the persumed gander was on guard on the shore of the lake. A male collected on June 8 on Promise Island weighed 1,897 g. and its testes were 2 and 1.5 cms. long respectively, wings 420 and 415, bill 45, tarus 82 mm. On July 20 five Canada Geese, very obviously much larger than two of the small local breeders with them, were observed grazing on the shore about two miles north of the settlement. They were presumably post-breeding or non-breeding wanderers of the form *Branta canadensis interior*.

BRANT. *Branta bernicla hrota*: Observed as a fairly common spring transient. On June 8 a Brant joined a small flock of Canada Geese resting on a frozen lakelet on Wag Island. On June 10 a flock of about 20 was seen in flight over the sea near Fairway Island. On the 13 there were about one hundred on Promise Island. An immature male was collected from a family party of four. It weighed 1050 g. On June 14 a flock of about 200 were resting on Finger Point and there was one there on June 22. On the 25th about 25 were seen on Promise Island. Savile (1951) did not record this species.

WHITE-FRONTED GOOSE. *Anser albifrons*. A rather scarce spring migrant. On May 30 six were seen flying southwest along the floe edge of Chesterfield Inlet. On June 3 there were about twenty geese of this species resting, among the large flock of Canada Geese on the landfast sea ice about 15 miles east of Rankin Inlet. On June 6 one flew southwest with four Canada Geese along the floe edge at Chesterfield Inlet. On June 7 near Chesterfield Inlet settlement a pair flying southwest overland and one June 13 a single bird flying northeastward over the land. This goose was not observed by Savile's party (Savile 1951).

SNOW GOOSE AND BLUE GOOSE. *Chen hyperborea, Chen caerulescens*. Spring transient. The great majority of Snow Goose flocks seen included about one Blue Goose for every three Snow Geese. A few flocks consisting only of Snow Geese were seen. It may be worth noting that the local Eskimos consider these two geese as belonging to one species as they "always see them together." With the large flock of Canada Geese seen resting on the ice east of Rankin Inlet on June 3 there were about 30 Snow Geese and a few "blues". From June 5 to 14 flocks of 30 to 50 were seen flying over

FIGURE 3. Nest of Snow Bunting in rusty tin can Chesterfield Inlet settlement, June 27, 1967.

Chesterfield Inlet in a southwesterly direction every day. This reverse migration presumably represented birds drifting southward from northerly breeding grounds where at the time of their arrival they found conditions not yet suitable for egg laying. On June 15 one flock of Snow Geese only was seen flying northeastward. Snow and Blue Geese were seen on the ground on Finger Point on June 6 and July 4; on Wag Island on June 8; on June 13 on Promise Island; and on the 19th on Sachpik Island. A single Snow Goose seen on July 10 and 11 on Promise Island was presumably a non-breeder.

MALLARD. *Anas platyrhynchos*. On July 5 a female was seen on the D.O.T. lagoon and on the same day three males were observed on a pool on Finger Point. This species was not previously reported for the area.

PINTAIL. *Anas acuta*. Fairly common, breeds. Pintails were first seen on June 13 when about ten were present on Promise Island. Some engaged in aereal pursuits in which two males pursued a single female. A nest with seven eggs was found in a clump of dead grass in a sparsely vegetated area of pebbles and sand on Promise Island on June 29 and another nest found on the mainland at Finger Point in a very similar situation on July 5 contained two eggs. These records constitute the first proof of breeding in this area. The breeding area may however extend some distance along the coast north of Chesterfield Inlet since on July 17 and 18th, on the occasion of my only visits to this portion of the area, some were seen as far north as Cape Silumiut. Savile (1951) recorded this duck but was unable to secure proof of breeding. Sutton (1931) who was in the area after the breeding season saw 30 to 100 daily from August 18 to 28.

GREEN-WINGED TEAL. *Anas carolinensis*. A pair was seen on June 14 on the D.O.T. lagoon and on the 15 a male just east of Chesterfield Inlet village. It was also observed on Promise Island, two males on June 28 and a female on July 10. The appearance of birds of this species and of the mallard, took place at dates that suggest

FIGURE 4. Nest of Oldsquaw on Promise Island, June 25, 1967.

northward wandering from breeding grounds farther south.

COMMON GOLDENEYE. *Bucephala clangula*. This duck, recorded by Savile (1951) as frequently seen between July 2 and 22, must be a regular post-breeding wanderer into the area, for in 1967 it was also recorded, between June 27 and July 18. Although males predominated, females or immatures were also seen. It was recorded as far north as Cape Silumiut where ten were seen on the wing on July 18.

OLDSQUAW. *Clangula hyemalis*. Very common breeding bird. First seen at the floe edge off Chesterfield Inlet on May 30 (none were seen here on May 28), they did not appear on pools on the land until June 11. By June 22 there was a pair on just about every pool including some as small as about 1/10th of an acre in area. On June 24, by which date the local breeding birds were already well established, large flocks appeared on lakes east and west of Chesterfield Inlet settlement and dissappeared again two days later. This second wave of spring migrants presumably involved birds en route to more northern breeding grounds. A nest with four eggs was found on the mainland on June 23 and another found on the 27 held eight eggs. Two nests found on Promise Island on June 25 had seven eggs each while another nest with seven and one with six was found there on June 28 (Fig. 4). One on July 5 had only two eggs and another on July 7 had six eggs. Young out of the nest were seen on July 10. A male was collected July 9 on Promise Island.

COMMON EIDER. *Somateria molissima sedentaria*. Common breeding bird in the coastal zone and on all offshore islands visited. Its spring arrival in the area at sea presumably preceded my own as some were seen off the floe edge on May 30 and Savile (1951) reported it on the sea from May 15 onward. Migration however continued until early June as a large loose flock of about 400 was seen off Promise Island on June 8. They were first seen on ponds on June 11, in 1950 the corresponding date was June 10 (Savile 1951). The following nests were found: one near Chesterfield settlement with

Figure 5. Black Guillemot on breeding ground Promise Island.

two eggs on June 17 and four eggs on the 20th. No further eggs were laid in this nest and the eggs were still unhatched on July 20. A nest with two eggs was found on Sachpik Island on June 19. A three-egg nest on Promise Island found June 28 was robbed, almost certainly by a Parasitic Jaeger. Others found on this island were: June 25 five eggs, another July 8 with 5 eggs. On July 13 a nest with seven eggs was found on Rockhouse Island. Nests were found also on an islet northeast of Out Island on July 19. The first young were seen on July 18. Males remained on the land until at least July 13. A male collected June 19 weighed 2,548 g., its measurements in mm. were, wing 307, bill 63, tarsus 45: a female collected June 28 was not weighed but had the following measurements in mm. wing 270 and 273, bill 52, tarsus 55. The wing colour of this last bird was characteristic of the subspecies indicated. A female collected by Savile on June 15, 1950, weighed 2,127 g.

King Eider. *Somateria spectabilis.* Breeds but is much less common than the preceding species. The offshore spring arrival is evidently considerably later than that of the Common Eider for in 1950 Savile's party did not record it until June 12 and in 1967 my first observation was on June 8 when a single male only was seen flying over the shore of Promise Island. Two days later about ten of both sexes were seen at sea near Fairway Island. The first appearance on fresh water was also later than in the case of the preceding species, namely June 19 in 1967, and the withdrawal of adult males from fresh water took place about July 6. A nest consisting only of a ring of down, but no eggs, was found on June 29 on Promise Island, and another on the same island on July 8 had five eggs. A male collected on July 5 weighed 1,754 g.

Red-breasted Merganser. *Mergus serrator.* Fairly common. May breed but no proof of breeding secured. On June 8 a pair was observed near Wag Island, and on June 10 a pair at sea near Fairway Island. A pair at Finger Point June 17, 22, and 27. A pair plus a female at Ayaratulik Lake on June

18. A pair and two other females on a lake about two miles east of Chesterfield settlement on July 12. A pair and two single females on July 13 at Rockhouse Island. Also several were seen on July 18 at Cape Silumiut. Savile (1951) and Sutton (1931) did not observe this species.

ROUGH-LEGGED HAWK. *Buteo lagopus*. Scarce spring transient. Single birds were seen over Chesterfield Inlet settlement (on one occasion over Sachpik Island) on five days between May 27 and June 9.

PEREGRINE FALCON. *Falco peregrinus*. The Chesterfield Inlet settlement was evidently within the hunting area of a pair of these falcons in the spring and early summer of 1967 for one paid brief visits to the settlement on six days between May 28 and June 25, and on June 6 both members of a pair were seen. A single Peregrine was also seen over Promise Island on June 28 and one on July 13 on Rockhouse Island. Savile (1951) who also saw one about the settlement in late May and in June, describes an old nest possibly of this species near which a falcon was seen two miles northwest of the village This would appear to indicate the cliffs at Goose Point which I visited on June 20 without seeing either falcons or signs of an old nest. On Rockhouse Island there are several cliffs I would have judged to be attractive breeding sites for this species but there too no signs of a nest were found.

WHITE-SHAFTED WILLOW PTARMIGAN. *Lagopus lagopus leucopterus*. Winter visitor in small numbers. Both Savile's party in 1950 (Savile 1951) and I found a few wings, presumably the remains of individuals that had wintered in the area. On June 13 I collected a lone cock on Promise Island, it weighed 680 g. and measured (in mm.): wing, 210, bill, 14, tarsus, 30. Presumably this was a bird that had delayed its spring migration to the nearest breeding area of this subspecies on Southampton Island or extreme northern Keewatin (Godfrey 1966). Sutton (1931) cites a report given to him by a Hudson's Bay Company employee of a nest with 14 eggs found some distance inland from the village. If this nest did indeed belong to a Willow Ptarmigan it would, in this area, almost certainly have been *Lagopus lagopus albus*.

ROCK PTARMIGAN. *Lagopus mutus rupestris*. Abundant breeding bird on all mainland areas visited and on Rockhouse Island, but not on the smaller more exposed islands such as Wag, Promise, and Fairway where none were seen in the breeding season. A large proportion leave the area in winter. The spring immigration was observed by Savile's party in 1950 between May 1 and 21 (Savile 1951). As I did not arrive until May 27 I missed most of this movement but saw a female resting on the sea ice two miles from land on May 30 and within the next two days saw one flying in over the sea ice from the south. In late May and early June the males, which probably perform the spring migration earlier, were seen singly on their territories and not all had yet acquired a mate while hens were seen in small flocks of three to seven birds up to June 5. A female taken by a native on June 18 had a shelled egg in the oviduct. A nest with ten eggs was found by Father Fafard of the Chesterfield Mission on June 27 and was seen by myself on July 1st. A hen with six downy young was seen on Rockhouse Island on July 13. Weights and measurements of four adults collected were as follows: Female May 30 weight 505 g. total length: 360, bill 11 and wing 190 mm. Males: June 2, 19, and July 12 weighed 525, 505, and 565 g. Their measurements were: wing 196, 190, and 187, bill 12, 12, and 13, tarsus 26, 27, and 28. The female collected May 30 had a fully developed black eye bar but this was absent in all other females seen at close range. Two downy chicks a day or two old weighed 20 g. each.

SANDHILL CRANE. *Grus canadensis canadensis*. Scarce breeding bird. One was shot by a native at Ayaratulik Lake on June 18 and I examined it in the flesh. It could not be sexed with certainty, and weighed 2,794 g. Its measurements were wing 445, bill 87, tarsus 180. On June 21 two were seen east of Chesterfield Inlet settlement, and on June 25 a pair was seen in northward flight over Fairway Island. On July 3 one which showed anxiety as if it had young or a nest nearby was seen about two miles east of Chesterfield village, while on the following

FIGURE 6. Patch of willow scrub on Rockhouse Island, July 13, habitat of Common Redpolls and Savannah Sparrows.

day Koluar and another native came across two downy young less than a week old near Ayaratulik Lake. This species was not recorded by Savile (1951) nor by Sutton (1931).

SEMIPALMATED PLOVER. *Charadrius semipalmatus*. Fairly common breeding bird. The first observation was of a pair at Rankin Inlet on June 3. At Chesterfield I did not see it until June 7, but its spring appearance here in 1950 was rather earlier i.e. June 2 (Savile 1951). A nest on a sandy beach which held three eggs on June 23 had the full clutch of four by the 26. The eggs hatched on July 18 giving an incubation period of twenty-three to twenty-four days. Savile's party in 1950 apparently found several nests and collected a male.

GOLDEN PLOVER. *Charadrius dominica*. Scarce spring and fall transient. The first 1967 sighting was of a flock of six seen on June 2. After this it was only observed on June 6 and 16, in both cases only two birds. Fall passage observations were made by Savile's party in 1950 and by Sutton (1931) in August.

BLACK-BELLIED PLOVER. *Squatarola squatarola*. Scarce spring and fall transient. Two were seen on June 7 and 9, five at Ikalukarjuk Lake on June 12, a few small flocks on Promise Island on June 13, and a single bird at Ayaratulik Lake on June 18. In 1950 the first spring sighting was made on June 8 and the last on June 25, fall passage sightings were between August 10 and 31 (Savile 1951).

RUDDY TURNSTONE. *Arenaria interpres*. Spring and fall transient. One was seen in the Chesterfield garbage dump, which at that season was on the harbour ice, on May 30 at which time the land was still completely snow covered. Others were seen up to June 22, the greatest number seen together being ten. They were usually seen on the beaches among heaps of dead seaweed. The 1950 spring passage was from June 11 to 22, and fall observations were made from July 2 onward Savile (1951).

Sutton (1931) saw some daily between August 19 to 25 in 1930.

WHIMBREL. *Numenius phaeopus hudsonicus.* Post breeding transient. Observed on June 26, then from July 7 to 21 in the Finger Point area and on Promise Island where the greatest number present at any one time was eight. One was also seen at Cape Silumiut on July 18. In 1950 it was observed between July 7 and August 19, up to twenty-seven on occasion (Savile 1951). Sutton (1931) also gives one August record. A female collected on July 15 weighed 440 g. and its measurements were total length: 445, wing 235, tarsus 54, and bill 30 mm.

KNOT. *Calidris canutus.* Very scarce spring transient. Only one observation of a single bird in breeding plumage on Promise Island on June 13. Savile's party also recorded only two sightings each of a single bird on June 9 and 17, 1950 (Savile 1951).

PURPLE SANDPIPER. *Erolia maritima.* Very scarce spring and fall transient. One was observed on June 13 on Promise Island. Savile (1951) records two June sightings of single birds and one in late August of two. Sutton (1931) did not record it during the ten days spent in August 1930 at Chesterfield.

PECTORAL SANDPIPER. *Erolia melanotos.* Scarce spring transient, possibly bred on Promise Island. A single bird which at times showed the anxiety typical of a bird disturbed near its nest; was seen there on June 25 and July 10. Savile's party recorded single birds only between June 9 and 17.

WHITE-RUMPED SANDPIPER. *Erolia fuscicollis.* Common spring and fall transient. A few were seen at Rankin Inlet on June 3. In the Chesterfield area it was not observed until June 8 and was last observed on the 28. They were seen in some numbers on mainland beaches feeding among heaps of dead seaweed and in small numbers on Promise and Fairway Islands. The song flight was recorded on June 12 and 21 as a buzzing insect-like "uss rrr, uss rrr". On taking flight the birds called "tsit, tsit". A female collected on June 25 weighed 40 g. The bird was not in full breeding condition and was probably a non-breeder. Records during the fall migration from July 26 to late August were obtained by Savile (1951) and for late August by Sutton (1931).

DUNLIN. *Erolia alpina.* Breeds in small numbers. First observed on June 8 (in 1950 on June 2, Savile 1951) when there were about 100 on Promise Island. On June 13 1967 there was a flock of at least 200 feeding on dead seaweed on a beach on this island. As this was by far the largest number seen this date represents the peak of the spring passage. The purring flight-song was heard on June 19 and 28. It was recorded apart from Promise, Wag, and Rockhouse Islands and the immediate vicinity of the settlement also on Sachpik Island and at Ayaratulik and Ikalukarjuk lakes. A nest with two eggs was found on June 18 on the mainland and another with four eggs on Promise Island on July 9. Savile's party collected a female, found two nests, and recorded a peak fall passage on August 23 (Savile 1951). Sutton (1931) also observed it in August.

DOWITCHER. *Limnodromus griseus or scolopaceus.* A single bird was seen on Promise Island on June 28.

STILT SANDPIPER. *Micropalama himantopus.* A single bird in full breeding plumage was seen on the east edge of the village on June 11, and on June 14 and 19 at the D.O.T. Lagoon. Neither of the above two species have previously been recorded in the area.

SEMIPALMATED SANDPIPER. *Ereunetes pusillus.* The most abundant breeding shorebird. First seen on June 8. (The 1950 first date was June 11 and in that year most local adults had left by August 7 migrants were seen after that date with a peak on August 21 according to Savile (1951). It was seen in all localities visited including the islands. Birds giving the flight-song were observed on June 11, 18, and 19 and July 7. The song to my mind is suggestive of the ring of an alarm clock alternating between two pitches, Savile's rendering as "vurravurravurra" is quite apt and is given as the bird circles about fifty yards above the ground flying with vibratory wing beats or at times glides with the wings at an angle of about 45°. A ground pursuit similar to that described by Savile was observed on June 13 and 20. The pursuer ran after the presumed female continually trilling "yu yu yu yu" with the tail cocked up and both wings raised at an angle of about 45°. The following nests were found: June 25 Promise Island one with four eggs, and two others each with four eggs on June 28. On the mainland a nest with four eggs on July 12, another with two eggs and two newly hatched young on July 14, and a set of downy young already out of the nest on the following day. Savile's party found four nests on the mainland (Savile 1951). The birds flushed from nests, ran a few steps in a "rodent run" attitude and then crouched, spread the tail and wings, touching the ground with both, and gave a call which was essentially a slower version of the flight-song.

The weights and measurements of adults collected were:

	Weight g.	*Total Length*	*Wing*	*Bill*	*Tarsus* in mm.
June 25 male	30	145	92	20	18
June 21 female	45	150	97	20	19.5 — Had one shelled egg in oviduct
June 20 female	15	153	98	20	20

Two males collected by Savile weighed 24.6 and 26.3 g.

SANDERLING. *Crocethia alba.* Fairly common spring and fall migrant. Seen from June 11 to 25, the maximal number seen at one time being about twenty. Then not observed again until July 20 when there were about ten. Savile's party recorded the spring passage in 1950 from June 10 to 25 and the fall passage from July 16 (with a peak about August 14) to August 22.

