

The Canadian Field-Naturalist

Vol. 63

OTTAWA, CANADA, SEPTEMBER-OCTOBER, 1949

No. 5

NOTES ON THE FAUNA OF THE FORMER NEMISKAM NATIONAL PARK AND VICINITY, ALBERTA^{1 2}

J. DEWEY SOPER

*Dominion Wildlife Service,
Edmonton, Alberta.*

FOREWORD

THE AREA dealt with in this paper lies in the treeless, semi-arid plains of south-eastern Alberta. The type of environment represented is typical of a wide expanse of territory on the Missouri drainage in Canada extending from approximately Big Muddy Lake, Saskatchewan, west to the foothills of the Rocky Mountains. The faunal aggregate is essentially simple, consisting of relatively few species, but some of these abound in individuals.

In the following pages, the various indigenous species listed are fairly representative of the characteristic shortgrass plains comprising a very large part of southern Alberta. Some members of the regional fauna not detected in the park are known to occur widely in surrounding country. Owing to the period when investigations were conducted, only summer resident birdlife is treated; many additional species are certain to occur during spring and autumn migrations. In addition, an obvious weakness exists with respect to water birds. Were the park to contain feeding and breeding waters, the ornithological properties of the area would be greatly enriched thereby, as the Great Plains ordinarily possess a marked attraction for ducks and shore-birds in large numbers where suitable sloughs and lakes occur.

Wildlife observations were carried out at Nemiskam National Park only at the height of summer. The more important results were obtained during the latter part of June, 1941. The actual park data are supplemented in the writer's experience by many months of field

work, since 1927, in areas of southern Alberta, relatively near by, which possess a practically identical biotic complex.

The area is easily reached by various roads connecting with the Provincial highway system. From the north the west gate is most readily accessible from gravelled Highway No. 3 by driving south from Bow Island on the road to the village of Nemiskam. Alternatively, one may proceed north from Nemiskam on the main secondary road that runs from Stirling to Etzikom, and Manyberries. The facility with which the park can be reached by these routes will be conditioned by the weather, as all immediate approaches are over earth roads which become temporarily useless during heavy rains. Park trails are of the same general nature, but, as they run over virgin sod, do not disintegrate in the same manner as graded earth roads.

My thanks are due to Edwin Matthews, Park Warden, who kindly assisted me in many ways while I was conducting the investigations and afterwards took the trouble to supply by mail certain faunal information that otherwise would not have been obtained. It is also a pleasure to acknowledge the kind assistance of Dr. R. M. Anderson, National Museum of Canada, Ottawa, who sub-specifically determined the small mammals collected in the park. It may be stated, also, that his recent publication, *Catalogue of Canadian Recent Mammals, 1946*, has been followed with respect to the nomenclature and sequence of species of quadrupeds treated in this paper.

With respect to the nomenclature of birds, the American Ornithologists' Union Check-List of North American Birds, Fourth Edition, 1931, has been followed, together with the succeeding Nineteenth to Twenty-second Supplements, inclusive.

¹ This park was cancelled by legislation adopted during the 1946-47 session of Parliament. The present observations were made and the manuscript written prior to the annulment of the park.

² Received for publication January 4, 1949.

PHYSICAL GEOGRAPHY AND CLIMATE

Nemiskam National Park is situated in Alberta about 42 miles southwest of Medicine Hat, 72 miles east-southeast of Lethbridge, and 36 miles north of the International Boundary. Pakowki Lake lies 12 miles southeast, and the nearest point on the South Saskatchewan River is 24 miles to the northwest. The centre of the preserve is at approximately 49°32' 50"N. Lat. and 111°14'W. Long. Geographical details of the district may be found on the Dominion Sectional Map No. 16, known as the Milk River Sheet. The reservation has an area of 8.5 square miles, or 5,440 acres.

The district varies in elevation from about 2,700 to 3,000 feet above sea-level, with the terrain rising gently to the south and west. The high plains sections of the park lie at an elevation of approximately 2,900 feet, while the minimum elevations on the bottomlands of the major coulees vary from 2,750 to 2,700 feet. Everywhere in the park and immediate vicinity the uplands are gently rolling in character. The greater depressions on the plains have been produced in connection with the drainage system and thus the high country becomes increasingly more undulating and rugged as the striking arroyos, lake basins, and river valleys are approached.

The notable coulees which traverse the plains are outstanding characteristics of the territory. The park is intersected by two of these — Chin and Fortymile Coulees. Such terrain presents ideal, rough country for antelope and mule deer, both of which have a liking for considerable variation in the topography. About one-third of the entire park consists of this type of land. The two coulees originate at considerable distances to the west and come together in the northeast corner of the park; to the east of the forks the valley is called Sevenpersons Coulee.

Chin Coulee is the principal depression in the park. It extends diagonally across the area from the southwest corner to the northeast end, dividing the preserve into two sections, the larger percentage of the high plains lying to the west. The portion of this coulee within the park is 3.3 miles long, with an average width of about three-quarters of a mile and a depth of 200 feet (Fig. 1). It constitutes a rather impressive topographical feature. A small creek flows through it to Sevenpersons Coulee, where it is joined by run-off waters from Fortymile Coulee. The greater part of the Chin Coulee bottomlands is gently undulating, arid, and grown more or

less sparsely to grasses, greasewood, sagebrush, and cacti. Only the lands bordering the creek are wet; in very narrow zonations they are inclined to be somewhat marshy. A dam was built in the southwest quarter of Section 12, Range 10, above which is an area of pond and marsh covering about 80 or 90 acres (Fig. 1).

The main escarpments and buttes of the area are steep and rugged, forming many sections of well-developed badlands. (Fig. 2). Most of the formation is a greyish-white material, suggestive of a highly compressed sandy clay, here and there exhibiting a local abundance of small fossil shells. This stratum is moderately hard, but it weathers much more rapidly than the dark layers of shale and sandstone which cap it and form sterile out-washes on the declivities below. In a few places very thin seams of soft coal were discerned in association with the shale and sandstone. The latter strata lie about two-thirds of the way up the valley walls from the level of the bottomlands and appear in most places to average between two and three feet in thickness. As the material below disintegrates, these strata assume the character of overhanging cap-rock, which finally breaks off in boulders of varying size to form small masses of talus, while some of the individual pieces roll farther down the slopes. Portions of this rock have a deep rusty colour. Above the sandstone stratum is a deep mantle of glacial clays, which goes to compose the high plains of the surrounding country. The geology of the district is referable to the Foremost Formation, Upper Cretaceous, of the Mesozoic Era.

Another conspicuous topographical feature is Fortymile Coulee. Its park section, running along the northern boundary, is nearly three miles long and averages about a half-mile in width, though in places it expands to nearly a mile. The depth varies from about 150 to 200 feet. On the whole, it is notably different from Chin Coulee, as most of the floor is flat, featureless, and of a somewhat marshy character, especially after floods and heavy spring runoff. At the height of summer it becomes dry, or nearly so, some parts developing into expanses of smooth, hard mud, interlaced with geometric cracks, while other areas are characterized by myriads of small hummocks, or "niggerheads". Generally speaking, the slopes of this valley rise more gently from the bottomlands than do those in Chin Coulee, with a greater accumulation of



Fig. 1. View of Chin Coulee, Nemiskam National Park, Alberta, looking northeast. Junction with Fortymile Coulee to be seen near the horizon. Marshy area above the dam lies in the left middle distance.

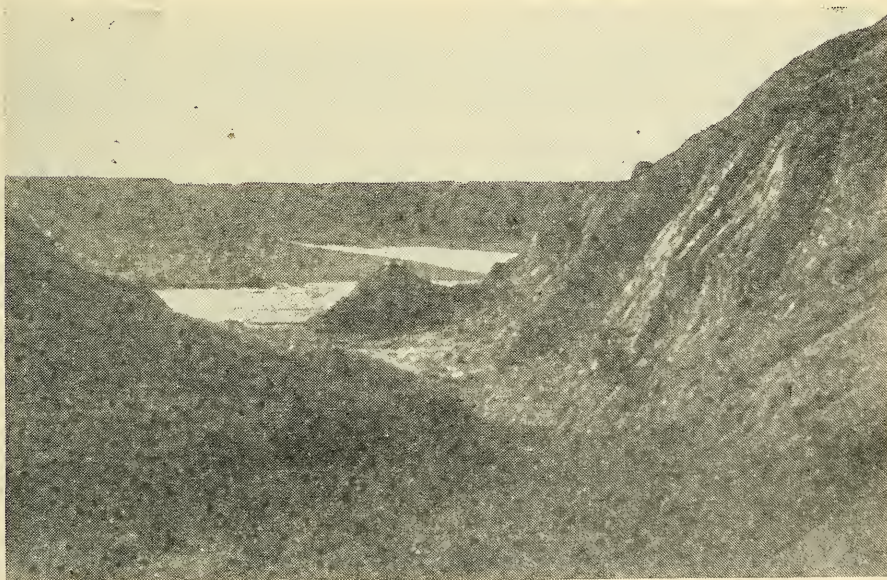


Fig. 2. A rugged, deeply eroded ravine tributary to Chin Coulee near the southern boundary of Nemiskam National Park. The west wall of the coulee is visible in the far distance, with the alkali-sagebrush bottomlands intervening.

detritus; there are practically no bedrock outcrops, or true badlands, and major tributary ravines are few and far between. Numerous minor washes, however, furrow the faces of the slopes. There does not appear to be an active creek in summer, as in Chin Coulee. In past ages both coulees were the scenes of enormous post-glacial drainage which carved out such conspicuous trenches across the face of the plains. Subsequent aqueous and atmospheric erosion has slowly sculptured the slopes into the form observed at the present time.

An artesian well on the floor of Chin Coulee near the south boundary is said to be 500 feet deep. While I was camped there a test was made on the rate of flow, which worked out to approximately 235 gallons an hour, or 5,640 gallons per day. The water gushes from a two-inch pipe into a wooden trough and from there flows into the creek that runs to the small reservoir above the dam. Owing to this supply of water, the marsh area at this point is permanent, although the flow is markedly offset by evaporation. Another artesian well is located at the warden's cabin on the high plain in the southeast corner of the Park (Fig. 4). The flow is similar to the one described above.

The region surrounding the park is very largely devoted to dry farming, although ranching is also carried on in the wilder and more rugged localities. As conditions are semi-arid, partial or total crop failure is not uncommon. This was particularly the case during the many years of acute drought following 1930, when extensive soil drifting was a prevalent feature. During, or even prior to, this period, scores of farms were abandoned. Even in normal times the mean yearly precipitation is only about 12 inches, while the average length of the growing season (number of days from average date of seeding to average date of first frost) is approximately 155 days.

Spring commences in late March or early April, and snow normally disappears by the middle of the latter month, if not earlier. During an occasional early spring, snow completely disappears in the latter part of March and the earliest vernal flowers appear on the plains a few weeks later. The summer is comparatively long, with moderate temperatures, but periods of excessive heat are not uncommon. Such spells may come as early as mid-June, or soon thereafter. During the investigations in 1941 the days were very hot,

the temperatures from June 23 to 25 running from 102° to 110°F. during the middle of the day. Temperatures on other days were in the high nineties. Autumn commences in the latter part of September and may be said to last until late October. Snow may arrive in November, but during some seasons it is absent until December, sometimes as late as Christmas. The cold is often intense. However, the winter in this region is frequently modified by chinooks, which occasionally melt all the snow during January or February. At such times conditions are spring-like, but these spells are normally followed by cold water, fresh snowfalls, and persistent winds.

NOTES ON THE FLORA

The region is classified as semi-arid, owing to the scanty precipitation. In consequence the vegetation is highly xerophilous, and similar to that prevailing throughout the Great Plains region of southern Alberta and Saskatchewan, especially on the Missouri River drainage. For the most part the vegetation is thin, and of a desert-like character; this especially applies to the badlands and the floors of the great coulees, where the soil is often poor and excessively dry. In many places the ground is sterile and bare, or sparsely clothed with a mat type of vegetation, while grasses and some other plants may exist only in scattered bunches. On the high, open plains the grasses are more continuous, including the gramma grasses of the genus *Bouteloua*, natural forage for the Pronghorn Antelope.

Highly typical of the region are sagebrush (*Artemisia*), greasewood (*Sarcobatus*), the little cushion cactus (*Mammillaria*), and the prickly pear cactus (*Opuntia*); the latter blooms profusely during the latter part of June and early July. While these species may occur at various levels up to the high plains, they are more abundant and reach their best development on the coulee bottomlands and adjoining benches. The sagebrush and greasewood frequently cover considerable areas without a break. In Nemiskam Park they usually grow to a height of from eighteen inches to two feet. The best examples are to be found in Chin Coulee. The sagebrush also climbs into the tributary ravines, as well as to ledges of the badlands proper.

Another characteristic shrub is the snow-berry (*Symphoricarpos*), which commonly thrives in scattered clumps in favourable habitats on benches and intermediate slopes and in tributary draws. Thickets of wild rose (*Rosa*) are also well distributed in similar

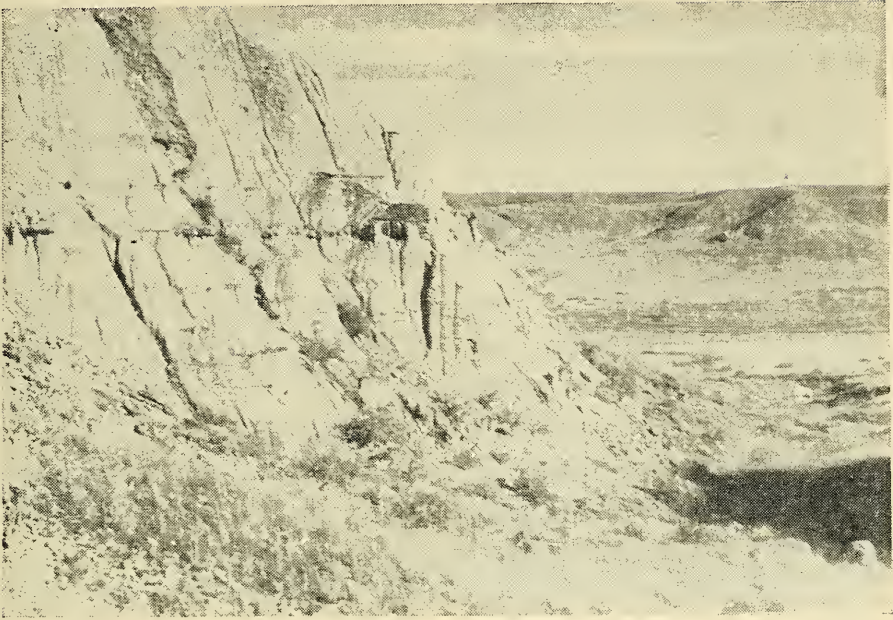


Fig. 3. Badlands section, showing effects of erosion and accumulation of talus forming the lower slope. Chin Coulee sagebrush flat in the middle distance. Nest of the Ferruginous Rough-legged Hawk is to be seen on a shelf of the acclivity to the left. June 25, 1941.



Fig. 4. Eastern portion of the high plains of Nemiskam National Park as seen from near the southeastern extremity of the area, looking north. Warden cabin, out-buildings and artesian well in the foreground. June 26, 1941.

situations. An unexpected feature was the occurrence of several shrubs usually found only in the humid parts of the Transition Zone; thus, on a few sheltered slopes of washes, or in hollows high up on the east slope of Chin Coulee and on the south slope of Fortymile Coulee, are small, dense thickets composed of chokecherry (*Prunus*), saskatoon (*Amelanchier*), silverberry (*Elaeagnus*), dogwood (*Cornus*), gooseberry, and black currant (*Ribes*). In one particularly dense and luxuriant copse of this nature chokecherries and saskatoons had attained a height of from 10 to 12 feet. Only a few such thickets occur in the park, and all are of small extent. Their presence in a semi-arid locality of this nature is probably explained by the fact that they are able to exist in nooks of northern exposure where deep snowbanks form in winter and are comparatively late in melting during the spring; these circumstances would provide much needed moisture and a certain degree of coolness well into late spring or early summer.

An even greater anomaly in the park flora is the presence of two western cottonwoods (*Populus Sargentii*?) in Fortymile Coulee. The trunks are about nine inches in diameter and the taller of the two is approximately 30 feet high. They grow well out on the bottomlands on a small area of well-elevated ground which is continuous with the slope on the south side of the coulee. This is a very surprising occurrence, as ordinarily the only trees found in the entire region are those which have been planted as windbreaks, aside from the woods existing on Cypress Hills and locally along the margins of the larger streams.

FAUNAL LIFE ZONE

The park lies deeply within the western, semi-arid division of the Transition Life Zone. This zoögeographic division is characterized by scanty rainfall, shortgrass treeless plains, and the presence of cacti, sagebrush, greasewood, and other plants of arid regions, together with certain typical mammals and birds. In some aspects of the situation even dilute Upper Sonoran Zone conditions are suggested. This will presently be noted in some detail. On the other hand, there is an interesting departure from 'normal' conditions, as expressed in the presence of such shrubs as chokecherry, saskatoon and dogwood, which are fundamentally characteristic of the more northern, or humid, division of the Transition Zone. Based on these and other features, it is evident that the

fauna and flora of the park are more composite in character than one would ordinarily have anticipated, in view of the location.

As already inferred, the life zone chiefly represented is the semi-arid division of the Transition. *Mammals* characteristic of this zone which occur, or did occur, in the park or vicinity are: Long-tailed Weasel, Badger, Kit Fox, Nebraska Coyote, Great Plains Muskrat, Richardson Ground Squirrel, White-tailed Jack Rabbit, Rocky Mountain Mule Deer, and Pronghorn Antelope. *Birds*: Franklin Gull, Swainson and Ferruginous Rough-legged Hawks, Prairie Falcon, Sage Grouse, Magpie, Western Willet, Arkansas Kingbird, Western Meadowlark, Desert Horned Lark, Lark Bunting, Brewer and Vesper Sparrows, and McCown's Longspur. *Shrubs*: silverberry, wild rose, sagebrush, and snowberry, although all of these species, like some of the mammals and birds which have been mentioned, also occur in parts of the western humid division of the Transition Zone.