RED PHALAROPE. *Phalaropus fulicarius.* Fairly common spring and fall migrant, breeds very locally. First observed on June 13 when there were about 50 at sea off Promise Island and a few actually on the island. A smaller number were seen flying landward from the floe edge near Chesterfield on the same day. All that were seen on that day, clearly enough to ascertain their sex were females. From June 14 to 24 there were a few of both sexes, with a maximum of seven on the latter date, on the D.O.T. lagoon or at times at tide pools on the adjacent beach. Mating while the birds were on shore was observed near the lagoon June 23. Elsewhere on the mainland it was observed only at Finger Point where there were a few up to June 24. Fourteen were seen in landward flight over the sea ice on June 18 near Sachpik Island and two over the False Inlet on June 20. On June 25 there were nine of both sexes on Promise Island and about as many on Fairway Island. I believe they nested on the latter island but I was unable to make a later visit there. On Promise Island a nest with four eggs was found on June 28 and a few matings were seen there, some on land some on water, on this and the next day. Between July 7 and 10 three more nests, each with four eggs were found as well as a nest in which only two eggs were laid. A sixth pair of birds made a nest-cup in which the male and immediately afterwards the female were seen to crouch briefly but in which no eggs were laid. All females left this island on the night of July 9-10. None were seen there during the next 24 hours and no females had returned by July 21 when I last visited the island. On that date the nest originally found on June 28 contained only two cold eggs. The eggs in two other nests had apparently hatched and in another the four downy were still in the nest and were being brooded by the male. The eggs in the nest in which only two eggs were laid were still being incubated. All but the first mentioned nest were within the ternery. The location of Red Phalarope's nests within Arctic Tern colonies has been noted by Lovenskiold (1964) in Spitzbergen and it undoubtedly helps to protect the eggs and young of Phalaropes from jaegers and other potential predators. Five of the six

Promise Island nests were within a strip 150 yards long and thus constituted a small colony.

The sighting of all Red Phalaropes that were definitely travelling, over the sea ice in a landward direction indicates a coastwise migration. Since Sutton (1931) recorded their arrival on Southampton Island north of the locality under discussion, earlier, namely on May 19, this suggests that birds breeding on Hudson Bay reach this area by travelling southward from Hudson strait.

A male collected June 23 weighed 40 g. and measured wing 134, bill 21.5 and tarsus 21 mm. Two females collected June 25 weighed 70 and 80 g. and measured wings 129 and 137, bill 23, and tarsus 21 and 16 mm. The total weight of four newly hatched young was 12.5 giving an average weight of 3.17 g.

Savile in 1950 first saw these birds on June 11 and later found one male with young on the mainland. He saw none on fall passage but Sutton (1931) recorded a few between August 19 and 21.

NORTHERN PHALAROPE. *Lobipes lobatus.* Spring and fall migrant and rather scarce breeding bird. First seen on June 13 at Promise Island when one pair was seen on this island and one pair at sea. One pair eventually attempted nesting on this island within the Red Phalarope colony for a nest-cup was found on June 29 but later rains inundated the area. On the mainland it was seen at the D.O.T. lagoon from June 14 to 30, five being the maximum number present, and also in the Finger Point area. It will be noted that for this species both sexes were represented from the first. A few were also seen on Fairway Island on June 25 where it may well have nested. A nest with four eggs was found on the mainland on July 12 about two miles southeast of the village and on July 2 a male was flushed from what was probably another nest in the same general area. Savile's first observation in 1950 was on July 11. He found no nests but saw slightly grown young on August 4. Sutton (1931) in 1930 saw many indicating fall passage on August 20 and 21. Savile collected a male weighing 34.65 and a female weighing 38.27 g.

This species almost certainly reaches this area by migrating from the south, which of course involves much overland flight.

POMARINE JAEGER. *Stercorarius pomarinus.* Scarce spring transient. Only two observations, a flock of eight, only one of which was of the dark phase, flying in from the inlet at Ikalukarjuk Lake on June 11 and a single bird over Promise Island June 13. Savile's party in 1950 saw only one flock, ten on June 5.

LONG-TAILED JAEGER. *Stercorarius longicaudus.* Single birds were seen on the wing on five days, from June 7 to 14 and one group of four flying in from the inlet at Ikalukarjuk Lake on June 11. Savile's party saw one on the spring passage and one in August (Savile 1951).

PARASITIC JAEGER. *Stercorarius parasiticus.* Well distributed breeding bird. First seen at the floe edge on May 29 and June 1 and at Chesterfield itself on June 9 (in 1950 it was first recorded on June 17). On June 25 a pair on Promise Island showed a vigorous distraction display, as if they had a nest, and the male of the pair when collected was found to have well developed brood patches. It's mate still gave a nest distraction display four days later although by then the nest had been robbed, presumably by other Jaegers. On the mainland a nest with two eggs was found on a slight ridge in a small marsh of tussocky grass on July 12. One of the eggs hatched on July 16 the other on the 19. When the adults at this nest were in aerial distraction display and calling due to my presence, another Parasitic Jaeger appeared and being attacked by the nesting pair only gave in and took off after some fighting on the wing. There were 2-3 apparent breeding pairs very near Chesterfield, a pair each on Promise, Fairway, and Wag Islands, and three to four pairs on Rockhouse Island. On Fairway one was seen robbing a Herring Gull nest and on Promise Island one was seen feeding on the corpse of an Oldsquaw. Savile's party in 1950 observed two mainland nests. A male collected June 25 weighed 465 g. and measured (in mm.): total length 472, wing 306, bill 28, tarsus 38. Savile collected a male weighing 503 and a female weighing 517 g.

GLAUCOUS GULL. *Larus hyperboreus.* Spring transient. Seen in small numbers, maximum six, almost always with Herring Gulls between June 1 and June 17 about the village or at the floe edge. Savile's party did not record this species (Savile 1951).

HERRING GULL. *Larus argentatus smithsonianus.* Fairly common breeding bird on the mainland and on offshore islands. Ten were already present on the frozen harbour at Chesterfield on my arrival on May 27. I was told they had first been seen about a week earlier, which corresponds well with Savile's first date of May 21. While most of the ground was still snow covered there was a flock on the frozen harbour where garbage was dumped and larger flocks at the floe edge, after mid-June they were dispersed in pairs and nested in scattered pairs on islets in lakes including one pair on Promise and Fairway Islands on June 28. Extremely few immatures were seen. A female with brood patches collected July 13 on Rockhouse Island weighed 930 g. and measured total length 593, wing 480, tarsus 64, and bill 47 mm.

THAYER'S GULL. *Larus thayeri.* Only one post-breeding record from Rankin Inlet. A sub-adult was collected there on July 24 when there were also three to four adults present among a flock of Herring Gulls. It weighed 1010 g. and its measurements were wing 420, bill 40, and tarsus 62 mm. The iris was brown, the eye ring grey, the bill pale yellow with a faintly orange gonys, tip of both mandibles dark, legs pale flesh colour. No black was visible on the wings of this bird in life though in the hand growing primaries with black tips could be exposed. In life I believed this bird to be an Iceland Gull and in view of this believe the gulls so recorded on this area by Savile might well have been Thayer's Gulls.

SABINE'S GULL. *Xema sabini.* A spring transient. First seen on June 13 when there were about 20 on Promise Island and a total of 200 to 300 busily feeding at sea between this island and Chesterfield. On June 17 about 20 were seen near Chesterfield and one in flight over Fairway Island on June 25. Neither of the preceding two species was observed by Savile's party.

ARCTIC TERN. *Sterna paradisaea.* Abundant breeding bird on offshore islands and in much smaller numbers on the mainland. First seen on June 13 when 60 or so were observed over the sea between Promise Island and the mainland. In 1950 the first observation was made on June 19 (Savile 1951). There were about one hundred pairs established on Fairway Island on June 25 at which time there were nest-cups but no eggs to be found as yet. The large Promise Island ternery contained about five hundred pairs and many nests with two eggs and some with single eggs were found on July 7. There was a small colony on the mainland at Finger Point where the first egg was found on July 3. The breeding population of Wag Island was about fifty pairs. Nests were in areas of gravel or very short grass. Two abnormally coloured eggs were found on Promise Island, sky blue with a broad brown band with black-brown spots near the more rounded pole. Savile's party in 1950 also found nests on islets on mainland lakes. They collected a female and a male which weighed 109 and 116.9 g. respectively.

THICK-BILLED MURRE. *Uria lomvia lomvia.* Non-breeding summer offshore resident. On July 19 I saw one which had been recently shot at Cape Silumiut. On July 22, while travelling by boat from Chesterfield to Rankin Inlet, I saw groups of up to 20 birds at sea off Fairway Island, there being altogether about 150 in the general area. Savile (1951) records 20 or more on July 1 between the mainland and Fairway Island.

BLACK GUILLEMOT. *Cepphus grylle ultimus.* Breeds abundantly on several offshore islands. First seen in small numbers from the floe edge on May 30 (in 1950 it was first observed on May 15 by Savile 1951). On June 13 there were about 300 off Promise Island some rested and displayed on small floating floes and a copulation was seen on such a floe. On June 25 a few birds acted as if they had eggs on Promise Island and on July 9 several nests with two eggs each were found under rocks (Fig. 5). Many appeared to have eggs under rocks which could not be raised to expose the eggs. The Promise Island breeding population was estimated at 200 pairs. Probably at least this number also bred on Fairway. The breeding population of Wag Island was estimated at 30 pairs. There was also at least one nest with eggs on an islet a few miles northeast of Out Island visited on July 19. The natives take a considerable number of eggs from all of these islands removing, in fact, all eggs they can reach by lifting up the rocks under which they are hidden. They harvest the eggs of these birds regularly. A pair collected on Promise Island on July showed the following weights and measurements: male 390 g., wing 161, bill 26, tarsus 37; female 450 g. (it had an unshelled egg in the oviduct), wing 155, bill 26, tarsus 36 mm.

SNOWY OWL. *Nyctea scandiaca.* Spring and summer transient and wanderer. One was seen on Sachpik Island on June 2 and another on Wag Island on June 8. On Promise Island a female appeared on the evening of July 8 which when first sighted was perched on a rock pile and was mobbed by Parasitic Jaegers. On my approach it took off and perched on a block of stranded ice on the shore. From here it swooped out several times at Black Guillemots swimming just offshore but did not succeed in taking one. I felt that a bird seen at this date should be breeding but certainly it was not doing so on Promise Island. On July 13 I had an opportunity to check the nearest land, Wag Island, in a low level helicopter flight. It was possible to identify birds down to the size of terns but no owl was found here or on Rockhouse Island, a good part of which I was able to cover on foot. I therefore presume that this was a non-breeding bird. Savile's party did not observe any Snowy Owls. (Savile 1951).

HORNED LARK. *Eremophila alpestria hoyti.* Common breeding bird. At least one was already present on my arrival at Chesterfield on May 27 (In 1950 the first spring observation was made on May 21). The song was first noted on May 24 and last on July 19. A nest with two eggs was found on June 14. Some were still present on September 1 in 1950 (Saville 1951). On the offshore islands it was seen only during the spring migration.

WATER PIPIT. *Anthus spinoletta rubescens.* Uncommon breeding bird. First observed on May 30 (in 1950 the first spring observation was on May 21) and seen fairly frequently thereafter. No nests were found in 1967 but Savile (1951) found a nest with six eggs on July 4 and collected a female weighing 27 g. He observed that most local birds left in early August but saw a scattering of migrants later.

RAVEN. *Corvus corax.* Scarce visitor. A raven's pectoral girdle with wings attached was found on Promise Island in June. One of the natives told me he had seen one near the settlement in the winter of 1966-1967.

CLIFF SWALLOW. *Petrochelidon pyrrhonata.* Vagrant. Close views of one were obtained on June 15 as it was flying about the Chesterfield hospital. It was still there on the following day when it was sheltering from the wind in the lee of a sandy cut bank.

SAVANNAH SPARROW. *Passerculus sandwichensis oblitus.* Rather local breeding bird. First seen on June 11 when there was one on Finger Point and another in song at Ikalukarjuk. On June 25 there was at least one pair on Promise Island; the male sang and also pursued the female on the wing. On the same day a few were seen and heard singing on Fairway Island. On July 2 there were two males a few miles east of the village and there were several on Rockhouse Island on July 13. On July 21 several young, already out of the nest, were located by their persistent calls for food and some adults were close to them. A male, collected on Finger Point on June 21, is referable to *oblitus.* Since Savile's party did not record this species it is possible that it only reaches this area in some years. Sutton (1931) found it fairly common in August 1930. In 1967 it used two habitats, areas of rough grass, probably lyle grass as at Finger Point and on Promise and Fairway Islands; or willow scrub (see Fig. 6) as in the one area in which it was observed east of the village and on Rockhouse Island.

OREGON JUNCO. *Junco oreganus oreganus.* Vagrant. A male was collected on May 21. It had been feeding on the manure-rich sweepings from the Chesterfield Mission chicken house. It weighed 15 g.

Common and Hoary Redpolls. *Acanthis flammea flammea* and *Acanthis hornemanni.* Local summer resident, probably both species breed. Single Redpolls or pairs which could not be differentiated as to species were seen from May 29 onward near the settlement, at Ikalukarjuk and Ayaratulik Lakes and on Rockhouse Island. Two pairs observed on Rockhouse Island on July 13 behaved as if they had young in a patch of willow scrub (see Fig. 6). A female Common Redpoll collected there weighed 10 g., total length measured 135, wings 72, tarsus 14 and bill 8 mm. On June 15 what must have been a Hoary Redpoll with clear white rump was seen at Chesterfield. Savile's party did not observe any Redpolls in 1950 (Savile 1951).

Lapland Longspur. *Calcarius lapponicus lapponicus.* The commonest breeding bird on the mainland, outnumbered only locally by colonially breeding terns on some of the offshore islands. In 1967 their arrival had no doubt preceded that of the observer for in 1950 Savile recorded the first on May 19. Nevertheless only few were about in late May 1967 and it was not generally distributed until early June. The song was first heard on May 24. On June 30 a nest with four eggs was found in a roadside clump of grass near the settlement and another on the same day also with four eggs overhung by a *Ledum* plant and lined with dead grass and a few feathers. On July 9 a nest with four newly hatched young and one egg was found on Promise Island. Savile also recorded it as the dominant breeding bird and reports nests with four and five eggs. Four males collected June 21-30, weighed 15-20 g., total length 158-159 mm, wing 90-93, bill 11 and tarsus 19-20 mm; three females collected between the same dates weighed 15 g., wing 89-90, bill 10-11, and tarsus 19-20 mm.

Snow Bunting. *Plectrophenax nivalis nivalis.* Common breeding bird. The spring arrival had been in mid-April according to local information. The song was last recorded on July 18 (almost exactly the same date i.e. July 17, 1950, was recorded for its cessation by Savile, 1951). In the village, several nested in man-made structures. Thus the first nest found with two eggs on June 19 was in a barrel filled with small rocks used to support the base of a telephone pole, while two other nests with four eggs and five eggs respectively found June 27 and July 7 were in rusty tin cans lying on the ground (Fig. 3). Natural nest sites were under slabs of rocks and the first newly hatched young were found in such a nest on July 11. A nest with only one egg on July 12 was made of moss and lined with dead grass and a few small gull feathers. A male collected June 21 weighed 17.5 g., total length 178, wing 105, bill 10, and tarsus 14 mm. A female collected June 30 weighed 20 g., total length 175, wing 103, bill 10 and tarsus 14 mm. Savile also found it to be a common breeding bird particularly within the settlement.

Species recorded by others but not observed by the author

Black Duck, *Anas rubripes*: One observed by Savile's party. Gyrfalcon, *Falco rusticolus*: A single bird seen on two days in late August 1950 (Savile 1951). Lesser Yellowlegs, *Totanus flavipes*: Sutton (1931) had a close view of one on August 19, 1930. Baird's Sandpiper, *Erolia bairdii*: Sutton (1931) recorded a flock of ten. Savile's party found it as a spring transient June 9 to 21 and also saw it on fall passage from August 6 onward with a peak about the 16. I was aware of these earlier records but failed to identify a single bird of this species in 1967. Iceland Gull, *Larus glaucoides*: Recorded by Savile as one or two adults on May 27 and a first-year bird on June 7 and a second-year individual on June 8. I feel it is possible that these might have been Thayer's Gulls. Great Black-backed Gull, *Larus marinus*: One was recorded by Savile in August 1950. Short-eared Owl, *Asio flammeus*: One reported by Savile on two days in June 1950. Northern Shrike, *Lanius excubitor*: One recorded by Savile in August 1950. Myrtle Warbler, *Dendroica coronata*: Savile examined one in the hand on June 11, 1950. On May 30, 1967 an unidentified Wood Warbler was seen at the floe edge off Chesterfield.

A twelve year old Chesterfield Eskimo boy Koluar who accompanied me on a number of bird watching walks and whom

I judged to be a good observer and who had studied the bird books in the school library, told me he had seen a male Red-winged Blackbird *Agelaius phoeniceus* on the pile of chicken house sweepings in the village in the spring of 1967 and in the previous year in the same place a Smith's Longspur *Calcarius pictus*.

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ADDITIONS TO THE FLORA OF CONTINENTAL NORTHWEST TERRITORIES, CANADA[1,2]

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A checklist of the vascular flora (Porsild & Cody 1968) has just been published. In this list a number of taxa have been marked as being new to the flora of the region. The material presented in the present paper documents these additions.

Specimens collected by W. J. Cody and J. A. Calder are preserved in the herbarium of the Plant Research Institute (DAO). Those of A. E. Porsild are in the National Museum of Canada (CAN). The location of other specimens cited is given throughout the text.

Ophioglossaceae

Botrychium boreale (Fries) Milde ssp. *obtusilobum* (Rupr.) Clausen MACK: Rare, a single plant on open, steep finely weathered sandstone slope, Horne Lake, Richardson Mts., 67°45′N 136°01′W, *Calder 33857.*

This is a northward extension of the known range of some 400 miles from its nearest station on the Canol Road in the Yukon Territory which was reported by Porsild (1951). A map of the distribution of this taxon is given in Clausen (1938).

Polypodiaceae

Cryptogramma Stelleri (Gmel.) Prantl MACK: rare, a single small colony on shale bank on slope above lake, Horne Lake, Richardson Mts., 67°45′N 136°01′W, *Calder 33874.*

Hultén (1941) gives the American distribution as: Alaska and Yukon, Alberta (Banff), Saskatchewan, Minnesota and Quebec to Labrador south to Washington, Colorado, Iowa and Virginia. Although it has a wide distribution, this fern is not frequently found because of its restriction to cool and shaded calcareous rocks. *C. Stelleri* has been recorded from only two localities in the Yukon Territory: Ogilvie Mts. and near Dawson. This collection from the Richardson Mountains is a northeastward extension of the known range of about 300 miles.

Dryopteris austriaca (Jacq.) Woynar MACK: common in deep moss and humus under *Abies lasiocarpa* on steep slope above hot springs, Canada Tungsten Mine, Flat River, 61°58′N 128°15′W, *Cody & Spicer 16361;* same locality, moist bulldozed area by the airstrip, *Cody & Spicer 16357;* same locality, in woods bordering picnic area by hot springs meadow, *Spicer 1645* (DAO).

Porsild (1951) recorded *D. austriaca* as new to the flora of the Yukon Territory on the basis of collections from Quiet Lake and Mt. Sheldon along the Canol Road. He (1966) added a third station from SW Yukon, Mt. Archibald; another unreported Yukon collection is *Calder & Kukkonen 27708,* in the Itsi Range, 62°57′N 130°09′W near the Yukon-Mackenzie border, not far from the Flat River collections reported here.

Dryopteris Phegopteris (L.) C. Chr. MACK: in deep moss and humus under *Dryopteris austriaca* under *Abies lasiocarpa* on steep slope above hot springs, Canada Tungsten Mine, Flat River, 61°58′N 128°15′W, *Cody & Spicer 16360.*

Porsild (1951) cited only one collection from the Yukon Territory. In 1960 *Calder and Kukkonen* (*27680*) discovered a second station in the Itsi Range, 62°57′N 130°09′ near the Yukon-Mackenzie border not far from the Flat River station reported here.