Park mammals which are customarily regarded as typical of the Upper Sonoran Zone are Osgood White-footed Mouse, Badland Meadow Mouse, California Porcupine, and Black Hills Cottontail. Birds noted in the preserve which are also normally referred to this zone are: Burrowing Owl, Say's Phoebe, Western Mourning Dove, Lark Sparrow, and Rock Wren. Plants found in the park which are considered principally Upper Sonoran are the greasewood and prickly pear cactus; sagebrush is also highly characteristic of this zone.

That the humid division of the Transition Life Zone is barely represented in very attenuated form is shown by the presence of such shrubs as saskatoon, chokecherry, gooseberry, and black currant, which were previously discussed. Northern Plains Skunk, Richardson Ground Squirrel, and White-tailed Jack Rabbit are common in this zone, though the latter two species are perhaps more typical of, and reach their maximum abundance in, the semi-arid division of the Transition Zone, where they were earlier listed. Birds observed in the park which are commonest in the humid Transition are Eastern Kingbird, Brown Thrasher, and Yellow Warbler; these three species inhabit the few small thickets that find foothold in Chin and Fortymile Coulees.

Many species of western mammals and birds range through two or more life zones. Of the native park mammals, for example, the Long-tailed Weasel, Badger, Richardson Ground Squirrel, and White-tailed Jack Rabbit

range from the humid Transition Zone through the semi-arid division of this zone into the Upper Sonoran Zone. Birds doing the same include Mallard, Pintail, Swainson and Marsh Hawks, Western Willet, Tree Swallow, Magpie, Western Meadowlark, Yellow-headed and Red-winged Blackbirds, Goldfinch, Vesper and Clay-colored Sparrows, and Chestnut-collared Longspur. Other park species, such as Osgood White-footed Mouse, Badland Meadow Vole, Great Plains Muskrat, California Porcupine, Black Hills Cottontail, Pronghorn Antelope, Sage Grouse, Rock Wren, Lark Bunting, Burrowing Owl, McCown Longspur, Sprague Pipit, and Brewer Sparrow, are well distributed in both the semi-arid Transition and Upper Sonoran zones. The classification given in preceding paragraphs, however, shows the zone in which the various species are to be regarded as most characteristic.

PRELIMINARY REMARKS ON THE FAUNA

During the park investigations every effort was made to detect all species of the mammalia which inhabit the area and to secure a representative series of specimens of the smaller species for accurate subspecific determination. To a certain extent results were disappointing, as only two species of mice were secured — Osgood White-footed Mouse (*Peromyscus maniculatus osgoodi*) and Badland Meadow Mouse (*Microtus pennsylvanicus insperatus*). There is every reason to believe, on zonal and geographical grounds, that several other of the smaller southern mammals inhabit this locality. From this the conclusion is to be drawn that either the species suspected to occur there are normally very scarce, or that in 1941 they were experiencing a low numerical level in a natural cycle of relative abundance. Some animals, although permanent inhabitants, are not normally very common on the Great Plains. The difficulty of locating some species that are not only regularly characterized by thin dispersal, but are furthermore notoriously local in their distribution, is also a factor.

A naturalist's early impression upon first driving through the park is that birdlife on the whole is not very abundant. This is somewhat modified, however, as attention is gradually directed with more thoroughness to various areas. Among the first species to be noted are Vesper and Clay-colored Sparrows, Lark Bunting, McCown Longspur, and Ferruginous Rough-legged Hawk. The latter are often to be seen soaring overhead or perched on prominent crags of the badlands buttes.

Another conspicuous bird, as well as a brilliant singer of arresting quality, is the Western Meadowlark, which inhabits both the high plains and the coulee bottomlands. Horned Larks are also found commonly dispersed in both situations, together with a few widely scattered Chestnut-collared Longspurs.

The commonest birds of the Chin Coulee bottomlands (and to a lesser extent of Forty-mile Coulee) are Red-winged and Brewer Blackbirds, Lark Bunting, Vesper and Savannah Sparrows, McCown Longspur, Horned Lark, and Killdeer Plover. Many Nighthawks are on the wing during the evening. Less numerous are Burrowing Owl, Brewer Sparrow, American Magpie, Arkansas Kingbird, Sharp-tailed Grouse, Swainson Hawk, Prairie Falcon, and Sprague Pipit. The most characteristic species to be found in the lateral ravines and adjacent badlands are Rock Wren, Lark Sparrow, and Say Phoebe. Inhabiting the small thickets of shrubbery were Eastern Kingbird, Brown Thrasher, Crow, Magpie, Goldfinch, Yellow Warbler, and Brewer Blackbird.

Of the waterfowl only a few Mallards, Pintails, and Coots were observed—all at the marshy pond above the dam in Chin Coulee. Were it not for this small reservoir it is quite probable that no ducks would alight in the park, as the creeks are too small to attract them. One Sora Rail was also detected in this marsh. The park list in its present form contains 48 species of birds; this is bound to be expanded when further investigations are carried out at different seasons of the year, particularly during the spring and fall migrations.

ANNOTATED LIST OF MAMMALS

1. Prairie Kit Fox.

Vulpes velox hebes Merriam.—The Kit Fox formerly ranged over the plains of southern Alberta and southwestern Saskatchewan to points in latitude at least 100 miles north of the park. Old residents stated that it formerly occurred in the latter area. No information was secured to indicate that the species exists anywhere in that region at the present time and it may be safely concluded that it has now locally disappeared. In 1927, I was told that a few still occurred in the vicinity of Milk River, south of Cardston, and near Altewan, but nearly all ranchers in the south stated that the species was nearly if not entirely extirpated in most districts. No authenticated records of occurrence have been obtained by me since that time.

2. Nebraska Coyote.

Canis latrans nebracensis Merriam.—These animals were seen on several occasions within the park, both in the deep coulees and on the high plains. A short distance east of Chin Coulee one was followed with the motor car for about a mile; it finally disappeared in the direction of Fortymile Coulee. Individuals and small groups were heard howling nearly every night. The species appears to be relatively common. No doubt the protection afforded by the park has permitted the animals to hold their own in the locality; probably it also accounts for the fact that they are not particularly wild and may often be seen travelling about in daylight.

3. Prairie Long-tailed Weasel.

Mustela frenata longicauda Bonaparte. — This is a characteristic mammal of the Great Plains which has a wide range across the southern portion of the Prairie Provinces. It occurs at least sparingly in the park, as a male specimen (456, 160, 54 mm.) was collected in Chin Coulee on June 24, 1941. The animal was sighted in mid-forenoon as it ran about in a Richardson Ground Squirrel colony, disappearing first in one burrow and then in another. The ground squirrels in the immediate vicinity vanished down their holes while the weasel furtively ranged from point to point; farther away the squirrels kept up an interchange of excited calls, well aware of an enemy in their midst. This was the only weasel observed in the park. While travelling across the prairies I have many times seen *longicauda* active during daylight hours.

4. Northern Plains Skunk.

Mephitis mephitis hudsonica (Richardson). —Nothing was seen of this species in the park, but Warden Matthews informed me that an occasional one was met with in Chin and Fortymile Coulees and in other suitable situations throughout the surrounding country. In 1927, while I was collecting for the National Museum of Canada, ranchers reported the species along Milk River and in the Cypress Hills. In a few localities of the south country the animals were said to be common; they have a wide distribution.

5. American Badger.

Taxidea taxus taxus (Schreber).—On June 24 a badger was seen on a greasewood flat near the creek in Chin Coulee, about three-quarters of a mile southwest of the dam. It

was then actively engaged in digging, and disappeared as the hole was approached. The animal may have been burrowing for Richardson Ground Squirrels, which were plentiful in the locality. Old and fresh badger diggings were seen in several places along the bottomlands of Chin Coulee, and another was noted on the high plains a short distance to the east. It appeared that at least two or three pairs of the animals inhabited the park. The species is widely distributed on the southern plains of the province.

6. White-tailed Jack Rabbit.

Lepus townsendii campanius Hollister. — This hare was observed on many occasions, both in the main valleys and on the upper shortgrass plains. However, it could not be regarded as particularly common. Warden Matthews stated a few years previously the animals were very scarce, but that a distinct increase in numbers had taken place in 1940 and 1941. This agrees with an upward trend in the cycle of relative abundance which has been noted over wide areas of the Prairie Provinces during the same period; it also coincides with an increase in the Varying Hare (*L. a. americanus*) population in the wooded sections of the West.

7. Black Hills Cottontail.

Sylvilagus nuttallii grangeri (Allen). — These rabbits were found fairly common in brushy ravines on the east side of Chin Coulee. They live in patches of wild rose, snowberry, and sagebrush in the lower reaches of the tributary coulees, under boulders, and in crevices which have developed in the walls of the badlands buttes. They were flushed on many occasions during the day when the badlands were being explored. Occasionally they were to be seen sitting in open view on lower ledges of the buttes, but more often they were hiding in holes, or in burrows in the slopes, or in scrubby thickets on the ravine bottoms and lower slopes. Two adults and two juveniles were collected, as follows: Adults: ♀, 405,66, 100, weight 3¼ lbs: ♀, 429,69,100, 3 1/3 lbs. Juveniles: 235,36,57, 9 ozs; and 238,37,58 mm., 9 ozs. At this time the young were about half-grown and capable of running through the badlands at a speed almost equal to that of the adults. At no time were the animals seen at the higher elevations, nor on the more or less open lower benches and bottomlands of the main coulees.