Potamogetonaceae

Potamogeton natans L. MACK: in 6 ft. water of small bay of lake, Rabbitkettle Lake, 61°57′N 127°13′W, South Nahanni

[1]Contribution No. 694 from the Plant Research Institute, Canada Department of Agriculture, Central Experimental Farm, Ottawa, Ontario.

River drainage, Mackenzie Mts., *Cody 17929.*

According to the map in Ogden (1943) this is a range extension of some 700 miles northward from a site in southwestern Alberta and 1700 miles northwestward from Lake Superior. This map however is now quite incomplete in the northern part because Scoggan (1957) has reported several sites in Manitoba; Russell, Ledingham and Coupland (1954) reported its presence in Saskatchewan. Hultén (1941) had already reported its presence in Alaska.

SCHEUCHZERIACEAE

Scheuchzeria palustris L. var. *americana* Fern. MACK: small boggy lake in midst of black spruce muskeg, in water rooted in muck and moss, Porter Lake, 61°31′N 108°06′W, *Cody 15507;* in water in small boggy lake in muskeg, Scott Lake, 60°06′N 106°23′W, *Cody 16261;* forming dense stand in small boggy lake in midst of black spruce muskeg, Spearfish Lake, 60°47′N 107°38′W, *Cody 15691.*

These specimens represent a northward extension of the known range into Mackenzie District from the south side of Lake Athabaska (Raup 1936).

GRAMINEAE

Agropyron sibiricum (L.) P.B. MACK: Occasional by airstrip, Fort Smith, *Cody & Spicer 11307.*
Introduced.

Agropyron violaceum (Hornem.) Lange var. *violaceum* MACK: Mackenzie River between Blackwater River and Norman, *Crickmay 150* (CAN); river bluff, vicinity of Fort Simpson, 62°51′N 121°23′W, *Raup &Soper 9119* (CAN); sand bar along river channel west of town, same locality, *Raup & Soper 9888* (CAN).

Agrostis exarata Trin. MACK: Mackenzie Mts: in sedge meadow by hot springs, Canada Tungsten Mine, Flat River, 61°58′N 128°15′W, *Cody & Spicer 17691, Spicer 1641* (DAO).

A map of the Alaskan distribution of this taxon is given in Hultén (1942). It is unknown in the Yukon Territory. Our collections are a remarkable extension of some 300 miles from near the Pacific Coast over the Yukon Territory to western Mackenzie District.

Festuca ovina L. ssp. *alaskana* Holmen MACK: Richardson Mts: Canoe Lake 25 miles west of Aklavik, 68°13′N 135°54′W, stony slope near top of hills, *Cody & Johansson 12875, 12880, 12881;* same locality, edge of tundra and stony slope, *Cody & Johansson 12888;* same locality, dry middle slope, *Cody & Johansson 12846;* same locality, dry hilltop, *Cody & Johansson 12868.*

Porsild (1966) has recorded this taxon from northeast of Lapierre House on the Yukon Territory side of the Richardson Mts. No. *12875* represents f. *pallida* Holmen.

Festuca prolifera (Piper) Fern. var. *lasiolepis* Fern. KEEW: wet sand along seashore, Baker Lake, 64°07′N 97°00′W, *Porsild 6109.* MACK: 20 miles below Hornby's Bend, Thelon River, *Tener 140* (CAN).

Fernald (1950) gives the range of this taxon as W.Nfld. and Anticosti I. and L. Mistassini, Que. It is known also from a number of other localities in the Labrador Peninsula, Northern Ontario and Northern Manitoba. See also Porsild (1966) under *F. vivipara.*

Koeleria asiatica Domin. MACK: Richardson Mts.: in moss on dry tundra, Canoe Lake 25 miles west of Aklavik, 68°13′N 135°54′W, *Cody & Johansson 12992;* occasional on steep west-facing shale slide above creek, Fish Creek on Yukon-Mackenzie border, 67°57′N 136°27′W, *Calder 34125.*

Porsild (1966) has provisionally placed *K. Cairnesiana* Hultén, known only from the type locality, between Aishihik Lake and the headwaters of the Nisling R. in the Upper Yukon River district, in the synonomy of *K. asiatica.* This species is known from the north slope of Alaska and Porsild (l.c.) suggested that it would not be surprising to find it in northwestern Yukon. The present collections extend the known range even farther east than this.

Poa abbreviata R. Br. MACK: rare, rocky north facing slope on flattened parts where water stands for short time, Cape Parry, 70°10′N 124°43′W, *Parmelee 2959* (DAO).

Poa abbreviata is known from Banks and Victoria islands across the Amundsen Gulf. A distribution map is given in Porsild (1957).

Poa alpigena (Fries) Lindm. var. *colpodea* (Fries) Schol. MACK: Letty Harbour, 69°50′N 124°24′W, *Dutilly 316* (QFA, photo DAO).

A distribution map is given in Porsild (1957).

Poa arctica R. Br. ssp. *caespitans* (Simmons) Nanf. MACK: rare on tundra by corral, top of Caribou Hills, Reindeer Station, 68°42′N 34°08′W, *Cody & Ferguson 10439;* moist black ground by ditch-like depression through low tundra near shore, Kidluit Bay, Richards Island, 69°31′N 133°48′W, *Cody & Ferguson 10168;* forming sod in sandy soil of corral area, Toker Pt., 69°38′N 132°54′W, *Cody & Ferguson 10275;* with *Dryas* in sandy soil on slope, Warren Pt., 69°44′N 132°30′W, *Cody & Ferguson 10222;* sandy soil around old tent frames, same locality, *Cody & Ferguson 10260;* Pelly Lake, 65°50′N 102°07′W, *Tener 551* (CAN). KEEW: Pelly Bay, 68°53′N 89°51′W, *Campbell s.n.,* Aug. 1964 (CAN); same place, *Macpherson 113* (CAN); Smith Island, east coast of Hudson Bay, 60°47′N 78°36′W, *Malte,* Aug. 24, 1928 (CAN).

A map of the distribution as previously known is given in Porsild (1957).

Poa Jordalii Porsild MACK: Mackenzie Mts: steep broken limestone slope, 9 miles NE of Little Divide Lake, 63°08′N 128°16′W, *Cody 16690, 16693;* shallow soil among limestone scree on steep tundra slope, mountains on north side of June Lake, 63°31′N 128°40′W, *Cody 17162, 17163, 17178.*

This is a southeastward extension of range of some 550 miles from the type region in the Brooks Range in northern Alaska (Porsild, 1965).

Poa Porsildii Gjaerevoll, *Colpodium Wrightii sensu* Porsild 1951 *non* Scribn. & Merr. MACK: Mackenzie Mts: turfy slope over limestone, 10 miles NE of O'Grady Lake, 63°05′N 128°50′W, *Cody 16939, 16944;* in wet turf in alpine valley floor, same locality, *Cody 16967;* steep broken limestone scree slope, 9 miles NE Little Divide Lake, 63°08′N 128°16′W, *Cody 16691;* top of limestone talus slope, 6 miles NWW Little Divide Lake, 63°05′N 128°35′W, *Cody 16586;* tundra meadow on limestone formation, 10 miles N of June Lake, 63°38′N 128°37′W, *Cody 17048;* late snow patch area, moist turf on rocky slope, limestone formation, mountain on north side of June Lake, 63°31′N 128°40′W, *Cody 17198;* tundra turf over limestone talus, same locality, *Cody 17141;* moist tundra turf meadow in saddle, limestone formation, middle slope of north side of Sekwi Mt., 63°30′N 128°40′W, *Cody 16373, 16377, 16378.*

The type of *P. Porsildii* was collected in MacMillan Pass on the Yukon-Mackenzie divide.

Puccinellia agrostoidea Th. Sør. MACK: moist sandy ground by flats near shore, Kidluit Bay, Richards Island, 69°31′N 133°48′W, *Cody & Ferguson 10162;* in reindeer corral, same locality, *Scotter 10246* (DAO); Hansen Harbour, Richards Island, 69°39′N 134°15′W, *Hughes,* 19 July 1962 (DAO); clumps in sandy soil of corral area, Toker Pt., 69°38′N 132°54′W, *Cody & Ferguson 10272;* sedge-grass community, same locality, *Scotter 10217* (DAO); scattered on gravelly promontory much exposed to Amundsen Gulf, Cape Parry, 70°10′N 124°43′W, *Parmelee 2974* (DAO); disturbed sandy soil, Nicholson Peninsula, 69°56′N 128°58′W, *Parmelee 2542* (DAO); common in disturbed soil, Clinton Point, 69°35′N 120°44′W, *Parmelee 3213* (DAO); Anderson River Delta, 69°42′N 129°00′W, *Barry 464* (DAO).

The specimens cited above help fill the gap in the known distribution of this species. The map in Porsild (1957) showed only three dots: two on Banks Island in the Arctic Archipelago, and one in central Yukon.

Puccinellia borealis Swallen, *P. Nuttalliana* sensu Cody (1965) MACK: This is an aggressive species which is now very common in such townsites as Aklavik and the Reindeer Station where it has been collected many times. Cody collections are as follows: Tuktoyaktuk, *10904, 10907, 10909;* Reindeer Station *10054, 10143, 10962, 10963, 13085;* Aklavik: *7918, 7930, 7931, 7932;* Eskimo Lakes: *10571, 10755;* Anderson River *10940, 12615;* Norman Wells: *7347, 7430, 7464, 7493, 7500, 7821;* Dodo Canyon, Canol Road, *7725;* 16 miles downstream from Fort Simpson, *8940, 8989;* Le Grand Detour, Slave River, *13894, 13937, 13948;* Fort Smith, *4626;*

salt plain west of Fort Smith, *4566, 4579.* Additional Mackenzie District localities are: west side of Bathurst Inlet, *Kelsall & McEwen 235* (CAN); McTavish Arm, Great Bear Lake,*Shacklette 2931* (CAN).

Puccinellia interior Th. Sør., *P. hauptiana sensu* Bowden (1961). MACK: rare in cleared ground by Community Centre, Fort Simpson, *Cody 8781*: vicinity of Fort Simpson, *Lindsey 216* (CAN).

Puccinellia interior was previously known only from the central parts of Alaska and Yukon (Hultén 1950).

Puccinellia pumila (Vasey) Hitch. KEEW: Rankin Inlet, *J. M. Macoun s.n.* 30 Aug. 1910 (CAN).

CYPERACEAE

Carex trisperma Dew. MACK: stony lakeshore, Mantic Lake 62°18′N 104°25′W, *Cody 15476.*

Our specimen is rather immature but seems best referred to this taxon; the northernmost collection cited by Scoggan (1957) was from Herb Lake village on Wekusko Lake, about 90 miles northeast of The Pas.

Scirpus rufus (Huds.) Schrad. MACK: La Roche qui tremp a l'eau, Fort Wrigley, *Lindsey 298* (CAN).

This is an extension of the known range of this species to the northwest from the shores of Hudson Bay at Churchill, Manitoba (Scoggan 1957).

JUNCACEAE

Juncus Dudleyi Wieg. MACK: occasional in silt at old sawmill site, north end of Long Island, Slave River, 60°48′N 113°15′W, *Cody 14441.*

Until now known from a single locality in the Mackenzie Basin: Fort Chipewyan, Lake Athabaska, Alberta (Raup 1936).

Luzula groenlandica Böcher MACK: wet lake bank, Mantic Lake, 62°18′N 104°25′W, *Cody 15459;* dried up muskeg, same locality, *Cody 15424;* moist depression in esker, Lynx Lake, 62°20′N 106°25′W, *Cody 15388;* gravelly tundra, Munn Lake, 63°35′N 110°02′W, *Cody 15877;* clumps in swampy tundra, Coppermine, *Findlay 246* (DAO); dry middle slope, Canoe Lake, Richardson Mts., 68°13′N 135°54′W, *Cody & Johansson 12841;* occasional on open gravel flats along margin of Fish Creek, Richardson Mts. on Yukon-Mackenzie border, 67°57′N 136°27W′ *Calder 34180;* spine of Liard Range 15 miles NW of Fort Liard, *Jeffrey 393* (CAN); vicinity of Lookout Point on Thelon River, 64°10′N 102°35′W, *Kuyt 70* (CAN); in sandy beach pool at mouth of small river, head of Hornby Bay, Great Bear Lake, *Shacklette 3156* (CAN); Mackenzie River Delta, East Branch, 68°40′-55′N, *Porsild 6560, 7262;* Dease Arm, Great Bear Lake, 66°53′N 118°36′W, *Porsild 4797;* McTavish Arm, Great Bear Lake, 66°20′N 118°30′W, *Porsild 5226;* Conjuror Bay, Great Bear Lake, 65°40′N 118°20′W, *Porsild 3604;* Keith Arm, Russell Bay, Great Bear Lake, 65°28′N 122°55′W, *Porsild 3435;* wet sandy soil near Burnside delta, west side of Bathurst Inlet, *Kelsall & McEwen 248* (CAN). KEEW: lake on Tha-anne River, 60°58′N 97°00′W, *Porsild 5581A;* Baker Lake, north shore, 64°30′N 97°00′W, *Porsild 6084.*

Since Böcher described this species from Greenland in 1950, it has been found to be widespread, but not common across the continental Northwest Territories.

Luzula rufescens Fisch. & Mey. MACK: Canoe Lake, 68°12′N 135°53′W, *Lambert 21* (CAN).

A map of the Alaska-Yukon distribution is given in Hultén (1943). All the collections except one from the Bering Sea coast, are from the drainage basin of the Yukon River. The Yukon specimens are all from the vicinity of Dawson. The specimen cited above is therefore a most interesting extension of range of some 300 miles to the northeast.

POLYGONACEAE

Polygonum caurianum Robins., *P. aviculare sensu* Cody *pp* MACK: west bank of Anderson River, 69°23′N 128°13′W, *Scotter 6446* (DAO); Anderson River Delta, 69°42′N 129°00′W, *Barry 220* (DAO, CAN); by the edge of gravel bar, Anderson River 30 miles above delta at timberline *Porsild 16778;* McTavish Arm, Great Bear Lake, 66°08′N 117°40′W, *Porsild 3712.*

A northwestern species; a map of the Yukon-Alaska distribution is given in Hultén (1944).

CHENOPODIACEAE

Atriplex glabriuscula Edmonst., *A. gmelinii sensu* Cody MACK: rare along gravel beach, mouth of Anderson River, *Cody & Ferguson 10954.*

Fernald (1950) gave the distribution of this species as "Seacoast", Greenl., Lab. Pen. and n. Man. s. to Nfld. and lower St. Lawrence, Que., thence to s. New England".

Atriplex hortensis L. MACK: Garden escape, Fort Simpson, collector unknown, Oct. 1937 (DAO).
An escape from cultivation.

PORTULACACEAE

Claytonia tuberosa Pall. MACK: Mackenzie Mts: bog, abundant, N. Redstone River Region, 63°34′N 127°13′W, *Kvale & Haggard 181* (DAO); in deep wet moss in meadow by lake, Grizzly Bear Lake, 62°41′N 127°50′W, *Cody & Spicer 17990;* rare in deep moss and muck in pocket of river valley, Flat River drainage 8 miles N of Canada Tungsten Mine, 62°02′N 128°10′W, *Cody & Spicer 17806;* in wet turf in alpine valley, 10 miles NE of O'Grady Lake, 63°05′N 128°50′W, *Cody 16965.*

Porsild (1951) reported this species as new to the Yukon Territory on the basis of a collection from the Mayo District. A map of the Alaskan distribution is given in Hultén (1944).

NYMPHAEACEAE

Nuphar polysepalum Engelm., *N. variegatum sensu* Cody (1965) MACK: patch 100 ft. long 10 ft. wide in 3 to 4 ft. water rooted in decaying vegetation and ooze of small inland lake, Eskimo Lake Basin 500 Lake, 68°57′N 132°34′W, *Cody & Ferguson 10506;* in a small lake, same locality, *Scotter 10281* (DAO).

The nearest known collection of this species is from Lapierre House at latitude 66°40′N in northern Yukon Territory.

RANUNCULACEAE

Ranunculus flammula L. *s. str.* MACK: moist stony shoreline of lake, Little Doctor Lake, 61°52′N 123°20′W, *Cody & Spicer 12069;* wet upper beach, Tsu Lake, 60°40′N 111°52′W, *Cody 14211;* locally common with *Veronica peregrina* on bouldery shore of Kakisa River, Enterprise-Mackenzie River Highway, *Thieret 5716* (DAO, CAN); in mud along slow-flowing stream, Mile 46 Enterprise-Mackenzie River Highway, *Thieret 5114* (DAO, CAN); rare, growing in wet sand or clay in disturbed area along small stream along road to ford (west) over Kakisa River, *Thieret 5002* (DAO, CAN); infrequent on gravelly-sandy beach of Kakisa Lake, *Thieret 5635* (DAO, CAN).

Thieret (1961) reported his specimens as *R. flammula* L. var. *ovalis* (Bigel.) Benson.

Ranunculus sulphureus Sol. MACK: Mackenzie Mts: in wet turf in alpine valley floor, 10 miles NE of O'Grady Lake, 63°05′N 128°50′W, *Cody 16974;* wet limestone talus by creek, same locality, *Cody 16989;* Richardson Mts.: occasional along margin of brook on south-facing slope, on Yukon-Mackenzie Border, 67°33′N 136°12′ W, *Calder 34069.*

A map of the previously known distribution of *R. sulphureus* is given in Porsild (1957). The record in Cody (1965) under *R. sulphureus* should be referred to *R. nivalis.*

PAPAVERACEAE

Papaver cornwallisensis D. Löve. MACK: Richardson Mts.: rare, one small colony on shale slide in sparsely vegetated area at about 3900 ft., margin of White Mts., on Yukon-Mackenzie border, 67°57′N 136°27′ W, *Calder 34200;* Mackenzie Mts.: steep limestone slope 5000-6000 ft. 7 miles SE of Little Divide Lake, 63°01′N 128°15′W, *Cody 16700;* black shale 6000 ft., Mountain River, Cache Creek, 64°45′N 129°28′W, *Johnson & Munro 209* (DAO); steep broken limestone talus slope, 9 miles NE Little Divide Lake, 63°08′N 128°16′W, *Cody 16689.*

D. Löve (Löve & Freedman 1956) stated that this poppy was known to her from Southampton, Cornwallis (type locality), Somerset and Ellesmere Islands and Boothia Isthmus, and with one exception grew on limestone gravel.

Papaver McConnellii Hultén. MACK: Richardson Mts.: occasional in wet muddy area on open rocky slope, Fish Creek, 67° 57′N 136°27′W, *Calder 34154;* noted in only two places on sparsely vegetated, steep shale slopes, Yukon-Mackenzie border, 67° 33′N 136°12′W, *Calder 34087*.

This species was described from material collected near Lapierre House in northern Yukon Territory. It is also known from Healy in the Alaska Range (Porsild 1951).

CRUCIFERAE

Alyssum americanum Greene. MACK: Fort Simpson, Summer 1853, no collector, (CAN-Herb Geo. Lawson).

The occurrence of this species in Mackenzie District has not been confirmed by recent collectors. It is possible that this specimen could have been brought back to Chief Factor McTavish at Fort Simpson by some servant of the Hudson Bay Company from the Yukon Territory.