8. Richardson Ground Squirrel.

Citellus richardsonii richardsonii (Sabine).—This ground squirrel inhabits the park in considerable numbers. It is locally abundant on the sagebrush and greasewood bottomlands of Chin Coulee and in suitable situations on the margins of the flats in Fortymile Coulee. For the most part the latter is too low for successful occupation, as during the spring runoff and after heavy rains the lands become wet and boggy. In Chin Coulee the animals form distinct colonies in several places, although they are also generally dispersed. While they occupy the lower benches and lateral coulees, or ravines, they are not as common there as on the slightly undulating bottomlands on both sides of the creek. The species occurs in some numbers on the high plains, but there it is more thinly represented; no distinct colonies were noted, as on the coulee lowlands. This is one of the commonest and certainly the most conspicuous of the park mammals.

9. Osgood White-footed Mouse.

Peromyscus maniculatus osgoodi Mearns. At the time of investigations this pale-coloured race was common and almost universally distributed. It haunts practically every type of environment in the park. Thus, traps yielded specimens on the high, shortgrass plains; in the rocky ravines; in the badlands flanking the coulees; in the brushy tracts on the valley slopes; on the sagebrush and greasewood flats of the main coulees; and along the creek. However, they vary in numbers from place to place. They were most abundant in the brushy and rocky lateral ravines and in the badlands sections of the coulee walls, where rock outcrops, scattered boulders, and clumps of sagebrush and wild rose afforded cover and protection. Many were also taken in small thickets of chokecherry, saskatoon, and snowberry sparingly scattered on the east slope of Chin Coulee and on the south side of Fortymile Coulee. Under one set of conditions chiefly in the sagebrush and greasewood flats of Chin Coulee and the first benchlands immediately above, 23 white-footed mice were collected in 90 trap-nights. From 75 to 100 feet above the floor of the coulee, in the rocky and brushy lateral ravines and in thickets on the main slope of the valley, 44 of the animals were secured in the same number of trap-nights. A good proportion of these were taken in the thickets of wild rose, chokecherry, etc., mentioned above. A small series of

specimens was preserved, as follows: ♂, 160, 64,20; ♂, 162,63,20; ♂ 164,68,19.5; and ♀, 162, 65, 20 mm.

10. Saskatchewan Jumping Mouse.

Zapus princeps minor Preble. — In 1941 Warden Matthews and his son stated that jumping mice occurred sparingly on the high plains in the park and vicinity. Examples had been seen in former years while cutting hay in damp depressions. Writing to me in August, 1943, Warden Matthews remarked: "I have now established beyond doubt that jumping mice occur in this locality. We were ploughing fireguards along the west side of the park when one jumped from under the ploughing and hopped away so quickly we could not stop the tractor in time to secure it before escaping into a pile of dry thistles". There is very little information about the genus *Zapus* on the shortgrass plains of Alberta, owing to lack of specimens. Since this is the only form known to occur there, it is assumed to be *Z. p. minor* that inhabits the park district. Specimens which I secured in 1927 at Lodge Creek, south of Cypress Hills, are referable to that subspecies.

11. Badland Meadow Vole.

Microtus pennsylvanicus insperatus (Allen).—This Great Plains subspecies occurs sparingly in suitable habitats. The majority inhabit damp places along the creek and the small marsh area above the dam in Chin Coulee. A few were also found in wild rose and snowberry tracts in the lower parts of the tributary draws along the east side of the coulee; conditions there were dry, with no surface moisture of any kind. After the spring freshets and during rains, however, the small occupied areas would become temporarily saturated. At the time of investigations the ground was very dry. No *insperatus* was taken at the higher elevations on slopes in ravines, or on the high plains. Out of a total of 180 trap-nights only five specimens were secured. Three of these were preserved, as follows: ♂, 174,49,21; ♂, 174,48,19.5; and ♀, 144,34,19 mm. In general characters, one of these shows some approach to *M. p. drummondii*, with which it intergrades on the perimeter of the shortgrass, semi-arid plains to the north and east, and in Cypress Hills. This race is sometimes referred to as the Bean Mouse, as farther south, at least, it lays up large stores of the underground beans of *Falcatia comosa* and the tuber of wild artichoke, *Helianthus tuberosus*.

12. Great Plains Muskrat.

Ondatra zibethica cinnamomina (Hollister). Muskrats were not personally observed in the park. Warden Matthews informed me, however, that a few inhabit the creek flowing through Chin Coulee and the small marsh area above the dam. They were not found in any other part of the area for want of suitable environment. In 1927 I found *cinnamomina* along Milk River and collected several specimens at Lodge Creek, Alberta, south of Cypress Hills. The animals were also reported in the Eagle Butte locality, at the west end of the hills. They occur locally throughout the semi-arid portion of southern Alberta.

13. California Porcupine.

Erethizon dorsatum epixanthum Brandt.—I did not find this animal in the park or immediate vicinity, but Warden Matthews and his son stated that one occasionally wandered into Chin Coulee. It would thus appear that an occasional one reaches this locality from the Milk River drainage, probably by way of Verdigris and Etzikom Coulees and possibly also from the southeast via Lost River and the Pakowki Lake lowlands. Though I have never noted this animal on the high, shortgrass plains, it no doubt travels over these at times from one coulee or river drainage to another. In 1927 I found the species fairly common along Milk River and at Lodge and North Fork Creeks, Alberta (south of Cypress Hills), where specimens were taken. It was also reported in Medicine Lodge Coulee and at Eagle Butte, which are about 34 miles east of Nemiskam Park.

14. Rocky Mountain Mule Deer.

Odocoileus hemionus hemionus (Rafinesque).—On June 24, 1941, an adult female was observed in a badlands draw on the east side of Chin Coulee. On the following day two adults, with four fawns, were seen in the distance on the high and open shortgrass plains about a half-mile to the northeast. Upon observing my approach they fled to the north and disappeared in a ravine at the junction of Chin and Fortymile Coulees, near the eastern boundary of the preserve. These were the only animals actually sighted, but their tracks were noted on many occasions in various sections of the park.

Since I covered nearly the whole area and on two occasions the greater part of it in a single day, seeing but three adults, it is

questionable if more than three or four pairs inhabit the park. No bucks were observed. Since the sexes are separated during the summer, it would appear that the males had withdrawn to other parts. If this was the case, it is clear that the animals are capable of leaping over the fence which surrounds the park. During the winter, when snow is banked in places along the fence (especially in ravines), goings and comings are probably accomplished with ease. If breeding takes place in the park it is obvious, however, that the bucks leap the fence during the fall before snowbanks are present. These remarks are of course made with the assumption that the bucks are absent from the park in the summer, as my observations tend to suggest.

15. American Pronghorn Antelope.

Antilocapra americana americana (Ord).—Special attention was given to the observation of this animal in the park, since the area was reserved and fenced for the express purpose of preserving the species. It may be mentioned here that during 1914 the rapid decline in the numbers of antelope in Canada was brought to the attention of the Dominion Government. Necessary action was then taken to establish areas for their permanent protection. Among these was Nemiskam Park (land reserved in 1915; established as a national park in 1922) where the main work in antelope conservation has been carried out. The original herd of this area numbered 42 head; they were secured through the simple method of building a fence around them, enclosing several square miles of terrain. Following these original efforts for the conservation of the Alberta antelope, additional protection was given under Provincial law over the region at large; this finally led to a greatly increased antelope population with the result that in recent years a short, open fall season has been in effect for hunting the animals in certain parts of the country, including southwestern Saskatchewan. It will thus be seen that complete protection for these animals over a long period following the year 1914 worked miracles in saving this unique mammal from extinction.

The park area provides an excellent antelope environment with ample water supply and the shortgrass habitat of rolling plains, interspersed with coulees and badlands, dear to the heart of the pronghorn. Since the rehabilitation of the species proved a success both within and outside of the park, it is

of these animals in the park as a serious responsibility. Consequently the antelope population of the enclosure is now confined to a relatively small representative herd. Here the traveller may see examples of an unusual species that is gifted with grace of outline and amazing powers of speed.

16. Plains Bison.

Bison bison bison (Linnaeus).—In earlier times these animals roamed the plains of southern Alberta in remarkable abundance. Signs of former occupation in the park territory and vicinity are still to be seen in such features as old, dimming trails and wallows and rare remnants of body bones and skulls. Within a few years even these will have disappeared as reminders of a once proud species now totally extirpated in the wild state from the Great Plains. Apparently the last of the animals were killed in this region about the year 1883.

ANNOTATED LIST OF BIRDS

1. Common Mallard.

Anas platyrhynchos Linnaeus. — A few were seen each time that the small reservoir was visited during the park investigations. It is quite probable that two or three pairs nest in the vicinity of this marsh. Were it not for the creation of the area through the building of the dam on Chin Creek, no waterfowl would be found in the park, as the creeks are too small to be of any particular attraction or usefulness.

2. American Pintail.

Dafila acuta Linnaeus.—Several were seen in the marshy pond above the dam, in Chin Coulee, on June 24 and 25, 1941. The same general remarks apply here as under the preceding species.