Arabis glabra (L.) Bernh. MACK: infrequent in semi-open *Calamagrostis* grassland with willows, *Betula glandulosa*, *B. occidentalis*, *Rosa*, *Shepherdia*, Yellowknife Highway between 13 and 14 miles north of Mackenzie River, *Thieret 5029* (DAO) (distributed as *A. Drummondii*); infrequent in shallow residual soil in limestone outcrop area, mile 24 Enterprise-Mackenzie River Highway, *Thieret 5131* (CAN) (distributed as *A. holboellii*); locally frequent in disturbed sandy soil along winter road, Kakisa Lake, *Thieret 4630* (CAN) (distributed as *A. holboellii*).

The nearest known station for this species is in the Peace River country (Raup 1934).

Cardamine minuta Willd. MACK: Richardson Mts., Yukon-Mackenzie border: common and scattered on wet flats along margin of Fish Creek, 67°57′N 136°27′W, *Calder 34148;* common in large clumps on sparsely vegetated shale bank, edge of White Mts., 67°57′N 136°27′W, *Calder 34219;* common in wet meadows especially along creek banks and rivulets, 67°33′N 136°12′W, *Calder 34009*.

A map of the Alaskan distribution of this species was given in Hultén (1945) under *C. microphylla*. The stations cited above extend the known range some 600 miles from western Alaska.

Cardamine umbellata Greene MACK: Mackenzie Mts.: in moss by edge of stream below terminal moraine, drainage into Flat River, 62°02′N 128°10′W, *Spicer 1747* (DAO); sedge-grass flats by lake, O'Grady Lake, 63°00′N 129°02′W, *Cody 16555;* in water among *Salix* stems along lakeshore, Selwyn Mts., 62°22′N 128°42′W, *Cody 17886*.

Porsild (1951, 1966) has listed a number of localities in the Yukon Territory for this taxon.

Draba aurea M. Vahl var. *leiocarpa* (Payson & St. John) Hitchc. MACK: Mackenzie Mts.: shale rocks, rare, Redstone River region, 62°55′N 126°38′W, *Kvale & Haggard 64b*, (DAO); dry muskeg, Gordon Lake, *Denton*, no date (DAO).

The only Canadian specimen cited by Hitchcock (1941) was from Chipuin Mt., Marble Mts., in British Columbia.

Draba exalata El. Ekman MACK: Mackenzie Mts.: steep limestone rocky mountain tundra slope, 7 miles SE Little Divide Lake, 63°01′N 128°15′W, *Cody 16713a;* alpine tundra, shallow soil over shattered limestone 6 miles NWW of Little Divide Lake, 63°05′N 128°35′W, *Cody 16568;* shale cliffs, north slope of Colonel Mt., *Raup & Soper 9620* (CAN). The last was distributed as *D. fladnizensis* var. *heterotricha*.

The type of *D. exalata*, *Porsild 233*, was collected on Seward Peninsula, Alaska.

Draba Macounii Schultz MACK: Mackenzie Mts: shallow soil among limestone rubble on steep tundra slope, mountain on north side of June Lake, 63°31′N 128°40′W, *Cody 17174, 17176, 17177;* wet depression on limestone mountain top, 10 miles NE O'Grady Lake, 63°05′N 128°50′W, *Cody 16901;* limestone talus slope, 6 miles NWW of Little Divide Lake 63°05′N 128° 35′W, *Cody 16572a;* dry grassy talus, Keele and Ekwi R., 64°06′N 128°08′W, *Kvale & Haggard 263p* (DAO); talus slope, Redstone River region, 63°35′N 127°00′W, *Kvale & Haggard 92* (DAO).

The type is John Macoun, Kicking Horse Lake, near the B.C.-Alberta border, July 20, 1885 (CAN).

Draba sibirica Pallas MACK: Mackenzie Mts. limestone talus slope, mountain on north side of June Lake, 63°31′N 128°40′W, *Cody 17206;* lake bank 10 miles NE O'Grady Lake, 63°05'N 128°50'W, *Cody 17008, 17009.*

The first North American report of *D. sibirica* was from the Ogilvie Mts. in central Yukon. Porsild 1965, 1967).

Draba stenoloba Ledeb. MACK: Mackenzie Mts.: in dry sand of esker at back of beach, O'Grady Lake, 63°00'N 129°02'W, *Cody 16443.*

Porsild (1951, 1966) has reported several localities for this species in the Yukon Territory. The nearest locality is in the Pelly Mts. at Mile 95 Canol Rd.

SAXIFRAGACEAE

Chrysosplenium Wrightii Franch. & Sav. MACK: Mackenzie Mts.: abundant on black shale, Mountain River, Cache Creek, 64°45'N 129°28'W, *Johnson & Munro 207* (DAO); rock and grass, dry, Redstone River Region, 62°35'N 127°00'W, *Kvale & Haggard 169* (DAO); Richardson Mts.: occasional in wet mossy niches at base of sandstone cliffs, late snow area, Yukon-Mackenzie border 67°33'N 136°12'W, *Calder 34052;* locally common in one small area on shale slide, same locality, *Calder 34110;* locally common on relatively bare shale slope, edge of White Mts., Yukon-Mackenzie border, 67°57'N 136°27'W, *Calder 34218.*

A map of the Alaska-Yukon distribution of this species is given in Hultén (1945). In the Yukon Territory it is only known from the two collections reported by Hultén (l.c.), Kluane Lake and White River, in the southwest.

ROSACEAE

Chamaerhodos erecta (L.) Bunge ssp. *Nuttallii* (T. & G.) Hultén MACK: Mackenzie Mts: shale rocks, abundant, Redstone River Region, 62°55'N 126°38'W, *Kvale & Haggard 63* (DAO).

Porsild (1951) reported that in the Yukon Territory this species is limited to dry calcareous slopes along the upper Yukon and its tributaries. The specimen cited above was gathered at 3500 ft.

Dryas Hookeriana Juz. MACK: Mackenzie Mts.: moist tundra on limestone mountain top, 6000 ft., 10 miles NE of O'Grady Lake, 63°05'N 128°50'W, *Cody 16907, 16917a.*

Porsild (1966) reported this Cordilleran species from SW Yukon.

Geum Rossii (R. Br.) Sev. MACK: Mackenzie Mts: grassy ridge, abundant, Mountain River Region, 64°47'N 129°37'W, *Kvale & Haggard 219* (DAO); dry grassy slope, abundant, Redstone River Region, 62°35'N 127°00'W, *Kvale & Haggard 172* (DAO); tundra turf over limestone talus, mountain on north side of June Lake, 63° 31'N 128°40'W, *Cody 17145;* Richardson Mts.: common in one spot in heathy area along margin of creek at about 3400 ft., Yukon-Mackenzie border, 67°57'N 136°27' W, *Calder 34244.*

The boreal range of *G. Rossii* was given by Porsild (1957) who (1966) lists its known Yukon stations, the nearest being McQuesten Range in central Yukon.

Rubus alaskensis Bailey MACK: MacMillan Pass, Mackenzie-Yukon divide, sunny willow covered slope above timberline, mile 284-90 Canol Road, *Porsild & Breitung 11242;* in a river meadow, same locality, *Porsild & Breitung 11243.*

Rubus alaskensis is an Alaska-Yukon endemic which in addition to the above listed collections is known from the Susitna Valley, Alaska and Mount Sheldon, Yukon.

Sanguisorba officinalis L. MACK: rare, damp soil near stream running into Dolomite Lake, Inuvik, 68°39'N 133°42'W, *D. E. Swales 539* (Macdonald College Herb., photo DAO).

In the Yukon Territory *S. officinalis* is known from the Yukon River drainage and from near Rampart House. A map of the Yukon-Alaska distribution is given in Hultén (1946).

LEGUMINOSAE

Oxytropis Scammaniana Hultén MACK: Mackenzie Mts.: mossy hillside over limestone shale talus, 6000 ft. North Redstone River, Ringstone Creek, 63°46'N 127°19'W, *Johnson & Munro 141* (DAO).

A map showing the previously known distribution is given in Porsild (1966).

Oxytropis sheldonensis Porsild MACK: Mackenzie Mts.: in turf among broken limestone on steep slope, middle slope of north side of Sekwi Mt., 63°30′N 128°40′W, *Cody 17343.*

The type was collected on Mount Sheldon, mile 122 Canol Road in the Yukon Territory.

Oxytropis varians (Rydb.) K. Schum. MACK: occasional near base of steep eroding bank, east side of westernmost Eskimo Lake, 68°46′N 133°16′W, *Cody & Ferguson 10826;* fairly common on upper part of steep sand and gravel bank, same locality, *Cody & Ferguson 10830;* river bank Anderson River Delta, 69°42′N 129°00′W, *Barry 150* (DAO); rare in sandy soil at top of bank overlooking small lake, Kidluit Bay, Richards Island, 69°31′N 133°48′W, *Cody & Ferguson 10191;* occasional on stony slope and in shallow soil over rock near lake by airstrip, Inuvik, 68°18′N 133°40′W, *Cody & Ferguson 9841;* Dolomite Lake, 68°18′N 133°30′W, *Scotter 7245* (DAO); shallow soil in crevice of limestone near top of 400 ft. hills, Campbell Lake, 68°14′N 133°28′W, *Cody & Kehoe 12702;* clump in moist sand, Cabin Creek, Mile 22E Canol Rd., *Cody & Gutteridge 7959;* sandy gravel, Carcajou River, mile 23E Canol Rd., *Cody & Gutteridge 7744;* shallow soil over rock, rare, Indin Lake, 64°17′N 115°12′W, *Cody & McCanse 3401;* dry sandy ridge, Moraine Point, Great Slave Lake, 61°36′N 115°38′W, *Lewis 462* (DAO); moist soil among gravel on steep middle slope of Nahanni Range, Little Doctor Lake, 61°52′N 123°20′W, *Cody & Spicer 12149;* gravel creek bed, west end of Cli Lake, 61°58′N 123°25′W, *Cody & Spicer 12211;* spine of Liard Range 15 miles NW of Fort Liard, *Jeffrey 376* (CAN); north peak of Nahanni Mt., *Wynne-Edwards 8490* (CAN); Liard River between Nahanni Butte and Simpson, *Crickmay 75* (CAN); Anderson River Delta, *Barry 150* (CAN).

A distribution map for this species is given in Porsild (1966). The Mackenzie specimens cited by Barnaby (1952) *sub D. campestris* var. *varians* are *O. hyperborea.*

CALLITRICHACEAE

Callitriche anceps Fern. MACK: in 4 inches water, Mantic Lake, 62°18′N 104°25′W, *Cody 15444* (DAO).

A map in Fassett (1961) gives its then known distribution. Our station is intermediate between stations on the east coast of Hudson Bay and western Alaska.

ONAGRACEAE

Epilobium leptophyllum Raf. MACK: in sedge meadow, Liard River 44 miles north of Fort Liard, 60°55′N 123°30′W, *Cody & Spicer 11967.*

Porsild (1966) gives the Canadian distribution (map 111). The nearest collection to that cited above is from the Liard Hot Springs in northeastern British Columbia (Porsild l.c.).

CORNACEAE

Cornus suecica L. MACK: in wet moss shaded by *Salix* and *Betula glandulosa* near lakeshore, Munn Lake, 63°35′N 110°02′W, *Cody 15935.*

Calder and Taylor (1965) gave a map of the western American distribution of *C. suecica.* The collection cited above is some 900 miles NEE of stations in northwestern British Columbia. To the east the nearest stations are in Labrador and in the Gulf of St. Lawrence region.

PRIMULACEAE

Androsace septentrionalis L. var. *puberulenta* (Rydb.) Knuth MACK: Salt Plain west of Fort Smith, 60°03′N 112°25′W, *Cody & Loan 3789;* among *Carex* on dry slope of cabin clearing overlooking Mackenzie River at Rabbitskin River, 61°47′N 120°42′W, *Cody & Spicer 11453;* Fort Simpson, *Cody & Matte 8012, 8086, 8117, 8295.*

The var. *puberulenta* appears to be occasional in dry open situations in southwestern Mackenzie District. *A. septentrionalis s. str.* occurs as far north as Ellesmere Island in the Arctic Archipelago.

Dodecatheon frigidum C. & S. MACK: Richardson Mts.: along wet creek banks and in wet meadows in alpine valley, about 5 miles north of Horne Lake, 67°49′N 135°59′W, *Calder 33982;* in moist moss in late snow patch, Canoe Lake, 68°13′N 135° 54′W, *Cody & Johansson, 12915;* eastern slope of Richardson Mts. west of Mackenzie River Delta, 68°00′N 136°00′W, *Bryant 6616* (CAN).

Dodecatheon frigidum was collected at Herschel Island, Shingle Point and Mackenzie Bay, all on the Arctic Coast of the Yukon Territory (Macoun & Holm 1921), and thus was certainly to be expected in the Richardson Mountains of Mackenzie District.

GENTIANACEAE

Gentiana affinis Griseb. MACK: Mackenzie Mts.: dry gravel-net bar, Keele River, *Kvale & Haggard 264* (DAO); immediate vicinity of Fort Good Hope, *McTavish s.n.*, July 1856 (CAN – ex Herb. Geo. Lawson).

This is a 1600 mile extension of range of a foothill species otherwise known north to the 54th parallel near the North Saskatchewan River. A map is given in Gillett (1963).

BORAGINACEAE

Eritrichium splendens Kearney MACK: Richardson Mts.: occasional in small clumps on steep open slope in finely weathered sandstone, Horne Lake, 67°45′N 136°01′W, *Calder 33851;* dry open area, same locality, *Youngman & Tessier 33* (CAN.)

Previously known from only a few collections in central and northwestern Alaska and from the Alaska-Yukon boundary at lat. 62°05′N. This is a northwestward extension of range of some 400 miles.

Mertensia paniculata (Ait.) G. Don var. *alaskana* (Britt.) Williams, *M. Eastwoodae sensu* Cody (1963). MACK: Mackenzie Mts.: between Dal Lake and Little Dal Lake, *Johnson & Munro 1* (DAO).

SCROPHULARIACEAE

Euphrasia arctica Lange KEEW: damp grassy tundra, south-facing bank of river, mouth of McConnell River, 60°50′N 94° 25′W, *MacInnes 229* (DAO, UWO).

This is an extension of the known range north along the Hudson Bay shore from the vicinity of Churchill, Manitoba (Polunin 1940).

Pentstemon Gormanii Greene MACK: Mackenzie Mts.: near Tsichu River, 4000 ft., 63°20′N 129°30′W, *Hopp 72* (CAN).

Until this collection *P. Gormanii* was known only from the upper and central Yukon River Basin (Porsild 1951).

Synthyris borealis Pennell MACK: Richardson Mts.: common in a few places on steep, heathy, east-facing slopes (rocky) above creek, Fish Creek area, 67°57′N 136°27′W, *Calder 34141;* occasional on steep SW-facing, shale slope, Yukon-Mackenzie border, 67°33′N 136°12′W, *Calder 34097.*

This rare species is endemic to central Alaska, Yukon and the Richardson Mts. of Mackenzie District. Until now known only from the Yukon River drainage. An additional collection from the Yukon Territory is as follows: rare and local in depression in lush meadow on SE-facing slope near summit, Cathedral Rocks, Ogilvie Mts., 66°02′N 138°44′W, *Calder & Gillett 26125.*

Pedicularis Langsdorfii Fisch. MACK: Richardson Mts.: common in open meadows by creek in alpine valley about 5 miles north of Horne Lake, 67°49′N 135°59′W, *Calder 33987.*

Pedicularis Langsdorfii is an amphi-beringian species which reaches its eastern limit of distribution in the Richardson Mountains of northwestern Mackenzie District. In northern Mackenzie District and in the islands of the Arctic Archipelago it is replaced by the closely related *P. arctica.*

Pedicularis Oederi Vahl MACK: Richardson Mts.: common in many places on open heathy slopes at about 3200 ft., Yukon-Mackenzie border, 67°33′N 136°12′W, *Calder 34011;* occasional on lush slopes by creek at 3400 ft. and on sparsely vegetated shale slopes at 3600 ft., Yukon-Mackenzie border, 67°57′N 136°27′W, *Calder 34184.*

A map (Fig. 127) of the previously known American range is given in Porsild (1966). Additional collections from the Yukon Territory are: common but scattered on alpine slopes just above treeline, 3000 ft., Cathedral Rocks, Ogilvie Mts., 66°02′N 138°44′W, *Calder & Gillett 26036;* occasional and scattered in heathy wet meadow in alpine valley near base of mountain, Mt. Sedgwick area, British Mts., 68°53′N 139° 06′W, *Calder 34450.*

Pedicularis parviflora Smith KEEW: very wet black soil with *Carex*, mouth of McConnell River, 60°50′N 94°25′W, *MacInnes 89* (DAO, UWO, CAN); wet marsh, same locality, *MacInnes 471* (UWO, CAN).

This is a northward extension of the known range along the Hudson Bay coast from between York Factory and Churchill, Manitoba (Scoggan 1957).

RUBIACEAE

Galium Brandegei Gray KEEW: wet mossy tundra, mouth of McConnell River, 60°50′N 94°25′W, *MacInnes 235* (DAO, UWO).

The nearest station to that cited above is one from Churchill, Manitoba (Scoggan 1957).

Galium kamtschaticum Steller MACK: along small stream, Hyndman Lake, 68° 14′N 131°06′W, *Scotter 10137* (CAN).

Fernald (1950) gave the range "w. Nfld.; mts. of C.B., Que., n.N.E. and n. N. Y. (E. Asia and Aleutian Ids.). Additional records from Alaska, the State of Washington and Lake Superior not known to Fernald (l.c.) are reported by Hultén (1949). The Scotter specimen, although lacking both flowers and fruit, seems quite characteristic of this species.

Galium tinctorium L. var. *subbiflorum* (Wieg.) Fern. MACK: scattered in poorly drained cut over spruce forest, Long Island, Slave River, 60°49′N 113°15′W, *Cody & Loan 4004;* wet upper beach, Tsu Lake, 60°40′N 111°52′W, *Cody 14210.*

Reported by Fernald (1950) "Se. Lab. and Nfld. to Alaska." but hitherto unrecorded for our area.

COMPOSITAE

Agoseris aurantiaca (Hook.) Greene MACK: Mackenzie Mts.: by hot springs, Canada Tungsten Mine, Flat River, 61°58′N 128°15′W, *Cody & Spicer 18027;* moist disturbed gravel by airstrip, same locality, *Cody & Spicer 16356, Spicer 1508* (DAO); grassy meadow by small lake, "Canex" Lake, 62°22′N 128°42′W, *Cody 17838;* open valley, wet area near hot springs, Flat River, *Youngman & Tessier 426* (CAN).

This is a Cordilleran species which Porsild (1951, 1966) has reported from alpine relic prairies in the Pelly and Selwyn ranges in the Yukon Territory. The localities cited above should be added to the map given by Porsild (1966).

Antennaria media Greene, non *A. media sensu* Raup (1947). MACK: Mackenzie Mts.: in moss beside stream, below terminal moraine, drainage into Flat River, 62°02′N 128°10′W, *Spicer 1734* (DAO); in clay near base of cliffs, same locality, *Spicer 1741* (DAO).

Antennaria media is a Rocky Mountain species.

Antennaria nitida Greene KEEW: steep sandy slope of esker, mouth of McConnell River, 60°50′N 94°25′W, *MacInnes 509* (UWO, CAN).

The type of *A. nitida* was collected on Charlton Island in James Bay. This species is known from Mackenzie District (Porsild 1950) but hitherto unrecorded from Continental Keewatin District. A distribution map is given in Porsild (l.c.).

Arnica latifolia Bong. MACK: Mackenzie Mts.: in moist meadow on limestone slope, Flat River drainage 8 miles N of Canada Tungsten Mine, 62°02′N 128°10′W, *Cody & Spicer 17788.*

Porsild (1951) noted that *A. latifolia* was rare to occasional in alpine meadows north to Macmillan Pass.

Artemisia alaskana Rydb. MACK: Richardson Mts.: common on steep west-facing shale slide above Fish Creek, Yukon-Mackenzie border, 67°57′N 136°27′W, *Calder 34128.*

Porsild (1951, 1966) has added a number of stations to the distribution given by Hultén (1950). The collection cited above is a northward extension of range of some 400 miles from the Pelly Mts. along the Canol Road.

Cirsium foliosum (Hook.) DC. MACK: in peaty soil in low area among grasses and sedges in natural clearing between *Salix* spp., Fort Smith, *Cody 14782;* sedge grass meadow, rare, west of Le Grand Detour, Slave River, 60°21′N 112°44′W, *Cody 13984;* dry sedge grass prairie, rare, near Hook Lake, 3 miles east of Slave River 60°43′N 112°50′W, *Cody 14115;* sedge grass meadow, rare, Slave River Delta: Jean River, 61°18′N 113°17′W, *Cody 14578;* road allowance through bushland, Fort Resolution, 61°10′N 113°40′W, *Cody 14378.*

Moore and Frankton (1964) have discussed the problems relating to *Cirsium* *foliosum* and *C. Drummondii*, two species which are almost limited to Canada in their distribution, and maps depicting their ranges are given. The specimen, *Raup 3422*, cited by Raup (1936) from Government Hay Camp, Slave River, Alberta, as *C. drummondii* is *C. foliosum*.

Erigeron hyperboreus Greene, *E. grandiflorus sensu* Cody (1965) *p.p.* MACK: rare in shallow soil in limestone crevice near top of 400 ft. hills, Campbell Lake, 68°14′N 133°28′W, *Cody 12711;* shale, abundant Redstone River Region, Mackenzie Mts., 62°53′N 126°38′W, *Kvale & Haggard 66* (DAO); east bank Tree River, Coronation Gulf, *Miller 165* (CAN); on damp rock ledges by Dolomite Lake, Inuvik, 68°39′N 133°62′W, *Swales 522* (CAN).

The type of this species, until now known only from Alaska (Hultén 1950), came from the Porcupine River near the Alaska-Yukon boundary. The collections cited above form a most interesting extension of the known range eastward into Mackenzie District.

Erigeron pallens Cronq. MACK: Mackenzie Mts.: dry soil and talus, Redstone River Region, 63°35′N 127°00′N, *Kvale & Haggard 131, 177* (DAO); grassy slopes, well drained, Redstone River Region, 62°55′N 126°38′W, *Kvale & Haggard 22* (DAO); black shale, Mountain River, Cache Creek, 64°45′N 129°28′W, *Johnson & Munro 187* (DAO).

The type came from Mt. MacDonald, Glacier, British Columbia. According to Hitchcock *et al* (1955) it is known from only three collections from the mountains of Alberta and British Columbia.

Erigeron purpuratus Greene MACK: Mackenzie Mts.: talus, Redstone River Region, 63°35′N 127°00′W, *Kvale & Haggard 97* (DAO); black shale, Mountain River, Cache Creek, 64°45′N 129°28′W, *Johnson & Munro 199* (DAO); Redstone River Region between Dal Lake and Little Dal Lake, *Johnson & Munro 70* (DAO); mountain range west of head of Bolstead Creek, Mile 111E Canol Road, *Wynne-Edwards 8383* (CAN).

This is a species endemic to northern British Columbia, Alaska, Yukon and the Mackenzie Mountains in western Mackenzie District. The specimens cited above form an extension of the known range from southwestern Yukon Territory. A map of the Yukon-Alaska distribution is given in Hultén (1950).

Hieracium gracile Hook. var. *yukonense* Porsild MACK: in gravel beside air field, hot springs one mile south of Canada Tungsten Mine, 61°58′N 128°15′W, *Spicer 1509* (DAO).

This is an endemic variety previously known only from Mount Sheldon and at Rose River mile 95 Canol Road (Porsild 1951) in the Yukon Territory.

Hieracium triste Hook. MACK: Mackenzie Mts.: valley slope among *Betula glandulosa*, rare, 6 miles NE O'Grady Lake, 63°03′N 128°55′W, *Cody 16881;* moist moss over limestone talus on steep creek bank, Flat River drainage 8 miles N of Canada Tungsten Mine, 62°02′N 128°10′W, *Cody & Spicer 17771.*

Hieracium triste has been recorded by Porsild (1951) from a number of localities along the Canol Road in the Yukon Territory.

Petasites hyperboreus Rydb. MACK: Mackenzie Mts.: open valley, wet area near hot springs, Flat River, *Youngman & Tessier 435* (CAN.)

Porsild (1951) states that this is a Cordilleran-Pacific Coast species thus far collected a few times in Alaska . . . and along the Haines Road just south of the British Columbia-Yukon border. Several Yukon localities are cited by Porsild (1966).

Senecio pauciflorus Pursh MACK: Mackenzie Mts.: in sedge meadow by hot springs, Canada Tungsten Mine, Flat River, 61°58′N 128°15′W, *Cody & Spicer 17688;* roadsides east of airfield, same locality, *Spicer 1535* (DAO).

Porsild (1951) has reported numerous collections from adjacent to the Canol Road in the Yukon Territory. The specimens from Resolution (*Harper 90128* (CAN) and Rae (*Russell* (CAN)) cited by Raup (1947) under *S. pauciflorus* have been referred to *S. indecorus*.

Senecio sheldonensis Porsild MACK: Mackenzie Mts.: grassy valley meadow "Canex" Lake, 62°22′N 128°42′W, *Cody 17861.*

The known range of *S. sheldonensis* was given by Porsild (1966) (Map 158).

Taraxacum integratum Hagl. MACK: Mackenzie Delta: Hendrickson Island, *Porsild 7462, 7463;* dunes, north end of Richards Island, 69°30'N 134°40'W, *Porsild 2296;* Kittigazuit Island, 69°22'N 133°40'W, *Porsild 2411;* Inuvik, *Swales 525* (CAN).

Taraxacum integratum was previously known only from Alaska.

Taraxacum pellianum Porsild MACK: rock scree, Bear Rock, 64°55'N 125°42'W, *Porsild 3399;* sandy beach, Richards Island, 69°32'N 133°45'W, *Scotter 10129* (CAN).

Previously known only from the Pelly Range in central Yukon Territory.

Taraxacum scopulorum (Gray) Rydb. MACK: Mackenzie Mts.: rocky tundra turf on steep slope of valley wall, mountain on north side of June Lake, 63°31'N 128°40'W, *Cody 17210;* wet limestone talus by creek, same locality, *Cody 17223;* in wet turf in alpine valley floor, 10 miles NE of O'Grady Lake, 63°05'N 128°50'W, *Cody 16978;* in alpine turf on granitic mountain, 5 miles SE of O'Grady Lake, 62°57'N 128°58'W, *Cody 16753;* rocky tundra slope, late snow area, 6 miles NWW of Little Divide Lake, 63°05'N 128°35'W, *Cody 16618;* in gravel of terminal moraine, drainage into Flat River 8 miles N of Canada Tungsten Mine, 62°02'N 128°10'W, *Spicer 1719* (DAO); among rocks along brook, Brintnell Lake, 62°05'N 127°35'W, *Raup & Soper 9558* (CAN) (distributed as *T. alaskanum* Rydb.).

Taraxacum scopulorum is a Rocky Mountain species.

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WINTER OBSERVATIONS ON BELUGA (*DELPHINAPTERUS LEUCAS*) IN JONES SOUND, N.W.T.

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On November 25, 1966, two hunters searching for seal breathing holes in the sea ice near the mouth of Starnes Fiord, S. Ellesmere Island, N.W.T., found an area of open water where a large number of beluga (*Delphinapterus leucas* Pallas) were apparently trapped. About 600 yards distant they discovered a second similar opening in the sea ice, and within two weeks of this a third was discovered equidistant from the others.

This was the first wintering of whales witnessed by any of the residents of Grise Fiord, a small community of eighty Eskimos who formerly had lived at various locations in eastern Hudson Bay, northern and eastern Baffin Island, Foxe Basin and Smith Sound. During the winter months following the discovery of these whales, hunters from Grise Fiord, approximately twenty-five miles distant, periodically hunted whales at these breathing places. In view of the seeming rarity of such winterings in the high latitudes, this report comprises those observations the writer was able to obtain during the course of five visits to the breathing holes.

Formation and Maintenance of Breathing Holes

The winter 1966-67 was unusual at Grise Fiord because of light winds and sparse snowfall. Weather conditions in Jones Sound are remarkably local however, and the preceeding statement principally applies to the region extending about thirty miles east and west of the community. Strong local winds, especially from the heads of fiords or down glaciers, can be experienced at any time.

Hunters believe that the usual strong winds blowing from the head of Starnes Fiord prevented this body of water from freezing during early October, a time when calm conditions prevailed and sea ice formed outside of the fiord. A sudden period of calm during this time, when temperatures rarely rose above 5°F and reached −5° most nights, would enable Starnes Fiord (an area of about 100 square miles) to freeze over rapidly, trapping any whales still in the Fiord. A 25-30 mile belt of winter ice, without leads or cracks would effectively prevent the trapped whales from reaching the open waters of Jones Sound.

Later examination of ice conditions in Starnes Fiord and the region surrounding the area where the whale holes occurred confirmed the hunters' opinions as to the conditions of the ice at the time of freeze-up.

When the holes were first located, the largest measured approximately thirty by ten feet; the other two holes were smaller, the smallest being circular, with a diameter of about eight feet. The edges had been built up by spray and waves generated by movement of the whales in the openings.

FIGURE 1. Beluga surfacing to breathe. Photographs taken on April 1 and 2, 1967, indicate the extent of ice-formation in the breathing hole during a 24 hour period.

The smallest hole was abandoned for a few hours during the night of November 28, following disturbance due to hunting. The next morning it had frozen over to a depth of about 3 inches, and was never re-opened. Hunters believe the whales can break new ice up to an inch thick using their heads, but that ice of a greater thickness and hardness than newly formed sea-ice would prove too difficult. At this time, night temperatures averaged −30°F, with day temperatures only a few degrees higher; it required eight to ten hours for an inch of new ice to form on holes in the sea ice.

The two remaining breathing holes became progressively smaller in area as the sides were built up by spray. By mid-December both holes had domed roofs of ice covering them, with a single elongate slit in the roof of the smaller of the two holes, and two elongate slits about one and two feet long in the centre of the other roof; these slits were parallel to the long axes of the holes.

At the end of December a heavy storm drifted and compacted considerable snow on the sea ice in this region. It seemed very probable that the holes would be completely drifted over with closure of the small holes. The hunters were certain, however, that the whales would be able to prevent the sealing of the ice-lined dome covering the breathing holes by the heat of their breathing immediately below the single short slits in the centres of the roofs.

On December 29 hunters removed the ice roof from each hole, exposing an area approximately six feet by three feet. When they returned to the site January 6 both roof domes had reformed.

TABLE 1. — Beluga lengths from hunting returns, Grise Fiord and Starnes Fiord, N.W.T.

Lengths	September 1–25, 1965		September 1–7, 1966		December 28, 1966 – March 31, 1967	
	Males	Females	Males	Females	Males	Females
5′ – 6′11″	1	1	1	1	0*	0*
7′ – 8′11″	2	1	1	6	0	0
9′ – 10′11″	6	3	7	7	3	0
11′ – 12′11″	1	8	2	10	5	11
13′ – 14′11″	4	0	5	1	2	2
15′	5	0	2	0	0	0
	19	13	18	25	10	13

*Two whales in this size class are not included as the sex was not observed (November 1966).

The second breathing hole was abandoned January 25; temperatures at this time were –40°F, and the number of whales surviving was estimated to be 25-30, from the original number of approximately 150.

The last whale-hunting at the breathing hole occurred April 2; on this occasion approximately 15-20 whales remained at a hole measuring approximately six feet by three feet, with a roof of compacted snow and ice having no opening at the centre. On April 5 hunters discovered the whales had left the breathing hole, which was now being kept open by ringed seal (*Pusa hispida*); the hunters presumed the whales were attempting to reach open water twenty miles distant. There were no pressure or tide cracks open in the immediate vicinity, and they considered the whales were in some way able to utilize seal breathing holes in the course of their journey to the open water.

Number and Composition of Whales

We estimated 150-200 whales initially frequented the three breathing holes; after removal of approximately 50 whales by mid-December numbers seemed scarcely diminished. By early January, however, following removal of between eighty and ninety whales by hunting, an estimated 30-40 survived, suggesting a slight dying-off independent of hunting mortalities.

No consistent account of size or sex distribution of whales was made. There were more young adults (light grey, 10-13 feet in length) than both juveniles (dark grey, 5-9½ feet) and fully adult whales (white, 12½ feet and above). The largest male measured 13′9″ and the largest female 13′8″ in a small sample of 25 whales.

Because of selective hunting during the winter, the size-frequencies shown in Table 1 are not representative of the trapped population. Bias is introduced because hunters preferred small whales due to ease of handling and quality of the skin (a northern delicacy).

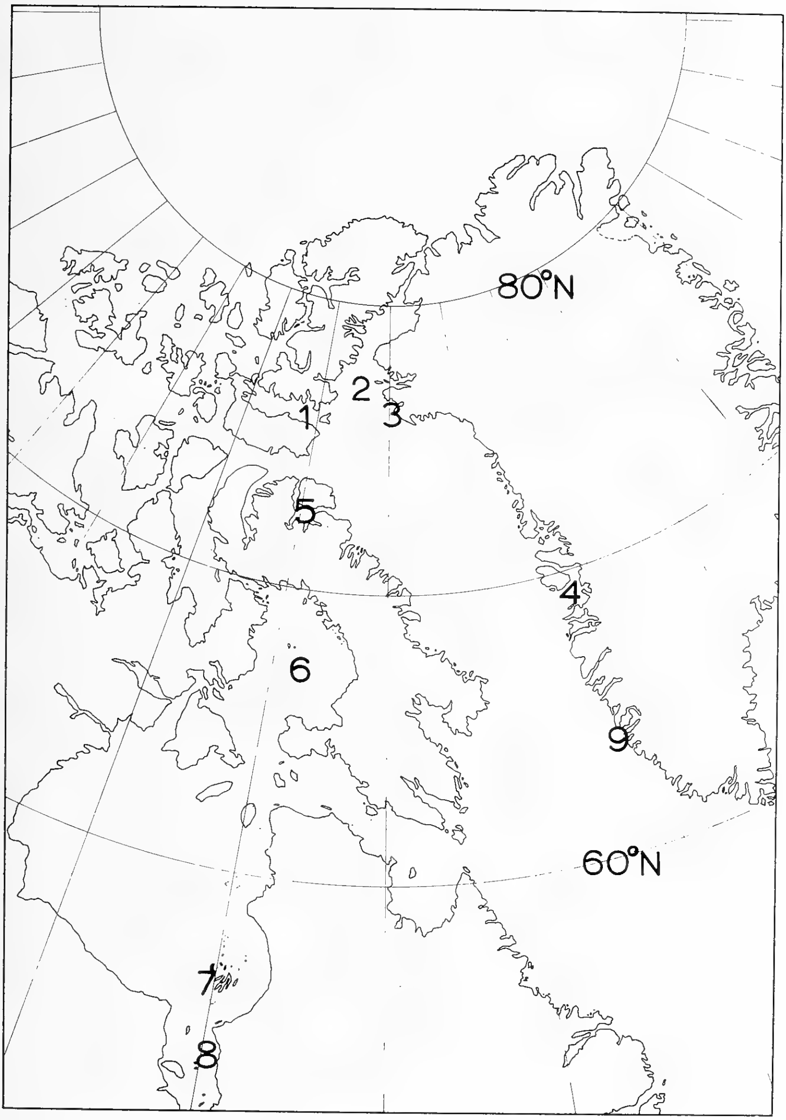

FIGURE 2. The Eastern Arctic. 1. Jones Sound; 2. Smith Sound; 3. Thule; 4. Disko Bay; 5. Navy Board and Milne Inlets; 6. Foxe Basin; 7. Belcher Islands; 8. James Bay; 9. Godthaab.

TABLE 2. — Liver weights, winter-killed beluga, Starnes Fiord N.W.T.

Date	Body length	Sex	Liver weight (Pounds)
Jan. 6	11′10″	Female	27
,,	13′3″	Male	40
Jan. 25	12′6″	Male	24
,,	12′4″	Female	40
,,	12′2″	Female	33
March 31	12′2″	Male	21
,,	12′2″	Male	20½

Two small individuals 5-5½ feet long, with fresh umbilical scars killed on November 29 are noteworthy, as they indicate that births occur well into the fall season.

During September most years, but not in 1967, when the beluga failed to appear, thirty or forty whales are killed in the immediate vicinity of Grise Fiord. The 1965 and 1966 fall kills were measured by the writer and are included in Table 1. The sex ratio of ninety-eight whales represented in these samples is close to unity (47 males, 51 females).

The largest whale measured at Grise Fiord was a male 17′4″ length; six other males were between 15 and 15½ feet in length. The largest female whale measured was 13′8″ length.

FEEDING AND CONDITION OF WHALES

Stomachs of forty-six whales were examined at intervals between November 25 and April 1; over half the stomachs were empty, or contained only water or mucus. Food remains were always in small amount, averaging about a half-litre of semi-liquid remains in most cases. Polar cod (*Boreogadus saida*) and crustacea (*Boreomysis nobilis*) were virtually the only food species.

Blubber thickness ranged from one to two inches measured mid-dorsally, in late December, and as little as one-half inch to one and one-half inches in late January. There was differential depletion of fat from the blubber layer over different regions of the body. The most marked withdrawal of fat occurred in the cervical and thoracic regions, where in extreme cases a fibrous layer containing little fat overlaid the ribs. However, even in these extremely emaciated individuals, blubber thickness remained near normal in the peduncle region, with an intermediate blubber thickness occurring in the abdominal region. For example, in one very thin female (13 feet six inches length) the blubber and fibrous layer extending from the scapular region to immediately posterior to the genital opening weighed 62 pounds (on one side of the body only), whereas blubber and fibrous layer covering the much less extensive peduncle region weighed 35 pounds on one side of the body.

Small liver size likewise reflected the nutritional stress of these winter whales; for comparison with the data presented below (Table 2), the liver of a summer caught whale (male, 10 feet length) weighed 29 pounds.