3. Swainson Hawk.

Buteo swainsoni Bonaparte. — An occasional example was observed in the lower length of Chin Coulee and in Fortymile Coulee. On June 25, a pair was found nesting in a western cottonwood in the latter valley; the nest was located about 14 feet from the ground and contained two downy young, just hatched, and an egg from which the juvenile was on the point of emerging. Another pair had a nest in a thicket of chokecherry and saskatoon bushes on the east slope of Chin Coulee about eight feet above the ground; it contained three

eggs on June 26. It is believed that only two pairs of these hawks were breeding in the park. The species, as a whole, is far from common in the district.

4. Ferruginous Rough-legged Hawk.

Buteo regalis Gray. — This is the common hawk of the park and deeply eroded valleys of the surrounding country. Possibly four or five pairs breed in the preserve, where they normally build their nests on prominent ledges and spurs of the badland buttes. While one is travelling along the great coulees, or on the adjacent high plains, a pair or two are usually to be seen soaring around at a height of several hundred feet. When nests are approached the birds become greatly agitated and give voice to almost continuous loud screams. Several nests were seen within the park boundaries. One was located at the mouth of the rugged draw up which the road grade ascends on the west side of Chin Coulee to the high plain above. It was built on a narrow ledge of a butte about 30 feet up (Fig. 3); the slope was scaled on June 26, when two downy juveniles which were evidently only three or four days old, were found. The nest contained fresh remains of Richardson Ground Squirrels, upon which the young hawks were being fed.

5. Marsh Hawk.

Circus cyaneus (Linnaeus). — One was noted in late June, 1941, slowly flying along the creek above the dam in Chin Coulee. No others were observed. The species is also uncommon in the surrounding territory, though in some parts of the south country it is more frequently encountered along the roads than any other hawk.

6. Prairie Falcon.

Falco mexicanus Schlegel. — One or two of these falcons were seen daily in the park. Doubtless at least one pair bred somewhere in the local badlands, but a nest was not discovered. The birds were seen chiefly in Chin Coulee, although one was noted in Fortymile Coulee and another was seen flying over the high plain near the eastern boundary of the park. Others were noted in adjacent territory.

7. Sharp-tailed Grouse.

Pedioecetes phasianellus (Linnaeus). — These birds were apparently uncommon in the park, as only two were seen during the investigations. One of these was flushed on

a grassy bench in Chin Coulee and the other on the upper plains to the east. Over the West, as a whole, the species showed a distinct increase in numbers, during 1941, as compared with previous seasons. Warden Matthews informed me that flocks were sometimes seen on the upper plains section of park and vicinity, particularly during the autumn.

8. Sage Hen.

Centrocercus urophasianus (Bonaparte). — This species was not seen in the park or vicinity, although it is fairly common in some localities in southeastern Alberta and farther east on the Missouri watershed in Saskatchewan. Warden Matthews informed me that rarely one of these birds is to be found on the sagebrush flats of Chin, Fortymile and Etzikom Coulees. They are more numerous in the southeastern part of the province and adjacent parts of Saskatchewan.

9. European Partridge.

Perdix perdix (Linnaeus). — I did not observe this species in the area, but Warden Matthews stated that it occasionally occurred there, as well as in the surrounding country. Of late years the birds have been rather scarce throughout the region, but an increase in the population was noticeable in the summer of 1941. After a rise in population for several years the birds were again scarce in 1946.

10. Sora Rail.

Porzana carolina (Linnaeus). — On June 24 and 25 one of these rails was heard in the small marshlands above the dam in Chin Coulee. It is assumed that a pair had taken up quarters there for the season and was breeding, as the environment is favourable in all respects for this purpose.

11. American Coot.

Fulica americana Gmelin. — A single individual was seen on each of two visits to the pond above the dam in Chin Coulee on June 25 and 26, 1941. It seems highly probable that a pair was nesting there at that time, since conditions were suitable and the bird or birds observed appeared to be established for the season. This is the only place in the park where the species could take up quarters; it is very scarce in the surrounding territory, where there is a dearth of suitable sloughs and where even some of the lakes, such as Pakowki Lake, continue dry.

12. Killdeer Plover.

Charadrius vociferus Linnaeus. — These plovers were common, or fairly common, in Chin Coulee, where they resorted to the wet ground at the artesian well, the borders of the creek, and the marshlands at and above the dam. Theirs were among the familiar bird voices of this great valley. A few others were noted in Fortymile Coulee and a pair was also present at the boggy tract fed by the artesian well on the high plain in the southeastern part of the park. They were undoubtedly nesting in the preserve. The species is well represented in suitable places throughout southern Alberta.

13. Willet.

Catoptrophorus semipalmatus (Gmelin). Only one Willet was observed during the park investigations. This one was encountered near the dam in Chin Coulee. In the light of subsequent observations, when the area was many times traversed, it would appear that this solitary example was merely a wanderer from some point on the surrounding plains and that the species does not breed in the preserve.

14. Franklin Gull.

Larus pipixcan Wagler. — This bird is only an accidental visitor in the park. During the entire stay it was only twice recorded, when a pair flew over Chin Coulee on June 25, and when a solitary example was seen the following day. I know of no place in this region where the species nests.

15. Mourning Dove.

Zenaidura macroura (Linnaeus). — This species is apparently of rather rare occurrence, as only one was detected during the investigations. This individual flew out of a chokecherry-saskatoon thicket on the east slope of Chin Coulee on June 26. Though the spot was visited several times later over a period of three days the bird was not seen again.

16. Burrowing Owl.

Speotyto cunicularia (Molina). — Two individuals were observed in Chin Coulee during the time spent in the preserve. It is highly probable that the species nests there. Three others were seen in the surrounding country, but in the region as a whole the birds are definitely uncommon. Sometimes long distances can be covered in southern

Alberta and Saskatchewan without observing any, though this is typical Burrowing Owl territory.

17. Short-eared Owl.

Asio flammeus (Pontoppidan). — In the early evening of June 25 one of these owls was seen flying slowly over the greasewood flats of Chin Coulee just west of the marsh area, where it was probably searching for white-footed mice or small birds. A peculiarity noted on this occasion was the hovering flight of the bird, which would silently flap its wings over one spot for about five seconds, then proceed to another location 25 to 50 yards away and repeat the performance. Once it was seen to light on the ground among greasewood and sagebrush, where it evidently picked up a mouse. In some localities the species is fairly common. On June 27, 1941, while travelling west and north to Taber, I noted six of these birds in one district within a distance of 10 or 15 miles.

18. Nighthawk.

Chordeiles minor (Forster). — Nighthawks were regularly observed each evening over the Chin Coulee badlands, where their familiar calls carried through the silence when other birds, with the exception of an occasional Vesper Sparrow, had ceased to sing. Owing to the regularity with which numbers of these birds were seen daily, there can be no doubt that many pairs nest in the badlands of the park.

19. Yellow-shafted Flicker.

Colaptes auratus (Linnaeus). — An unexpected ornithological feature was the occurrence of one of these birds in the park on the day of my arrival. This individual was seen near the west grade leading down into Chin Coulee. The species was not again encountered in the preserve. In the treeless regions these birds are seldom seen, though they habitually feed upon the ground.

20. Eastern Kingbird.

Tyrannus tyrannus (Linnaeus). — These birds were locally present in the park, where they inhabited copses of silverberry, saskatoon, dogwood and chokecherry; these grow at wide intervals on the east slope of Chin Coulee and the south slope of Fortymile Coulee. In the former locality a nest which contained four fledglings two or three days old was found on June 25 in a saskatoon bush four feet from

the ground. The species was not ordinarily present in places where thickets were absent.

21. Arkansas Kingbird.

Tyrannus verticalis Say. — Only one pair of these kingbirds was seen in the park; the birds were nesting in a western cottonwood a short distance up Fortymile Coulee, the nest being located on the lowest limb, near the trunk, about six feet from the ground; on June 25 it contained three eggs. In the adjoining cottonwood, a few feet to the north, was the nest of a pair of Swainson Hawks which was previously mentioned. The kingbirds evidently had no fear whatever of their raptorial neighbours.

22. Say Phoebe.

Sayornis saya (Bonaparte). — This is a typical bird of the badlands and is well distributed in the tributary ravines leading to Chin Coulee. However, it appeared to inhabit only those valleys in which erosion had created vertical sections, or small cliffs, preferably with protruding caprock. In one of the latter situations a nest was discovered on June 25; it contained four downy juveniles about a week old. In spite of the heat, the parent birds, uttering their plaintive notes, continued to make frequent visits to the nest.

23. Horned Lark.

Eremophila alpestris (Linnaeus). — Horned Larks were common throughout the area, both on the high plains and in the great coulees. Immatures of the year were awing in considerable numbers at the time of the park investigations. The race represented here is apparently the Desert Horned Lark, *E. a. leucolaema*.

24. Tree Swallow.

Iridoprocne bicolor (Vieillot). — Three only were seen in the park, flying across Chin Coulee. It is scarcely likely that these birds breed in the area.

25. Barn Swallow.

Hirundo rustica Linnaeus. — A single example was observed flying westward near the junction of Chin and Fortymile Coulees. Doubtless this species nests more or less commonly throughout the region in farm and ranch buildings. It is not known to nest in the park.

26. Cliff Swallow.

Petrochelidon pyrrhonota (Vieillot). — While not actually observed in the park, it is

no longer necessary to regard the propagation known to breed here occasionally, at least, as old nests were seen on the side of a steep butte in a section of badlands bordering Chin Coulee. From observations made in the summer of 1941 it would appear that the birds do not nest there every year.

27. American Magpie.

Pica pica (Linnaeus). — Several were observed each day during the period of park observations, chiefly in and about Chin Coulee, although others were seen inhabiting thickets on the south side of Fortymile Coulee. No evidence of nesting was found, but it seems practically certain that a few pairs breed in the park. The birds ordinarily appeared to haunt only the badlands, as none was noted on the open, upper plains.

28. Common Crow.

Corvus brachyrhynchos Brehm. — This species is uncommon in the park area, although a few individuals were to be seen each day in about the same numbers as the magpie. It is not known to nest there, but a few pairs may do so in some of the clumps of shrubbery which occur on slopes and in the ravines. Nests were searched for without result.

29. Rock Wren.

Salpinctes obsoletus (Say) — The Rock Wren, like the Say Phoebe, is highly typical of the dry, southern coulees with their badlands formations and scattered sagebrush. The birds were commonly distributed in the more rugged gulches and washes tributary to Chin Coulee, especially on the east side. One was noted in a barren gully on the south side of Fortymile Coulee, but the species does not appear to be as well distributed there as in the former section of the park. The birds certainly nest in suitable situations throughout the area. On several occasions individuals were noted darting into crevices in the buttes, where their nests were undoubtedly located, though they were too far in to be seen.

30. Brown Thrasher.

Toxostoma rufum (Linnaeus).—A pair was seen on June 26 in a patch of shrubbery on the south slope of Fortymile Coulee. They were unquestionably nesting in that section. As these were the only examples observed in the park, it is obvious that the species is uncommon.

31. Mountain Bluebird.

Sialia currucoides (Bechstein). — On June 23 a pair was observed on the plain near the west gate of the park. The species was not again noted in this locality, but it was several times encountered while I was travelling west and north to Taber and Brooks.

32. Sprague Pipit.

Anthus spragueii (Audubon). — One was heard singing at a height of several hundred feet over the high plain east of Chin Coulee on June 25. As this was the only one heard or seen during the investigations, the species may be regarded as of only casual occurrence in the district. It was only rarely noted while crossing the Great Plains to the southeast and east. In view of the time of year when the above individual was detected, it is likely that at least one pair nests in the park.

33. Yellow Warbler.

Dendroica petechia (Linnaeus). — Moderately common in the scattered thickets of chokecherry, saskatoon, and silverberry which grow locally on the slopes of Chin and Fortymile Coulees. It was the only warbler detected in the park. Although no nests were found, there can be no doubt as to the breeding of the species in this area. At the time of late June investigations the males were still singing vigorously.

34. Western Meadowlark.

Sturnella neglecta Audubon. — This brilliant singer of the western plains is a fairly common inhabitant of the park, frequenting the high shortgrass plains as well as the sagebrush and greasewood flats of Chin and Fortymile Coulees. It was seen in practically all parts of the preserve, but is less common in the badlands areas than on the upper plains. On the whole, the species is scarcer on the arid southern plains than farther north, in the central parts of the province. The birds continue in full song until well into July or even early August. While no nest was found, it is clear that the birds breed in the area.

35. Yellow-headed Blackbird.

Xanthocephalus xanthocephalus (Bonaparte).—Several were seen each time the small marsh above the dam in Chin Coulee was visited. It is assumed that at least two or three pairs were nesting there. The birds were not encountered in any other part of the park.

36. Red-winged Blackbird.

Agelaius phoeniceus (Linnaeus). — Examples of this species were common along the creek and in the marshlands above the dam in Chin Coulee, where they were nesting. A few were also seen in Fortymile Coulee and at the boggy tract near the artesian well on the high plain in the southeastern part of the park. Contrary to popular belief, these birds do not require water at their nesting sites. In the semi-arid south nests have many times been found in low thickets of wild rose where no surface water exists.

37. Brewer Blackbird.

Euphagus cyanocephalus (Wagler). — These blackbirds were also common in the preserve, occurring chiefly in Chin Coulee and tributary arroyos, where they were nesting. The creek and pond above the dam were marked attractions, as they came there regularly to drink, in common with many other species. A few were also noted in shrub-grown draws on the south side of Fortymile Coulee and on the high plains, but, as previously mentioned, they were more abundant in Chin Coulee.

38. Goldfinch.

Spinus tristis (Linnaeus).—A solitary goldfinch was seen flying over Chin Coulee on June 24. No others were recorded while working in the district.

39. Spotted Towhee.

Pipilo maculatus Swainson.—This bird was not actually sighted in the park, but one was unmistakably heard singing in a brushy draw on the south side of Fortymile Coulee on June 26. An effort was made to bring the individual into view, but all tactics were unsuccessful. It is quite apparent that the species is very scarce in this area, though on some parts of the Missouri watershed it is quite common in brushy ravines opening into arid coulees.

40. Lark Bunting.

Calamospiza melanocorys Stejneger.—This species is common on the sagebrush and greasewood flats in Chin Coulee and to a lesser extent in Fortymile Coulee, where it undoubtedly breeds. The birds also inhabit the high plains, but in the park territory they are definitely less numerous than on the bottomlands. The males were still singing in full force when the late June observations were made. In parts of southeastern Alberta the species is abundant, both in bottomlands areas and on the upper plains.

41. Savannah Sparrow.

Passerculus sandwichensis (Gmelin). — *Sandwichensis* occurs sparingly along the creek and about the bog area in Chin Coulee, where doubtless a few pairs nest. Two were noted on the swampy ground near the artesian well in the southeastern part of the park. The males were still singing their nuptial songs at this period. On the whole the species may be classed as scarce in the area under review.

42. Baird Sparrow.

Ammodramus bairdii (Audubon). — This is another species which is rare in Nemiskam Park. Throughout the investigations only one was noted, when a singing male was heard on the high plain east of Chin Coulee on June 25. A few were seen in southwestern Saskatchewan and southeastern Alberta while I was en route to the park, but they were found commoner to the north.

43. Vesper Sparrow.

Poocetes gramineus (Gmelin). — Vesper Sparrows are among the more plentiful and familiar birds of Nemiskam Park. They occur nearly everywhere in the area, being about as numerous in the great coulees and tributary arroyos as on the shortgrass plains above; they breed throughout the region.

44. Lark Sparrow.

Chondestes grammacus (Say).—While I was travelling about the open country in the park very few of these interesting birds were observed. Until the second day in the area it appeared that they were scarce. However, upon my exploring the badlands and tributary draws of Chin Coulee, the birds proved to be much more numerous than at first supposed. They seem to prefer the rugged terrain of badland draws, with their sparse covering of grasses and clumps of rose bushes and sagebrush, where they breed. In such places the birds were fairly common. An occasional individual was encountered in the broader sagebrush and greasewood flats of Chin Coulee and also on the flanks of Fortymile Coulee. The males continue to sing lustily until the early part of July, their sparkling, melodious trills being among the sweetest of voices to be heard in the badlands.

45. Clay-colored Sparrow.

Spizella pallida (Swainson).—Birds of this species were noted in only moderate numbers, but they were found scattered about in most

sections on both the high plains and the lands embraced by the coulees and badlands. Probably owing to the dearth of shrubbery in the upper, shortgrass country, the birds are more often seen in the stands of wild rose, snowberry, and sagebrush which grow more or less plentifully in the coulees. While no nest was discovered, there can be no doubt that these sparrows nest in favourable situations throughout the preserve. The hoarse, monotonous song of this species was often heard on the greasewood and sagebrush flats of Chin Coulee.

46. Brewer Sparrow.

Spizella breweri Cassin.—This species is uncommon in the park, but it was noted several times on the open greasewood and sagebrush flats of Chin Coulee above the dam. The birds were observed in no other area within the preserve. This species, after the song season ends, might easily be overlooked among Clay-colored Sparrows. However, the songs are very different; the latter's is composed of rasping notes like *zee-zee-zee-zee*, while that of Brewer Sparrow consists of musical, buzzy trills on different pitches; although these are low in volume and, in a wind, almost inaudible, the notes are quite distinctive. At least three males were heard singing in Chin Coulee and it is presumed that they were breeding in the vicinity.

47. McCown Longspur.

Rhynchophanes mccownii (Lawrence).—These longspurs are among the most characteristic of the Nemiskam Park birds. They occur in moderate abundance on the high plains east and west of Chin Coulee, in the bottomlands of the latter, and on immediately adjacent shortgrass benches. A few were also noted in Fortymile Coulee. It is quite evident that considerable numbers breed in the park. At the time of investigations the males were still giving voice to their delightful flight songs. On a still morning, in some parts of the plains where the birds were plentiful, their tinkling, warbling melodies were often commingled with a peculiarly wild and captivating effect. In numerous districts of southern Alberta they are very abundant during the breeding season.

48. Chestnut-collared Longspur.

Calcarius ornatus (Townsend).—While occurring in the park, it is scarce in comparison with the number of McCown Longspurs which inhabit the area. My records show that only five or six birds in all were seen there, most of which were singing males. According to my observations, this species is not common anywhere in southern Alberta, but it surpasses the McCown Longspur in abundance in southern Saskatchewan east of Val Marie. Undoubtedly a few of the present species nest within the park, where they favour the high plains more than the coulee lowlands.