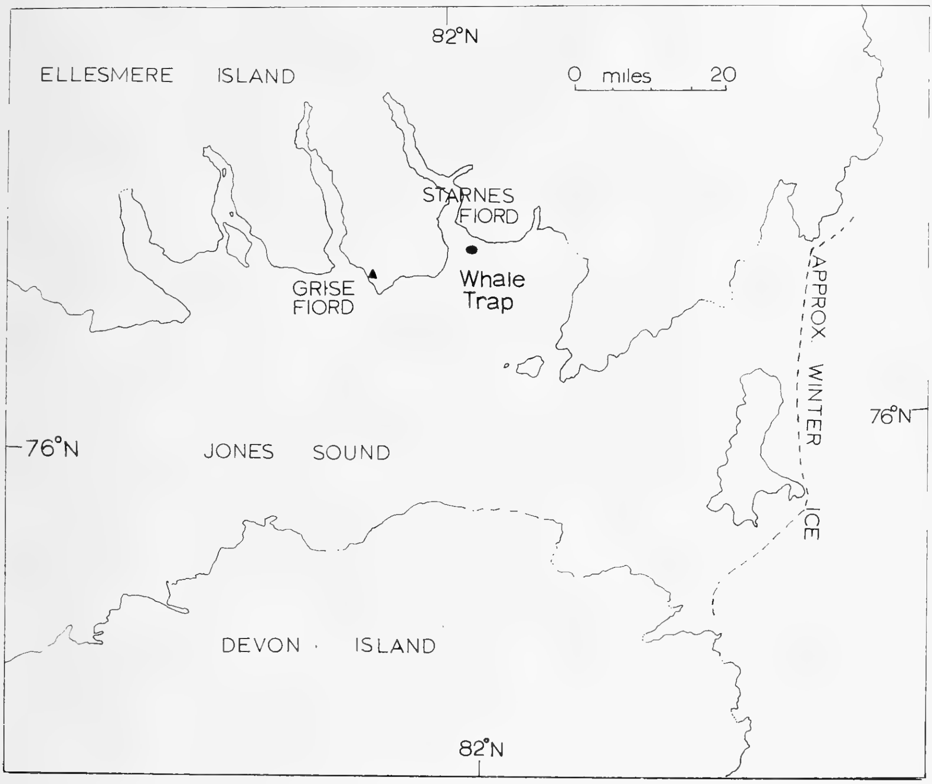

FIGURE 3. The Jones Sound Region.

BEHAVIOURAL AND PHYSIOLOGICAL OBSERVATIONS

On November 28-29 ten females 12 feet and over in length were examined; none were pregnant, and six had a small quantity of either green-coloured milk or a clear fluid present in the mammary glands. On December 27-29 five females were examined and found to be not pregnant; on this date no liquid could be expressed from the mammary glands, though of seven females examined during January, February and March, one did have a small quantity of clear fluid in the mammae. None of the twenty-one females, judged from size, colour and ability to lactate as being sexually mature, were pregnant.

Despite the fact that smaller individuals were selectively hunted, the differential survival of larger individuals was apparent once numbers were reduced. By mid-January small individuals had virtually disappeared from the group of trapped whales remaining. A small number of measurements from landed whales indicates this trend (Table 3).

Observations on leanness and swimming behaviour gave the definite impression that the whales were steadily weakening from the time of first sighting (November 25) until the end of January, when about 20-30 whales survived at a single breathing hole. On February 20, however, the surviving whales

TABLE 3. — Lengths of winter-killed beluga, Starnes Fiord N.W.T.

Date	Sample size	Average length	Range
December 28.	7	11′3½″	10 0″ – 12′1″
January 7.	8	11′9½″	9′9″ – 13′3″
January 24.	4	12′3½″	12′2″ – 12′6″
February 21.	1	13′8″	
March 31.	3	12′8″	12′2″ – 13′9″

appeared considerably stronger and fatter; the whale skin, which a month earlier had been considered tasteless, was now much improved in quality. A steady improvement continued, and on March 31 the numbers had not appreciably decreased.

It was not possible to make systematic observations on undisturbed behaviour as hunting activity, removal of the ice-roof, use of lanterns to see during prevailing darkness, and the presence of blood in the holes resulting from harpooning and shooting, all must have disturbed the whales in some measure during the periods of visiting. Initially hunting was conducted with a minimum of blood-letting in the belief that the presence of blood in the water would drive the whales off. It was subsequently observed, however, that once alternative blood-free holes were unavailable, whales tolerated blood and whale offal accidentally contaminating the breathing hole.

Whale noises were heard occasionally, but the noise of breathing and splashing sounds generally masked vocalizations. However, while whales were being withdrawn from the water other whales generally refrained from breaking surface and were observed swimming back and forth beneath the open water. On one occasion as a large whale was being hauled from the water tail-first, several other whales crowded around the head of the dying whale and considerable shrill vocalization was clearly heard. This continued until the whale disappeared from the edge of the breathing hole, out of sight of the whales remaining in the water, whereupon there was immediate silence and dispersal of the assembled whales. Despite its actual ineffectiveness in this case such behaviour can be classed as 'succorant' (Scott 1958).

The manner in which whales surfaced varied both according to the structure of the ice hole and the number of whales present. During November the large numbers of whales surfaced for purposes of breathing in two different ways. At the two large rectangular holes a succession of whales, perhaps 30-40 in number, would break surface, blow and inspire, then dive, all in similar fashion to that observed in open water conditions during migration when whales swim near the surface. This same school would reappear perhaps half a dozen times in rapid succession so that the water surface during these few minutes was constantly broken by the heads and backs of moving whales. A few minutes calm would follow, then another group of whales appeared and behaved similarly. It was possible to recognize individuals by head scars.

In November one smaller circular hole about eight feet in diameter was also used by groups of whales. This hole was entered vertically by about twelve or fifteen individuals, close packed with head and flippers rising out of the water, bobbing up and down for three or four respiratory exchanges before disappearing into the depths to be replaced almost immediately by the next group.

During December and subsequent months breathing behaviour changed. Numbers of whales were greatly reduced, and those remaining were at a single roofed hole. On removal of the roof, breathing took place at the periphery of the hole, the whales often being radially arranged with their heads surfacing just inside the hole, more usually at one end of the elongate hole (Figure 1). Breathing was now associated with greatly reduced movement, the noise of actual ventilation being the greatest proportion of that generated.

A LITERATURE SURVEY OF BELUGA WINTERINGS IN THE ARCTIC

It appears that beluga are encountered far less frequently during winter than narwhal (*Monodon monoceros*). Apparently narwhal remain in the bays and fiords as the new ice forms, so that entrapment may occur if sudden calm conditions allow extensive winter ice formation; beluga on the other hand generally move south ahead of ice formation(Degerbøl and Freuchen 1935). During the winter 1914-5 unusual weather conditions resulted in several thousand narwhal being trapped in the Disko Bay region of western Greenland; however, only two small groups of beluga were associated with this mass occurrence of narwhal (Porsild 1918). In 1943 several hundred narwhal and beluga in approximately equal numbers wintered off the north of Disko Island (Vibe 1950). In north Greenland it appears as though wintering beluga are rare: Holtved (1967) mentions a group of eighty and another unspecified number in the Smith Sound region. It seems probable that beluga winter more especially in the Disko Bay region of western Greenland (Vibe 1967) and until recently at least, habitually in the Godthaab Fiord region (Moeller 1964). In recent years the wintering distribution of beluga appears to have altered, and a more northerly or westerly winter distribution is posited (Vibe 1967).

In the 1940's, a large number of female and young beluga, together with a few old males, were trapped one winter in the Navy Board Inlet region, and in 1958 three individuals were trapped in Milne Inlet: these cases are the only ones known to experienced hunters from northern Baffin Island (Markusie and Ningyok, pers. comm.). During the spring 1957 about 100 beluga were found near Blacklead Island in Cumberland Sound (RCMP Game Report, Pangnirtung).

Beluga are sometimes taken in late winter by northern Alaska hunters in the Wainwright area (Nelson 1966); informants confirm that this also occurs in the Barrow region (Antonio Weber, pers. comm.). However, these Alaskan records may refer to early spring arrivals, rather than true wintering groups, that become trapped when leads freeze over or disappear with shifting ice. A true wintering occurred in the Eskimo Lakes, Mackenzie Delta region during 1966-7, when approximately fifty beluga trapped in the fall persisted in freshwater lakes until January (Hill 1967).

Beluga are sometimes trapped by winter ice in the complex fiords of the Belcher Island archipelago, in southern Hudson Bay: three were located by hunters in January 1961, and one harpooned at a breathing hole five years earlier. Similar occasional winterings are reported from eastern James Bay (Freeman, field notes).

Association of Beluga and Other Species

On February 21, 1967, a large ringed seal was taken at the whale breathing hole; at this time about 25-30 beluga were present.

One year-old ringed seal was observed in the breathing hole April 1; it was shot the following day as it entered a den situated about 75 feet from the breathing hole where 15-20 whales still survived.

The whales were absent when the hole was next visited, April 5, but the continued presence of water in the hole suggested it was in use as a seal breathing hole. A ringed seal was in fact taken from the hole April 26.

It appears that when narwhal and beluga occur together at a breathing hole, the species surface separately to breathe (Vibe 1950).

Discussion and Conclusion

Perhaps the most significant feature of this winter occurrence of beluga was the continuing survival of adults during several months of restricted feeding, and despite the iceing-over of the breathing hole which allowed only a small air space for breathing exchange.

Predictably, small individuals were less capable of withstanding the continued metabolic stress than the larger whales. To what extent the reduction in numbers due to hunting aided the survival of remaining whales cannot be evaluated. Whales, and in particular beluga are very sensitive to stress (Norris 1966), and intermittent periods of human interference, at approximately ten or twelve day intervals, must have added to the stress otherwise resulting from the restrictive situation.

That the poor feeding conditions occasioned stress can hardly be doubted. Diminishing blubber reserves not only affect thermoregulation through a decrease in insulatory material and, in time, shortage of fuel, but result in loss of buoyancy and probably an adverse body-fluid balance.Lilly (1966) states that whales maintain water balance through both metabolic water production and directly from their food; with restricted food intake, dehydration becomes a real threat.

The flaccid condition and reduced weight of livers, as well as the general appearance of the whales (see below) was taken as an indication of the poor nutritional state of the animals. I think the absence of pregnant cows in a sample of twenty-one mature females probably indicates loss of fetuses due to chronic metabolic stress.

The skin did not change in appearance during the five months of observation; there was none of the roughening or sloughing-off that has been observed in poorly-fed captive beluga (Ray 1966). Perhaps the small amounts of living food available to these trapped beluga supplied critical amounts of essential nutrients not available to captive animals. Despite the normal appearance of the skin surface during December, however, a marked loss of flavour occurred; the characteristic taste returned in March when the whales were visibly improved in condition.

The appearance of some whales in December and January suggested extreme emaciation: a hollow between the head and trunk and longitudinal folds along the ventral surface of the body were marked features. Fat reserves were depleted unevenly, the peduncle keeping normal fat thickness when the thorax had lost its fat reserves. This uneveness suggests the importance of the flukes, both as the means of propulsion, and in thermoregulation where the continued functioning of the counter-current heat exchange mechanism requires insulation of venous blood from low ambient temperatures (Scholander 1958).

The presence of new-born calves in this trapped population indicates a breeding season for the species extending from March (Degerbøl and Freuchen 1935) until November.

In a recent review of epimeletic (care-giving) behavior in whales (Caldwell and Caldwell 1966) abundant examples of succorant behavior in four Odontocete families were cited, but no evidence of this behavior was obtained for the Monodontidae. This present paper reports the first observation of succorant behavior in the cetacean family Monodontidae.

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NOTES

Apparent Recovery of Translocated Arctic Fox

A TAG recovered on an arctic fox (*Alopex lagopus*) trapped on the Belcher Islands in Hudson Bay (Figure 1), is apparently identical to one placed on a fox captured at Aberdeen Lake, Northwest Territories, which subsequently escaped near Ottawa, Ontario. The record is surprising, however, in that the distance between the points of escape and recovery is over 700 miles, and perhaps questionable in that the reported sex of the captured fox differed from that of the tagged one. On the other hand, no one else was tagging arctic foxes with the kind of tag used, nor indeed, in Canada, with any kind of tag.

Several arctic fox whelps were tagged on the central Canadian mainland barrens in the course of studies on the breeding biology of the species undertaken between 1959 and 1963 as a research project of the Eastern Region, Canadian Wildlife Service. The entire litter of eleven whelps inhabiting a den (Den No. 19 of my series) at Aberdeen Lake was marked during July 1963, and some of the whelps were recovered in live-traps at another den (No. 23) about two miles west of the first during the same month. Six of the recaptured animals were brought south in August of the same year: following November 1963, they were kept in pairs in outdoor cages on the farm of Mr. T. H. Manning near Merrickville, Ontario. None of the three pairs bred in captivity.

On January 3, 1965, two arctic foxes escaped from their cage by drawing a hinge-pin on the door. A white fox seen a day later within two miles of Manning's farm was probably one of the escapees. Despite advertisement, no more was heard of them. However, the capture on or before December 27, 1964, of an arctic fox at Lac Papineau, Co. Papineau, Quebec, some 80 miles down the Rideau and Ottawa rivers from Merrickville, was reported in the *Montreal Gazette*, January 19, 1965, in "Izaak Hunter's" sporting column. The animal, which appeared from the skull to be a $2\frac{1}{2}$-year-old vixen, was caught by Mr. Willie John Mapp, and its skin is in the possession of Mr. Jean Gelinas of Montreal. It bore no ear tags, and was furthermore captured before the escape.

In January 1967, at Howard Point on the Belcher Islands, over 700 miles north of Merrickville, Mr. Charlie Kudlowanek caught an arctic fox bearing an ear-tag of the same kind as those I used (Ketchum Miniature "Kurl-lock", Ketchum Manufacturing Sales Limited, 396 Berkeley Street, Ottawa), and with the same number stamped on it as on the tag borne by the vixen of the escaped pair. Through the courtesy of the then manager of the Hudson's Bay Company post on the Belcher Islands, Mr. L. Hornsby, and of the Superintendent of Game at Fort Smith, the tag was sent to me for identification.

In reply to a query, I was informed in July 1967 (after a time lapse of six months), that the fox was a male in good condition, though the accuracy of this statement may well be questioned in view of the considerable time between the capture and the report.

Mr R. Standfield, Research Branch, Department of Lands and Forests, Ontario, and Mr. Pierre DesMeules, Quebec Wildlife Service, have informed me that they know of no arctic foxes being ear-tagged in their provinces. It therefore seems very probable that the trapped animal was the one which escaped near Ottawa almost exactly two years before.

It is interesting to note that the Belcher Islands are only some 250 air miles off a line joining capture and escape points. A suggestion that the arctic fox possesses navigational ability and a

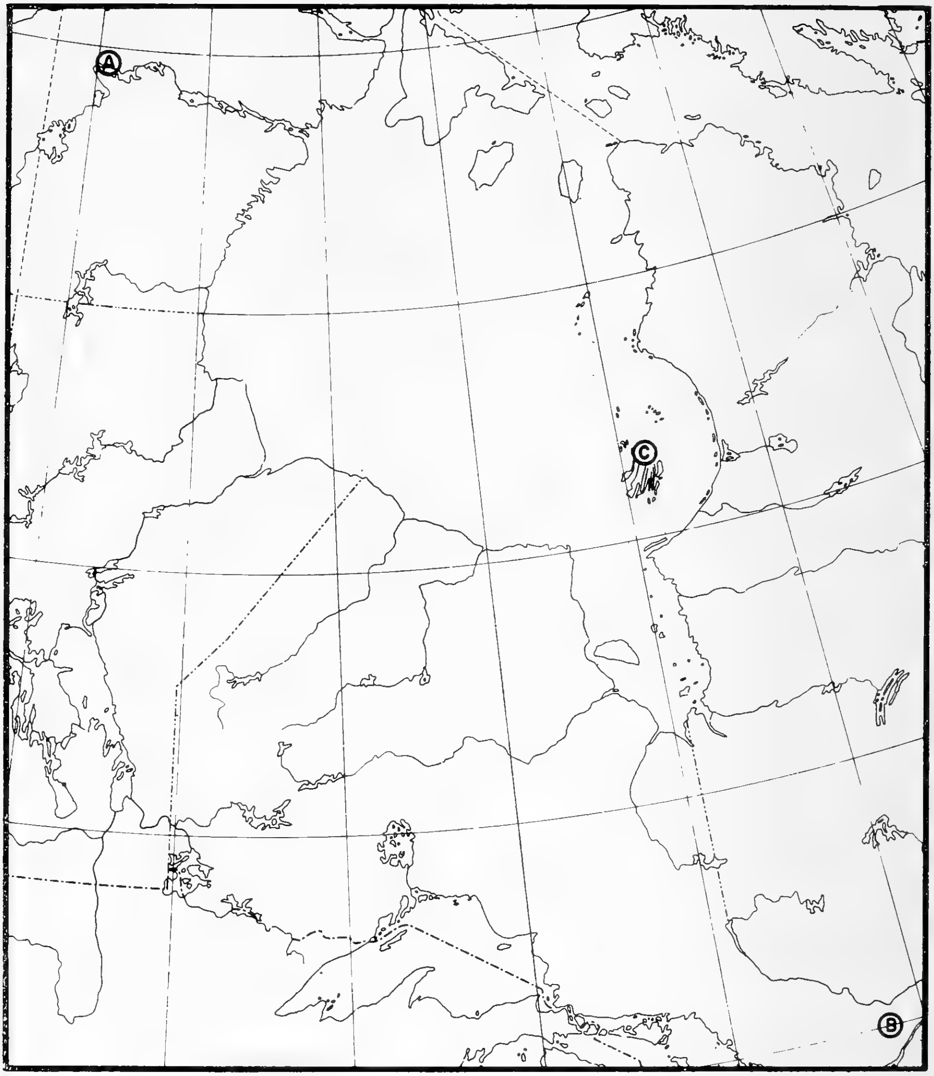

FIGURE 1. Central Canada, showing (A) place of capture, and (B) place of escape, of an arctic fox, and (C) place of capture two years after the escape of what seems to have been the same animal.

homing instinct would not be unprecedented: the rapid drop in the ratio of white to blue arctic foxes in the catch of Northwest Greenland after each of the periodic population peaks (Braestrup, 1941: Elton, 1949) might in fact be most easily explained by a return to the west of the white migrants. The maintenance of the "Obdorsk" and "Pechora" varieties in the arctic fox populations of the northern European U.S.S.R. provides a parallel (Shilyaeva, 1966). Published tag returns (Schwartz, 1966) show that arctic foxes may disperse several hundred kilometers from their breeding grounds, but provide no evidence on homing.

I am grateful to Dr. N. S. Novakowski for helpful comments.

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Studies of the Byron Bog in Southwestern Ontario. XXXIV. Additional Observations on Reptiles of the Bog

IN A PREVIOUS article (Judd, 1965) an account was given of observations on toads, frogs and turtles of the Byron Bog. The present account gives further observations relating to turtles and snakes. In the description of the Byron Bog (Judd, 1957) it was pointed out that there are three zones in the area. They are designated as A, B and C on the map accompanying the description and their outer limits are shown on the map. Zone A is the central floating bog based on a mat of *Sphagnum* moss and covered almost completely by leatherleaf, *Chamaedaphne calyculata*. Zone B is a low, wooded region, damp or flooded, with hardwood trees and shrubs at its outer limits and black spruce and larch at its inner limits. Zone C consists of wooded slopes occupied by deciduous trees and shrubs. In the floating bog is Redmond's Pond (D).

Measurements of specimens (carapace length of turtles, total length of snakes) were made as shown in Conant (1958). Specimens preserved in the collection of the Department of Zoology, University of Western Ontario are designated UWO.

Chelydra serpentina serpentina (L.), COMMON SNAPPING TURTLE. On May 14, 1965 a turtle was noted partly submerged in the water at the west shore of Redmond's Pond. In an attempt to catch it, it was poked with a dip-net, but it escaped. The length of its carapace was estimated as 12 in. On May 19, 1966 a turtle of about the same size was seen in a ditch in the northeast part of Zone B. On May 16, 1967 the attached carapace and plastron of a turtle (UWO), with all other parts of the body removed, were found lying on the *Sphagnum* moss near the north end of Redmond's Pond. The carapace was $4\frac{1}{8}$ in. long.

Clemmys guttata Schneider, SPOTTED TURTLE. William Edwin Saunders of London, Ontario, for several years wrote columns entitled "Nature Week by Week" for the London Free Press. In two of these he discussed the distribution of turtles in the vicinity of London. In one (1942a) he wrote of the spotted turtle "which is found in swamps such as the Foster swamp north of Springbank." In the other (1942b) he said of the spotted turtle: "This is a rare species, to be found among vegetation in damp places, and most that I have seen have been in the Foster swamp north of Springbank." The name "Foster Swamp" or "Foster Bog" is a name formerly applied to the Byron Bog when it was owned by the late Thomas Foster who farmed in London Township.

On June 21, 1966 I found a spotted turtle (UWO) crawling over the *Sphagnum* moss in the northeast part of Zone A. The length of the carapace was 4½ in. All the claws and toes of the two front feet were missing and the skin was closed over the remaining stumps which were actively used in crawling. Conant (1858) points out that this is the "polka-dot" turtle and that the number of yellow spots on the carapace is extremely variable, from none at all to 100 or more. In the specimen from the bog the spots are large and distinct and the numbers of them on the various scutes are included herewith, as follows, using terminology for the scutes as in Conant (1958):

One nuchal scute: 2 spots

Twenty-three marginal scutes: 1 spot each

Three marginal scutes: 2 spots each

Five vertebral scutes (from anterior to posterior): 6, 6, 6, 8, 6 spots

Four left costal scutes (from anterior to posterior): 4, 11, 6, 4 spots

Four right costal scutes (from anterior to posterior): 6, 12, 5, 4 spots

This gives a total of 115 spots.

Storeria dekayi ssp. Holbrook, NORTHERN BROWN SNAKE. On April 1, 1967 a snake (UWO), 13 in. long, was found crawling on the ground in the woods in the southeast part of Zone B. In the two parallel rows of spots down the back of this specimen, the spots are dark and distinct with no crosslines linking them across the back, a condition typical of the subspecies *S. d. dekayi*. The ventral and subcaudal counts, however, are 121 and 55 respectively, for a combined total of 176. This figure places the specimen on the dividing line between *S. d. dekayi* (total 175 or less) and *S. d. wrightorum* (total 176 or more) (Conant, 1958: 125). Extreme southern Ontario is usually regarded as a zone of integradation between these forms (see Conant 1958: map 83; Logier and Toner 1961: 62). Mr. F. R. Cook of the National Museum of Natural Sciences National Museums of Canada, is currently studying the status of Canadian populations of this species

Thamnophis sirtalis sirtalis L., EASTERN GARTER SNAKE. Garter snakes were encountered about the perimeter of the bog. One was crawling in the grass on the slopes of the northwest part of Zone C on May 13, 1962, one was coiled up beneath a crumpled piece of plastic sheeting on the northwest part of Zone B on July 14, 1965 and one was crawling along a cinder path in the northeast part of Zone B on August 22, 1967. On October 14, 1966 three snakes were found. One of these (UWO) was 28 in. long and was crawling about on the upper slopes of the northwest part of Zone C and the other two were moving about, close to one another, among fallen leaves on the southwest slopes of Zone C.

Lampropeltis triangulum triangulum Lacepede, EASTERN MILK SNAKE. One snake (UWO), 9 in. long, was found on September 11, 1964 by Mr. W. T. Cumming in his backyard at 812 Headley Drive which comprises part of the western slopes of Zone C. The light patch on the nape of the neck was distinctly Y-shaped, a marking typical of this form.

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Occurrence of *Rhus copallina* in Leeds County, Ontario

THE winged or mountain sumac, *Rhus copallina* L., a distinctive but rare shrub in Canada, is known from only a few scattered localities in southern and eastern Ontario (Soper and Heimburger, 1961) the northern limit of its range. Macoun (1883) reported that he and later Rev. J. K. McMorine had found it on some of the Thousand Islands, the first records known for Leeds County. No specimen, however, is preserved in the extensive McMorine collection at Queen's University. The next report (Macoun, 1895) has the Rev. C. J. Young finding it near Lansdowne on a rocky hillside.

There were no other records of its occurrence in Leeds County until the summer of 1967 when the author located several sites on Dunder's Mate, a granite knob near Morton which is about 25 km north of the Thousand Islands; subsequent visits to the neighbouring roche moutonees yielded further sites. Exploring the Lansdowne area early in 1968, we found other sites near Landon Bay and a large one on Mt. Fitzimmons. In June of 1968 additional sites were located on Blue Mountain, a series of quartzite outcrops on the South-east side of Charleston Lake 10 km north of Lansdowne.

All known localities are as follows and are indicated on the inset map (Figure 1). Thousand Islands, J. K. McMorine, cited by Macoun 1883, no specimen. Thousand Island, Macoun 1870 (MTMC). Lansdowne, C. J. Young 1891 (Can.). Dunder's Mate near Morton, 027/306, S. P. VanderKloet (Q.K.). Rock Dunder near Morton 030/309, 1968 (Q.K.). Morton, 031/301, 1968 (Q.K.). Morton, 035/302, 1968 (Q.K.). Morton, 038/308, 1968 (Q.K.). Landon Bay near Lansdowne, 158/119, 1968 (Q.K.). Mt. Fitzimmons near Lansdowne, 170/131, 1938 (Q.K.). Blue Mountain near Lansdowne, 158/202, 1968 (Q.K.).

The plant is not rare on these Leeds County outcrops, only hard to find: it is a small shrub, growing in colonies, stems about 10 to 60 cm. tall, a few up to 80 cm. Sometimes it forms an under story to the abundant shrub *Rhus typhina* sometimes it lines chinks in the bare granite among *Danthonia spicata*, *Carex communis*, and *Vaccinium angustifolium.* The new findings on ridges, indicate the shrub is not as rare in Leeds where pitch pine is also very common, as had been supposed. The same may apply to the Kaladar sites first noted by Barry in 1947, removed some 65 km to the West.

A striking difference between these sites on the northern shores at the Eastern end of Lake Ontario and those in Norfolk and Middlesex Counties is ecological: in the former *Rhus copallina* is restricted to rocky outcrops, and in the latter to sand-plains. In New York State, where occurrences are more frequent (House, 1924) both conditions are

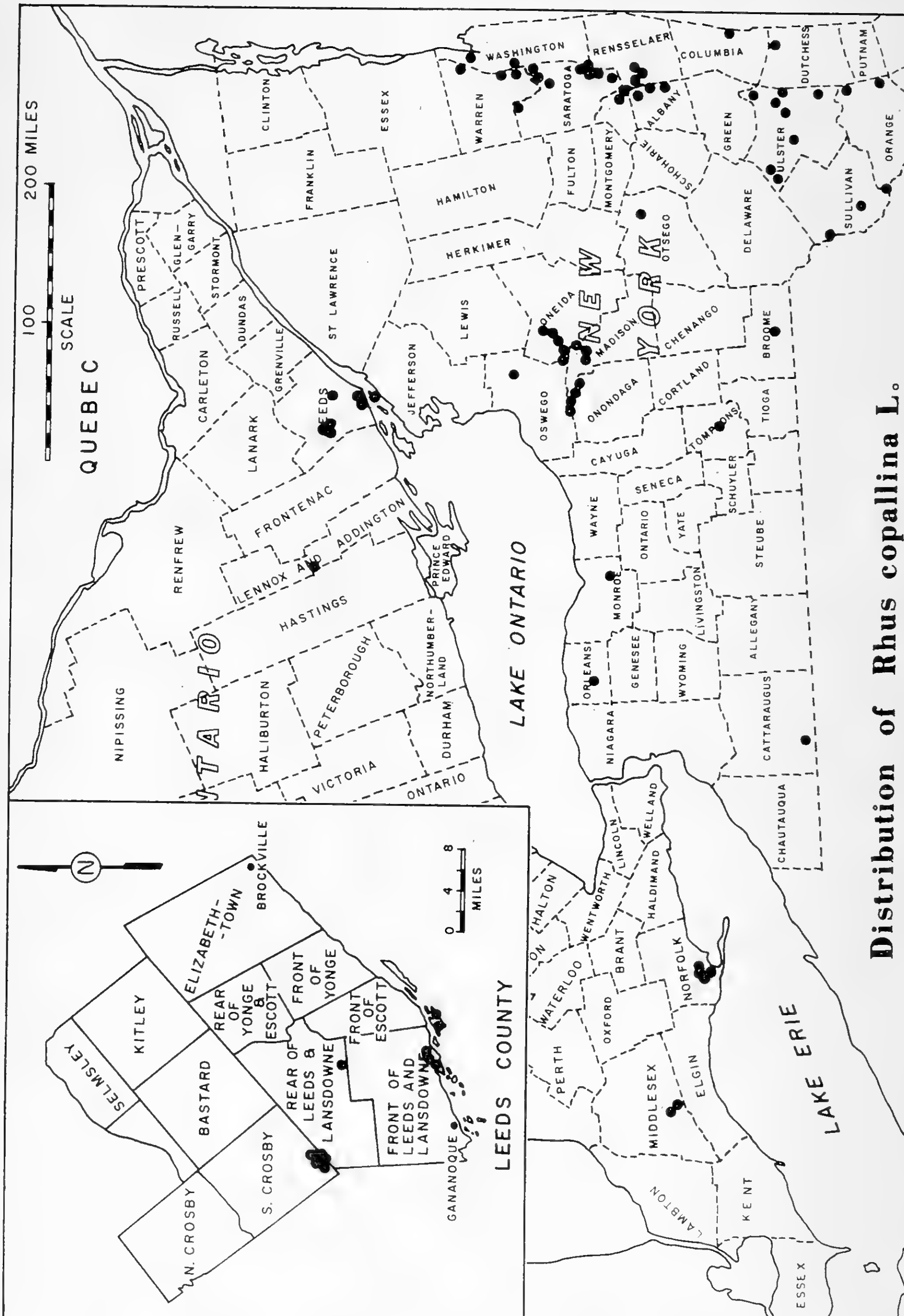

FIGURE 1. Map of parts of Ontario and New York State, with Leeds County enlarged as inset, showing localities for *Rhus copallina*. New York records kindly supplied by Stanley J. Smith, N. Y. State Museum. Leeds County records cited in text.

also present: the sites around Oneida Lake are on sterile sand, and those along the Hudson valley are on rock. Throughout its broad distribution — New Hampshire to Georgia, north to Ontario, West to Michigan, Missouri and Texas (Barkley, 1937) — occurrences are characteristically clustered and localized, often but one site per state.

In the south Barkley (1937) established var. *leucantha* with its centre in Florida and var. *lanceolata* with its centre in Texas. These varieties hybridize freely with the var. *latifolia* Engler which is our northern form. Gleason (1958) avoids the difficult problem of classification but mentions that progressing southward the number of leaflets are more numerous, narrower, and are more acuminate. In Leeds the number of leaflets are often 5 to 7, sometimes 9; the plant stature is diminutive compared to the southern clones which may attain the size of a small tree. No mature seeds have yet been collected at the Leeds County sites though flowers and aborted ovules are common at some sites.

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NEWS AND COMMENT

Enqual

ENQUAL (which stands for Environmental Quality) is a voluntary, non-partisan, non-profit association which had its beginnings at the University of Victoria in November, 1966. Although originally drawn principally from the University of Victoria, "membership is open to all who wish to contribute to the development of an environment of high quality for human life in British Columbia".

The following information about ENQUAL is abstracted from the ENQUAL BULLETIN, Volume 1, No. 1. Spring, 1968.

Principles

1. ENQUAL recognizes that man evolved on this planet and that his welfare is inextricably linked with it. Man is an integral component of a complex interacting system, not something apart.
2. ENQUAL is aware that, although man has developed great technological capabilities for changing his environment, deterioration is often an unplanned consequence. Belief that change *is* progress toward a better life may blind us and delay recognition of adverse consequences.
3. ENQUAL questions whether this planet can indefinitely support an environment of high quality for human life with current methods of resource management.
4. ENQUAL believes that the better the understanding of the ionsequences of technology, the better man will be able to choose and manage his destiny.

What should ENQUAL do?

ENQUAL activities could take many forms. At present the following are considered to be the most feasible:

1. Act as an educational and information centre to publicize problems and alternatives in the use of environmental resources.
2. Act as a clearinghouse and communications centre between groups concerned with resource utilization and environmental quality.
3. Act in a watchdog capacity, prepared to publicize a balanced view of the issues involved in resource management practices, expecially where these may lead to environmental deterioration.
4. Investigate or stimulate research on specific environmental problems, and publicize findings.

Since its beginnings ENQUAL has held ten evening meetings at the University of Victoria. The following subjects were discussed:

1. Definition of objectives and course of action of ENQUAL.
2. Specific environmental problems to develop an appreciation of their complexities. A local expert was usually invited to lead off the discussion. Topics included were sewage disposal, pollution, parks, freeways and greenbelts.
3. The relationship of ENQUAL to other organizations concerned with resource management and environmental quality.

Agreement was reached on the following:

1. Environmental problems are sufficiently complex that to publically propose any solution without thorough knowledge of the facts gained by intensive study would be fatuous and might negate any effective role that ENQUAL might play in the future.
2. Adequate problem analysis and proposals for alternative solutions can often take years to complete; ENQUAL cannot at present engage in detailed studies with its limited resources of money and man-hours.

3. A forum of uninhibited dialogue between professionals and laymen which enhances our knowledge of man-environment relationships should be a continuing function of ENQUAL.
4. ENQUAL should continue its educational role, fostering examination of diverse aspects of environmental quality and communicating these views as widely as possible. An informed public understanding of choices and consequences is essential.

The following ENQUAL subcommittees were formed in 1967:

1. Buttle Lake Investigations (a beautiful mountain lake in which pollution has only recently started).
2. Parks and Recreation (to analyze the British Columbia Parks Act).

ENQUAL members are currently engaged in research and surveys on the microflora and microfauna of Buttle Lake and Portage Inlet in relation to pollution; the plankon populations of 16 other lakes on southern Vancouver Island; pollution centres in British Columbia and other problems related to environmental quality.

During 1968 ENQUAL intends to continue the educational program of evening seminars on environmental problems including domestic waste disposal, urbanization and open space, economics of resource management and pollution control. An expert will be called to introduce each topic and an opportunity for group discussion will follow. The aim of these seminars is to develop an awareness of the problems encountered in resource management and provide a broader knowledge base for rational decisions on current ENQUAL projects.

ENQUAL proposes to use the ENQUAL BULLETIN to reach those who cannot attend the seminars. The Bulletin will put before its readers information pertinent to British Columbia by reprinting or abstracting selected articles, reviewing lengthy works, listing references, and reporting ENQUAL studies and seminars.

The continued development of an ENQUAL Information Centre is considered to be of great importance. The literature on environmental quality and resource management is immense, but often is inaccessible to many who want it. The building of an information retrieval facility is planned and the facility will be made available to those who have questions to answer and decisions to make.

Other activities will be considered as ENQUAL's resources increase. ENQUAL's capabilities will increase as support grows. ENQUAL needs:

1. MEMBERS—to study and report on environmental problems and solutions
   —to work on project committees
   —to promote public awareness of the principles guiding ENQUAL
2. DONATIONS—in any amount from any source wishing to assist in ENQUAL's efforts.

Membership dues for 1968 were as follows:

Regular	$5.00
Student	$2.00

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—Editor

PREDATION ON PEREGRINE FALCONS

THE following quote from "The President's Letter", Number 14, 1968 published by the International Council for Bird Preservation may be of interest to the readers of this journal.

"A further, and most serious, menace to birds of prey has arisen within the last few years with the unprecedented increase in "falconers" so-called, who form themselves into associations whose objectives are not the sport of falconry, and which has resulted in a large commercial traffic in these birds. At the meeting of the European Section ICBP in Hungary an alarming report contributed by the French Section from Monsieur J. F. Terrasse, President of *L'Association Nationale des Fauconniers et Autoursiers Français,* gave details of the depredations of German falconers and dealers on the eyries of Peregrines and other falcons in France, Italy, Sicily and Spain. In some cases not only the young birds but also the adults were taken. Similarly disturbing reports as to the extent of the traffic came from Austria, Belgium, Germany, Great Britain and Yugoslavia, particularly with regard to the enormous increase of small zoos displaying birds of prey and the great publicity given in certain quarters which induces people, who know nothing about falconry or how to keep these birds, to wish to possess them. Birds of prey have become big money, and the traffic is not confined to Europe and the U.S.A. but also extends to North Africa and Asia. Further, the birds are frequently "packed" in the most appalling conditions. There is indication that the laws for the protection of birds of prey and owls are not only being widely broken in France but also in a number of other countries.

A resolution was adopted at the Conference in Hungary calling for the prohibition of the export and import of all birds of prey and owls except under licence. The reputable falconers' clubs are as concerned, if not more so, as the conservationists at the present situation, and the President of the British Falconers' Club, Mr. J. G. Mavrogordato, reported to the Conference that recently an International Association of Falconry and Conservation had been formed to endeavour to halt the trade.

The birds of prey received an almost knockout blow as a result of the use of pesticides and unless urgent and effective steps are taken to control it this pet-trade will seal their final doom."

EDITOR

THE JOSSELYN VAN TYNE MEMORIAL FUND AWARD

THE attention of all students of birds is invited to forthcoming awards from the Josselyn Van Tyne Memorial Fund in support of research projects. See *The Auk*, January 1969, on how to apply, or, write Dr. Paul H. Baldwin, Zoology Department, Colorado State University, Fort Collins, Colorado 80521. Canadians are invited to submit applications.

EDITOR

THE FORD FOUNDATION PLANS $6,000,000 GRANT TO THE NATURE CONSERVANCY

THE recent announcement by the Ford Foundation that the foundation has extended $6,000,000 of credit to the U.S. Nature Conservancy has brought into sharper focus the acute problems associated with the protection of lands having outstanding natural and scenic values. The grant was the largest of its kind ever made by the

Ford Foundation and the first of its kind to a conservation organization. The money will be used for the preservation of natural areas that are threatened by commercial development. With the help of the Ford grant, about 100 tracts of land with a total of more than 50,000 acres will be secured by the end of 1969. The Foundation grant is not a gift but rather it is credit extended, which means that the conservancy can borrow up to six million dollars, with the Foundation guaranteeing repayment. This credit enables the Conservancy to act quickly to acquire a tract, then hold the land until a local, state or federal agency can find the funds to buy it.