NOTES ON REPTILES

1. Plains Garter Snake.

Thamnophis radix (Baird and Girard).—Several garter snakes, believed to be referable to this species, were encountered in Chin Coulee and tributary ravines. They are reported to be more or less common throughout the region.

2. Bull Snake.

Pituophis sayi sayi (Schlegel).—Bull, or Gopher Snakes were reported as not uncommon in this district. I saw only one in the park; this individual was discovered on the high plains east of Chin Coulee. With some little difficulty it was measured alive, the approximate length being six feet two inches. Rattlesnakes were anticipated in the badlands section of the park, but none was seen; I was subsequently informed that the species was not known to occur there, but many examples have been seen in the Manyberries district and south. There seems to be a belief among plainmen that the Bull Snake and the Rattlesnake do not occupy the same range.

3. Hernandez Horned Lizard.

Phrynosoma douglassi hernandesi Girard. Numbers of these lizards inhabit the coulees in the park. One was found on the badlands on the east side of Chin Coulee near the southern boundary of the preserve. Warden Matthews informed me that he had many times observed them in this tract. They also range in widely scattered coulees of southern Alberta and along the Milk River Valley and tributary drainage areas.

WATERFOWL OF THE FORESTED PORTIONS OF THE CANADIAN PRE-CAMBRIAN SHIELD AND THE PALAEOZOIC BASIN¹

HAROLD C. HANSON², MURRAY ROGERS³ and EDWARD S. ROGERS⁴

IN RECENT YEARS there has been considerable speculation as to the numbers of game ducks⁵ produced on the Pre-Cambrian Shield of Canada, particularly in the forested sections, fig. 1. Some investigators, although recognizing that the optimum density of nesting game ducks in the above region is low, have claimed that because of the vastness of the area involved, considerable numbers are produced in the aggregate. Other workers have said that despite the enormous area involved the total numbers of game ducks produced would be negligible in proportion to the numbers reared in other types of country i.e., the prairies and park lands. The productivity of the Palaeozoic Basin, that great muskeg-covered plain lying adjacent to the west and south coasts of Hudson and James bays, has been of an equally speculative nature. In view of the recent duck decline, it is timely that the productivity of the Pre-Cambrian Shield, as well as the Palaeozoic Basin, be re-evaluated.

The following discussions are based on field studies by the authors in 1946, 1947, and 1948 and a survey of the literature. Hanson made his observations in the muskeg covered plain west of James Bay in the summers of 1946 and 1947 in conjunction with a study of the Canada geese nesting in that area. Murray and Edward Rogers made their observations in the summers of 1947 and 1948 while carrying out an archaeological investigation in the Pre-Cambrian Shield country lying east of James Bay.

ACKNOWLEDGMENTS

The senior author is grateful to the Arctic Institute of North America for funds which made possible the field work in northern Ontario in 1946 and 1947, and to Ducks Unlimited for funds to carry out an aerial survey of the Palaeozoic Basin. On this survey Mr. Paul Queneau rendered notable assistance.

¹ Received for publication March 10, 1949.

² Assistant Game Specialist, Illinois Natural History Survey, Urbana.

³ Mechanical Engineer, Methuen, Mass.

⁴ Lincoln, Vermont.

⁵ Term "game ducks" here refers to: mallard, black duck, gadwall, baldpate, blue-winged teal, green-winged teal, shoveller, wood duck, red head, canvasback, ring-necked duck, greater scaup, lesser scaup, white-winged scoter and ruddy duck.

⁶ The first ten miles of the Pagwa River after leaving the village of Pagwa traverses the Shield, (Williams, 1921).

Field studies made in Quebec in 1948 by Murray and Edward Rogers were supported by grants given to Edward Rogers by the Peabody Foundation for Archaeology and the Viking Fund.

ROUTES TRAVELLED

Leaving from the village of Pagwa River in 1947, Hanson reached Ft. Albany on James Bay via the Pagwa, Kenogami and Albany rivers. At the juncture of the Kenogami and Albany rivers, the Albany was ascended to Ogoki, a distance of about 82 miles. The Albany River was then descended to its mouth, fig. 2, but en route to Ft. Albany, the Pagashi River was investigated for a distance of about 15 miles.

Murray and Edward Rogers began their 1947 canoe journey from Oskelaneo, Quebec, on the old transcontinental C.N.R. line and reached Rupert House at the southeast end of James Bay by the following waterways: Oskelaneo River, Gouin Reservoir, Lake Dubois, Pike Pond, Ventadour River, lakes Gabriel, Nemenjish, Obatogamau, Chibougamau, Dore, LeMoyné, Wakonichi, Mistassini, Albnel and the Rupert River. A portion of the Temiscamie River was also investigated, fig. 2.

The route taken by the Rogers' in 1948 differed from the 1947 route as follows: the Tournemine River, a tributary of the Temiscamie, was ascended; instead of crossing Lake Mistassini to the mouth of the Rupert River, the inward route from Long Portage (connecting Lake Albnel to Mistassini) south to Lake Obatogamau was retraced; between Lake Obatogamau and Lake Dubois, a more easterly route, through lakes Jourdain and Ducharme, Scatsi River and lakes Potrin-court, Buade and Normandin was followed.

The latitudes of the rivers and lakes surveyed in the Palaeozoic Basin and the Pre-Cambrian Shield are approximately the same and the climatic conditions are at least roughly comparable.

GEOLOGY, TOPOGRAPHY and VEGETATION

The canoe routes described above are through two quite different types of country. The Pagwa, Kenogami and Albany River route⁶ traverses the Palaeozoic Basin, an immense coastal plain, the limits of which



Fig. 1. Map showing the Pre-Cambrian Shield, Palaeozoic Basin and limit of trees in Canada (from official Canadian maps).

extend from Churchill on Hudson Bay to a distance of 60 miles south of James Bay and between 180-240 miles west of James Bay. Underlying the Basin are nearly horizontally bedded limestones of Devonian, Silurian and Ordovician age. Over these rock strata lies a water-impervious clay which is primarily responsible for the development of muskeg, the type of vegetation covering almost the entire Basin, fig. 1.

The rivers of the Palaeozoic Basin flow over bed rock. They reach peak flood stage at the ice breakup and then begin a steady drop in level until the succeeding autumn, fig. 3. In summer, the Pagwa River is reported to run nearly dry in places, while the Kenogami River has shallow rapids in some sectors, but is of considerable depth along its lower reaches. The upper Albany River, between The Forks and Ogoki, has been aptly described as simply a fast chute and even at flood stage approaches a rapid in many places.

In June, 1947, the current of the Albany River above The Forks was estimated to flow at the rate of 8-10 miles per hour. No important river enters the Albany in this section. Below The Forks the Albany River is wider and the current is somewhat slower. Four large islands and a number of smaller ones occur in its lower reaches, while its estuary contains a multitude of large and small islands.

These rivers have built up natural levees along most of their lengths from ice action and deposition during floods. White and black spruce and balsam fir of appreciable size are limited to the levees and to the islands; the interior lower lying muskeg contains only stunted black spruce and tamarack. Most of the Kenogami and Albany River country was swept by fire in the early part of the century with the result that except on islands and in protected or low places, aspen and birch are now the predominant trees on the river terraces.



Fig. 2. Map showing routes of travel by the authors in Ontario and Quebec.

The route travelled in Quebec was through "A high, rolling plateau, which rises somewhat abruptly, within a few miles of the coast line, to heights between 1,500 and 2,000 feet, the latter elevation being somewhat greater than the watershed of the interior. The interior country is undulating, and is traversed by ridges of low rounded hills that seldom rise more than 500 feet above the surrounding level." (Low, 1896) Sections of the Pre-Cambrian Shield near James Bay rise so slowly that 100 miles inland the elevation is only 700 feet above sea level, while at Lake Mistassini the elevation is reported to be 1,300 feet.

Lakes in the interior of the Labrador Peninsula of Quebec are estimated by Low (1896) to cover approximately one-fourth of the total land area. The largest lake is Lake Mistassini which covers about 1,200 square miles, table 1. According to Low, most of the lakes seldom exceed 50 feet in depth and

many are under 20 feet. These are generally characterized by having shorelines highly dendritic in outline.

Differing from this interior lakeland is the coastal plain, a belt about 100 miles in width lying along James Bay. This area, which is covered with a deep mantle of marine sands and clays that have filled in the depressions and prevented the formation of lakes, is cut by a network of small streams (from Low 1896).