The Nature Conservancy has already made headway in its objective of saving for posterity as much of vanishing natural America as possible. As of Mid-April, 1968, the Conservancy had been instrumental in saving some 285 tracts throughout the United States. The lands vary in size from 1 to 11,290 acres and are either owned or are sold, deeded or leased to government agencies with conditions determining future public uses.

Not only has the Nature Conservancy preserved various irreplaceable lands for public use but it has also saved taxpayers millions of dollars by anticipating huge increases in land costs. Anyone wishing to join or contribute to U.S. Nature Conservancy should write to 1522 K Street, N.W., Washington, D.C. 20005.

EDITOR

REVIEWS

Strangers in High Places: The Story of the Great Smoky Mountains

By MICHAEL FROME. Doubleday & Company, Inc., Garden City, New York. 1967. 394 pp. $6.95.

A book of many facets, Strangers in High Places encompasses both the natural history and the human history of the Great Smoky Mountains, including the forty-year struggle by men of vision to bring about the creation of a great national park.

Horace Kephart, "dean of American campers", arrived in the Smokies at the time of the big logging companies, and witnessed with dismay the ruthless slashing of the virgin forests. Kephart, and other men of influence, threw their whole weight behind the idea of a national park to save the magnificent forests of the Smokies. The story of the creation of the park is one of almost superhuman achievement . . . of halting the powerful lumber companies, of politicians who vowed to vote "not one cent for scenery", of raising funds in poverty-stricken states . . . a story of democracy at work. There is a sobering discussion of park problems today, of the danger that the sanctuary will revert to an overcrowded playground, an awareness that park values are not safe.

The Great Smoky Mountains, with sixteen peaks above 6,000 feet, form the greatest height and mass in the Appalachians. Never glaciated, the green mountaintops provided sanctuary for plants driven south by advancing glaciers. With the retreat of the glaciers, plants moved northward again, but many remained to share the Smokies with more southerly species. The unique remnant forest that survives in the Smokies today is an example of the flora of pre-glacial times.

The human history includes one fascinating chapter after another on the humanity that has ebbed and flowed through the Smokies. We are given the poignant story of the native Cherokee Indians, a stark unpleasant picture of the arrogance and inhumanity of the invading whites, and a picturesque account of the character and culture of the mountain settlers who were somehow bypassed by the mainstream of civilization. There are interesting accounts of famous personalities of the Smokies, botanists and geographers, missionaries and ethnologists, bearhunters and moonshiners, loggers, politicians and statesmen, all portrayed with a lively personal human touch that charms the reader.

A book to whet one's interest and deepen one's appreciation of this magnificent national park. An exhaustive camping and hiking appendix, bibliography and notes are appended.

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Handbook of the Crayfishes of Ontario

By DENTON W. CROCKER and DAVID W. BARR. Royal Ontario Museum Life Science Miscellaneous Publication University of Toronto Press. 158 pp. + xiii, 86 figs., 1968. Hardcover $6.50.

In an age when scientific interest is focussed primarily on molecular biology, the appearance of this excellent study on the crayfishes of Ontario, prepared by university scientists, is a refreshing change of pace to those who find deep fascination in whole-animal biology and natural history in general.

This very readable, glossy page, hardcover or paperback book draws attention to a familiar but relatively little understood group of aquatic invertebrate animals. For each of the nine species of crayfish established in the Canadian region, from the Rockies to the Maritime provinces, the authors have provided dorsal-view photographic illustrations, drawings of diagnostic characters, extensive lists of recorded occurrences and a distributional summary. The key to species utilizes characters that are independent of sex or moult stage and the key couplets are multiple-character. Food and feeding habits, general ecology, and life cycle are described for each species. A special chapter on the biology of crayfishes includes description of external body features and appendages, habitats, breeding cycles, egg laying, early life stages, and reproductive potential. Crayfish are mainly omnivorous and herbivorous, but sometimes carnivorous and even cannibalistic, and in turn they are preyed upon by most game fishes, many amphibians and reptiles (especially turtles), aquatic birds (e.g. kingfishers) and mammals (mink, racoon). The remarkable tunnelling and chimney-building habit of some species (*Cambarus fodiens-diogenes* group) protects the animals from enemies and from desiccation during dry spells. Certain leeches live commensally on the carapace and small ostracods on the gills.

The authors discuss man's utilization of crayfish as food (mainly in the Mississippi basin and in Europe), as bait for game fish, and as readily available and hardy animals for scientific research. They point out, however, that farmlands, lawns, and dikes may be seriously riddled and damaged by crayfish burrows and valuable animal resources may be parasitized by worms that complete their life cycles in crayfish. Particularly useful is the chapter on techniques for preservation and study of crayfish, and for aquarium and pond-culturing of these large-clawed crustaceans. A good glossary of technical terms and comprehensive list of references complete the book.

The text is reasonably free of mechanical errors and the substance is subject to few serious criticisms. The chapter on crayfishes as a global group, while emphasizing North American distribution and dispersal, does not take into account (1) the virtually proven thesis of continental drift and its bearing on the world distribution of crayfish families (in place of Ortmann's 1902 "land bridges" hypothesis), (2) the likelihood of "replacement" of the relatively primitive crayfishes in tropical fresh waters by the more highly and more recently evolved fresh-water crabs, and (3) the fossil record and its bearing on the phylogeny of these ancient crustacean types. The distribution maps are clear and very useful but the map for *Cambarus bartoni* indicates the range in Atlantic drainages for which records are not given nor have been previously published (e.g. Gaspe peninsula, N.E. New Brunswick, northern Nova Scotia). The illustrations and photographic plates are of good quality but infrequently show the structure and armature of the chelate-walking legs, diagnostic in species such as *Orconectes immunis*. A discussion of common names and an attempt to coin common names might have been opportune, as has been done with unionid bivalves of North America. The chapter on man and crayfish suggests the scope of fields in which profitable research on these animals may yet be pursued.

The authors, with the support of the Royal Ontario Museum, are to be congratulated on their timely, well executed, and reasonably priced monograph that will be especially valued by professional carcinologists, students, and lay naturalists. They have set a quality standard and stimulus for what hopefully may be many more such contributions on the fauna of this country.

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Wild Flowers of Alberta

By R. G. H. CORMACK, Department of Industry and Development, Edmonton. 1967. 415 pp. illus. $6.00 from The Queen's Printer. Edmonton.

Alberta is indeed the most fortunate of the Canadian provinces in possessing popular volumes on natural history subjects. The present book is the third of a series, *The Birds of Alberta* and *The Mammals of Alberta* having been published earlier by the Government of Alberta and *Alberta: A Natural History* recently published by a private printer at Edmonton.

Wild Flowers of Alberta is dedicated to The Boy Scouts, Girl Guides, Cubs and Brownies of Canada. To children and interested laymen of Alberta and adjacent provinces, this book will be a most useful picture guide to help them to identify the showy flowers they find. Some 400 plants are illustrated in colour; each plate is accompanied by a simple not too technical description and notes on distribution and other items of interest. The latter are particularly well written and easy to understand. Line drawings illustrate the few technical words that are used to describe parts of the plant throughout the text. A map showing the main highways and secondary roads is to be found at the front of the book, and a map of the vegetation zones of the province is at the back. Separate indices of common and scientific names are provided. There are no keys.

The author has selected the illustrations from a large number which were contributed by over 60 individuals. With such difficult subjects as plants, and the techniques employed by the various photographers, it was inevitable that some are better than others. In many cases, the reproduction of colour leaves much to be desired. For example on page 9 we read "The most conspicuous of these is the Samphire whose bright red succulent almost leafless stems stand out in sharp contrast---", but unfortunately what should be bright red in the illustration is a yellowish orange.

The organization of so many photographs and their correlation to captions and the corresponding text is indeed a difficult task. On pages 128 and 129 the captions for the Alpine Wallflower and Double Bladder Pod have been switched. It is to be hoped that there are no others. The inclusion of the Latin name as well as the common one with the plate might have eliminated this. The coining of new "common" names is deplored. The name "Head-shaped Lousewort" for *Pedicularis capitata* involves a particularly poor translation of the term *capitata*, which in this case means 'gathered together to form a dense cluster', rather than head-shaped.

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An Introduction to the Behaviour of Ants

By JOHN H. SUDD. The Macmillan Company of Canada Limited. 1967. 200 pp. $3.95.

This well-written and extremely interesting book is packed with information. The field covered is exactly what the title implies, there is no information on a taxonomy of ants nor on their physiology. Nine chapters discuss senses, navigation, nesting, food gathering and distribution, reproduction, organization and social evolution of ants. Each chapter is indexed under numbered subheadings; thus it is easy to get immediately to almost any subject desired. Although the book can be read from cover-to-cover, it is very concentrated and rich fare and is probably better used as reference book or opened and browsed at any place desired. For those interested in the study of ants it is first class, containing as it does hundreds of references leading into the enormous literature on ants. Even experienced myrmecologists will find the book very useful in this respect. On the other hand, those interested in natural history and having no more than an occasional curiosity about the behaviour of ants, will find the modest price of this book a very worthwhile investment. I recommend it most enthusiastically.

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Freshwater Fishes of Connecticut

By WALTER R. WHITWORTH, PETER L. BERRIEN and WALTER T. KELLER, State Geological and Natural History Survey of Connecticut, Department of Agriculture and Natural Resources, Hartford, Bulletin 101:i-vi + 1-134, illustrated. 1968. $1.50 (U.S.).

This book treats the 82 species of the fresh waters of Connecticut. A figure, a spot distribution map, a brief description and life history are presented for each species. Tables summarizing the ecological preferences, the characteristics of Connecticut watersheds along with the usual notes on identification, a glossary, 5 pages of references and an index are included.

The drawings will be useful to the angler, though not always completely accurate (viz. the complete lateral line in *Cottus cognatus*). The spot distribution maps are excellent, and should give a good idea of the distribution of most species. It will be a welcome addition to the shelf of the angler or one who wishes to increase his knowledge of Connecticut fishes, especially at the price of only $1.50.

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Fishes of the Bahamas and Adjacent Tropical Waters

By JAMES E. BÖHLKE and CHARLES C. G. Chaplin. Published for the Academy of Natural Sciences of Philadelphia by Livingston Publishing Company, Wynnewood, Pennsylvania. xxiii + 771 pages, 700 black and white figures, 32 colour plates. 1968. $29.50 (U.S.).

In handling and using faunal works and expedition reports of the 1800's one often poignantly regrets the passing of folio editions embellished with fine copper plate engravings. A modern counterpart has now appeared in the elegant *Fishes of the Bahamas.*

The topography and organization is excellent. Running titles in species accounts are in bold face. Family names are repeated on the right hand corner of the right hand page, making it easy to thumb to the desired family. Only one species account with its black and white drawing is allowed per page, seldom wasting space. The publishers have not been parsimonious with margins. Colour plates, when present, are almost always placed opposite the appropriate species account. Happily, non-glossy paper has been used.

The book is divided into the following principal parts: an introduction (with geography and history), family guide, species accounts, glossary, references and index. Instead of a family key, the authors have wisely chosen a pictorial guide which those unaware of family identity are much more likely to find useful. The definition of ciguatera poisoning in the glossary is too broad. All permutations of names are given in the index. A summary of major habitats and a list of poisonous fishes would have been interesting and useful in the introduction.

The body of the text consists of family and species accounts; classification at or above the ordinal level is not given. The family accounts are discursive. Well illustrated keys to the genera and species follow. These will be useful to students of the West Indies as well as the Bahamian ichtnyofauna.

The species accounts are divided into sections titled: *Illustrated specimens* (gives length of figured specimen and maximum length of species), *Distinctions*, *Coloration*, *Remarks* and *Distribution*. The *Distinctions* section is a brief diagnosis. A brief description or at least a summary of meristic characters would have been useful here to aid in identifying variants or new records. The section on coloration, usually based on fresh specimens, will be most useful. Under *Remarks* is given a valuable capsule description of ecology, with material seldom found in older faunal works. Life history information is often missing. Many observations, obviously from skin or scuba diving, are included. Under distribution are given the limits of world distribution and notes on occurrence in the Bahamas. An imaginative series of common names have been given, many coined or from the West Indian vernacular. Five hundred and seven species are said to be treated.

Thirteen pages of references are given. It is a pity that the authors' knowledge of the literature was not brought together into a complete bibliography. (As the publishers do not provide book copies for review, the reviewer provided his own.)

This book is an example of love's labours not being lost; of it, the authors and publishers may be rightly proud.

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The Birds of Simcoe County, Ontario

By O. E. DEVITT. 1967. Brereton Field Naturalists' Club, Barrie, Ont. 192 pp., 32 photos, 1 fig.

The first edition of this well-prepared annotated list was published almost 25 years ago and was reviewed in *The Canadian Field-Naturalist* 59(5): 169. This new edition has been substantially updated, expanded, and much improved in text detail, format, and illustrative material.

The new edition raises the list of species known to occur in the county from 257 to 284 (plus one hybrid), while the number of hypothetical species remains the same at five. The 22-page introduction includes a brief history of Simcoe County ornithology, information on birds killed at the Barrie TV tower, a summary of modern changes in the bird fauna, descriptions of the area, and a map showing the localities mentioned. There is an 8-page bibliography.

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The Birds of Alberta

By W. RAY SALT and A. L. WILK, Department of Industry and Development, Government of Alberta, Second (Revised) Edition, 1966. Queen's Printer, Edmonton, 511 pp. $5.00.

First published in 1958, this useful, jacket-pocket-sized book has been revised by the senior author. The new edition treats 325 species compared to 315 in 1958. The newcomers to Alberta are Cattle Egret, Black-crowned Night Heron, Brant, Black Brant, European Widgeon, Turkey (introduced) European Common Crane, Glaucous-winged Gull, Parula Warbler and Scarlet Tanager.

Although the introduction to this edition states that, in general, the book follows the American Ornithologists' Union's 1957 check-list, there are many spelling errors in the Latin and common names of birds, and no fewer than six of the ten new species are out of agreement with the AOU's sequence.

The book is well produced on good paper, and it is abundantly illustrated with photographs, paintings and sketches.

The photographs represent the efforts of 21 photographers. By and large, they are excellent, featuring the work of acknowledged experts in this field – Kathleen Hodges of Calgary; Prof. Cyril Hampson of Edmonton; and Stewart MacDonald of Ottawa. A newcomer to this reviewer, Douglas Gilroy of Saskatoon, has examples that stack up well against the best. Unfortunately, much of the illustrative material has been marred by poor reproduction, many plates being oversupplied with blues or greens.

Bird paintings total 117, and, like the photographs, are reproduced in this book in colour. For the most part they are delightful (Allan Brooks, T. M. Shortt), but some of Brooks' were first published in the Birds of Western Canada in 1926 (Orange-crowned and MacGillivray's Warblers), and their continued use can only do the original artist an extreme injustice. Moreover, readers will be forgiven if they do not share Dr. Salt's enthusiasm for the bird art of Reginald Chandler (Knot, Hooded Merganser) and his own (flycatchers, Swainson's Thrush). In addition to the full-color photographs and paintings, there are 35 splendid black-and-white sketches of birds by Mr. Shortt.

For a book of this kind, the text is entirely adequate, containing updated information on the status of each species in the province; useful maps of bird distribution, vegetation and roads; bird abundance; their field marks, nesting and environment; and short descriptions of males, females and young of the various species.

That a book of this kind, however, should be produced under government auspices without a list of at least the principal publications on the birds of the province is a reflection on the work of the scores of ornithologists who have helped build our knowledge of the Alberta fauna up to the point where books like the present one can be undertaken.

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OTHER NEW TITLES

The following titles are presented as a service to readers. Their listing does not preclude them from possible review in a future issue of this journal.

Bird Life in the Royal Parks. 1965-1966 —Report of the Committee on Bird Sanctuaries in the Royal Parks (England and Wales), British Information Services, New York, 1968. Illus. 35 p. $1.20 (US).

Ecology of Intertidal Zones. G. K. Reid. Rand McNally, 1967. Illus. $1.20 (US). Paperback.

Communications in the Animal World. W. F. Evans, Crowell, 1968. Illus. by Nancy Lou Gahan. $5.95 (US). For the general reader.

The Collection and Processing of Field Data. A CSIRO symposium, Canberra, August-September, 1966. E. F. Bradley and O. T. Denmead, Eds. Interscience. Wiley, New York, 1967. Illus. 597 p. $17.50 (US).

Pigeons and Doves of the World. Derek Goodwin. Illus. by Robert Gillmor. Trustees of the British Museum of Natural History, London, 1967. 446 p. British Museum of Natural History Publication Number 663. £6 6s (UK).

Principles of Insect Chemosterilization. Germain C. Labrecque and Carrol N. Smith (Eds.). Appleton-Century-Crofts, New York, 1968. Illus. 354 p. $16.00 (US).

The Organism as an Adaptive Control System. John M. Reiner. Prentice-Hall, N.J., 1968. Illus. 224 p. $6.75 (US).

Mathematical Challenges to the Neo-Darwinian Interpretation of Evolution. A Symposium, Philadelphia, April, 1966. Paul S. Moorehead and Martin M. Kaplan (Eds.). Wistar Institute Press, Philadelphia, 1967. Illus. xii + 140 p. Paperback. Wistar Institute Symposium Monograph No. 5. $5.00 (US).

Arctic Alpine Environments. Volume 10, Proceedings of the 7th Congress of the International Association for Quaternary Research, Boulder-Denver, Colorado. August-Sept., 1965. Sponsored by the U.S. National Academy of Science–National Research Council. H. E. W. Night, Jr. and W. H. Osburn (Eds.). Indiana University Press, Bloomington, 1968. Illus. 308 p. $12.50 (US).

The Evolution and Classification of Flowering Plants. Arthur Cronquist. Houghton-Mifflin, 1968. Illus. 396 p. $6.95 (US).

Great National Parks of the World. Richard Carrington. Random House of Canada Ltd., Toronto, 1968. Illus. 240 p. $25.00.

Curious Naturalists. Niko Tinbergen. Doubleday & Company, 1968. Paperback reprint of the 1958 edition. This delightful book describes the activities and discoveries of a small number of naturalists studying the behavior of animals in their natural environment. Includes experiments and behavior relating to bees, wasps, gulls, kittiwakes, moths, butterflies and other animals. Uses non-technical language and is written in a flowing style that keeps the reader's interest high. Very highly recommended for both naturalists and scientists. Illus. 301 p. $1.75 (US). Paperback.

Man in the Everglades: 2000 Years of Human History in the Everglades National Park. C. W. Tabeau. University of Miami Press, 1968. Revised Edition. Illus. 192 p. $4.95 (US).

Evolution in Changing Environments: Some Theoretical Explorations. R. Levins. Princeton University Press, 1968. Illus. 120 p. $6.50 (US).

A Conservation Saga. Ernest F. Swift with sketches by Betty R. Thomas and forward by Senator Gaylord Nelson. National Wildlife Federation, Washington, D. C. Illus. 264 p. $5.00 (US).

INDEX TO VOLUME 82

Compiled by Miss Charlotte E. Dill

A NOTE ON THE PRODUCTION OF THIS JOURNAL

The *Canadian Field-Naturalist* conforms to recommendations on the lay-out 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 'Thriftcoat'. The journal is printed by The Runge Press Limited, 124 Queen Street, Ottawa 4, Ontario.

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