The soil of the Shield is "derived from the underlying Archean rocks, and is mostly in the form of glacial till, mixed with boulders of various sizes". At the time (1892-1894) Low made his survey of the Labrador section of the Shield, black spruce was estimated to compose 90 per cent of the forest with white spruce, tamarack, balsam fir, birch and aspen making up most of the remainder. These species are present in the Palaeozoic Basin but, with the exception of the black spruce and

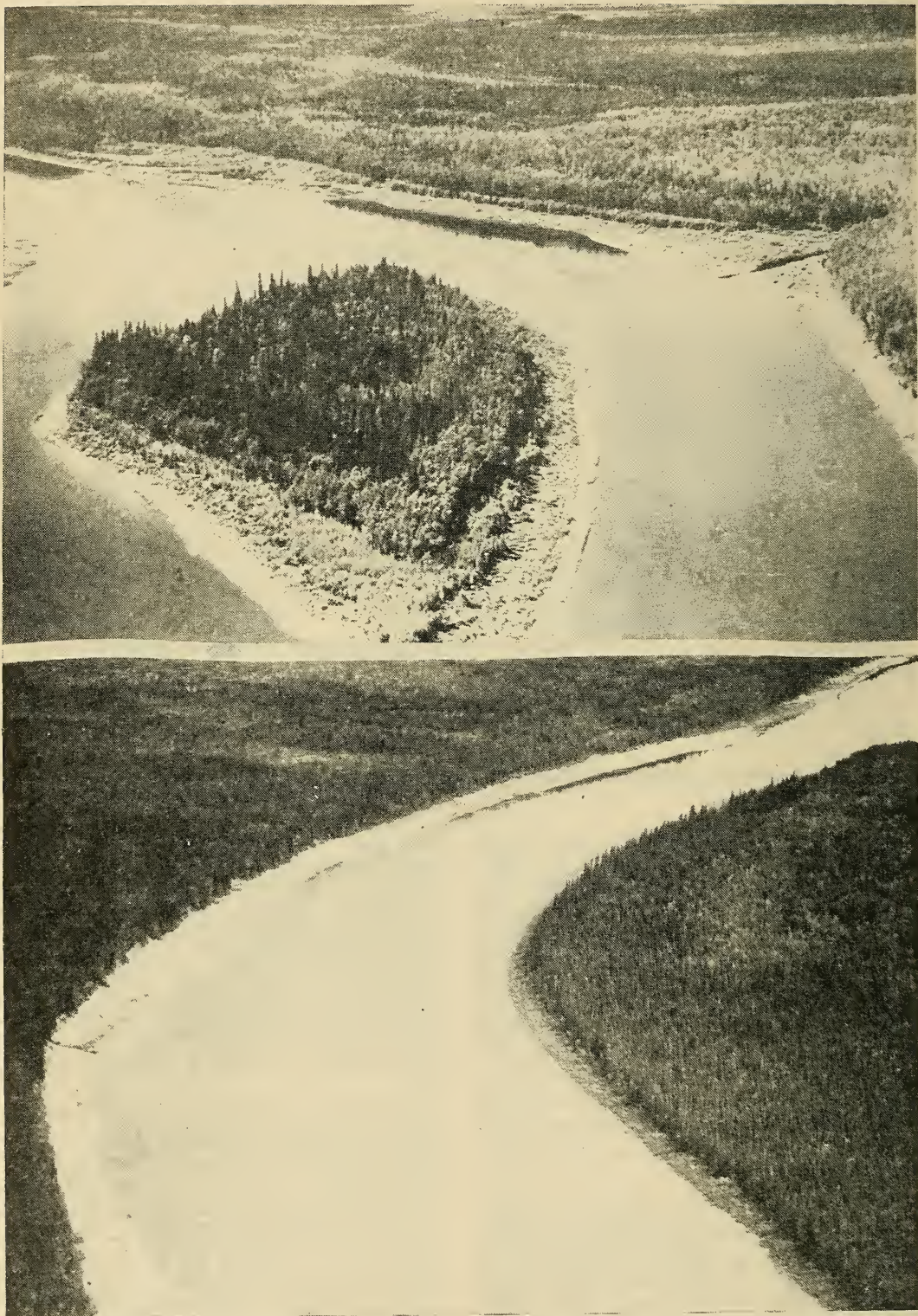


Fig. 3. Two typical rivers in the Palaeozoic Basin. The upper photograph shows the Albany River 21 miles below Ogoki; the lower photograph is of the Ekwan River, approximately 62 miles from its mouth on James Bay.

TABLE 1. — NOTES ON SOME WATER AREAS TRAVERSED ON THE PRE-CAMBRIAN SHIELD.

| Lake Travelled | Approximate Area or Length | Remarks |
|------------------|----------------------------|---|
| Gouin Reservoir | 450 sq. mi. | Extremely dendritic in outline. Figure 2 shows generalized outline. Contains many islands, some over 12 miles in length, shorelines studded with dead trees, live timber, second growth spruce and aspen. |
| Lake Dubois | 12 sq. mi. | Shallow, contains a number of rocky islands, shoreline rocky. |
| Lynxeye Lake | 18 sq. mi. | About one quarter of shoreline burnt over. |
| Lake Gabriel | 18 sq. mi. | Contains islands. They and virtually all of the surrounding country burnt over in recent years. |
| Lake Nemenjish | 10 sq. mi. | Has several marshy areas with <i>Scirpus</i> margins. |
| Lake Obatogamau | 40 sq. mi. | Contains a multitude of large and small islands, shoreline nearly all rocky. |
| Lake Chibougamau | 90 sq. mi. | Contains rocky islands, shoreline of rocky outcrops and boulders, country south of this lake rolling drift-covered hills. |
| Lake Dore | 30 sq. mi. | Contains rocky islands, country north of here rocky and of marked relief. Shoreline sandy, grasses and rushes in small bays and mouths of creeks, shoreline of bedrock or boulders. |
| Lake Mistassini | 1,200 sq. mi. | Most of the surrounding country has been burned over, now replaced in part by second growth. |
| Lake Albanel | 300 sq. mi. | Contains very many rocky islands; shoreline rocky. |
| Rupert River | 277 mi. | Upper third of river varies in width from 100 yards to 1 mile, contains many small rocky islands, current swift. Lower third contains numerous falls and rapids. |

tamarack, occur mainly on the river terraces. Jack pine occurs on the Pre-Cambrian Shield but only rarely in the Palaeozoic Basin. Additional notes on this area are presented in table 1.

TIME AND COVERAGE OF OBSERVATIONS

The period of time over which each series of observations was made differs considerably, as can be noted from tables 2, 3 and 4. This

time factor alone invalidates too close a comparison of each set of figures, but some of the resultant differences tend to cancel out each other. For example, the observations in the Palaeozoic Basin were made only during the month of June, when many of the females would not be observed because of egg laying or incubation. However, to offset the absence of some females, single drakes were occasion-

TABLE 2. — NUMBERS OF WATERFOWL OBSERVED ALONG A WATER ROUTE THROUGH

| Section of Water Route Travelled | Dates of Travel | Mileage | BLACK Duck | | | American |
|---|-----------------|---------|-----------------|-------------------|---------------|-----------------|
| | | | Number Observed | Per cent of Total | Per 100 Miles | Number Observed |
| | | | | | | |
| Pagwa River (C.N.R. line to Kenogami River) | June 3-4 | 32 | 6 | 24 | 19 | 14 |
| Kenogami River (mouth Pagwa River to Mammattawa) | June 4 | 24 | 5 | 12 | 21 | 13 |
| Mammattawa to mouth of the Kenogami River | June 6-7 | 58 | 4 | 28 | 7 | 5 |
| Albany River (Ogoki to The Forks) | June 16-17 | 82 | 0 | 0 | 0 | 13 |
| Albany River (The Forks to mouth of Chippie River) | June 17-18 | 57 | 0 | 0 | 0 | 8 |
| Albany River (mouth of Chippie River to first islands in the estuary of Albany River) | June 18-20 | 78 | 7 | 28 | 9 | 0 |
| Total or Average | | 331 | 22 | 16 | 7 | 53 |

ally observed on the rivers of the Palaeozoic Basin swimming about in small areas of quiet water close to shore. The reluctance of some drakes to flush gave the impression that the spots they occupied may have been waiting territories, if this concept of territory (Hochbaum 1944) applies to mergansers as well as to certain other species of ducks.

A similar situation would exist for the observations made in June in the Pre-Cambrian country, but from mid-July on the situation would be reversed. The females with broods would be most conspicuous, while the yearling birds and drakes would be undergoing the moult, at which time they could be expected to be especially wary and inconspicuous and to be congregated near the center of the larger bodies of water.

Observations made after August are probably no longer indicative of the local nesting population as by that time many of the young are on the wing and with the adults are participating in extensive local movements or are beginning to migrate. This seasonal shift in the behavior of the duck population is best illustrated by the influx of black ducks into areas which contained relatively few ducks in the early part of the summer, table 4. Hence, figures used in comparing waterfowl populations in the two areas are based mainly on observations up to September.

Another factor to be considered in interpreting the data presented is that the observations made on large bodies of water, such as Gouin Reservoir and Lake Mistassini, would include ducks noted along one shore line and on or above the open water on the opposite side of the canoe for a distance of from one-eighth to one-quarter of a mile. Tables 2, 3 and 4 include only the totals of adult ducks tallied, brood records being presented in the text and in tables 5 and 6.

The number of miles travelled was obtained by using a map measure on 8 mile-1 inch maps (National Topographic Series). Actual distances covered in many instances exceed the calculated mileage by about 25 per cent due to the observers following irregularities in the shoreline. However, as many birds were observed only while in flight, the number that would have been tallied had a more direct course been chosen, probably would not differ appreciably from the totals given in tables 2, 3 and 4. In any event, in converting observations to 100 miles of travel, it was deemed wisest to base distances on the best available standard—the 8 mile-1 inch maps—rather than on personal estimates of distances.

WATERFOWL POPULATIONS

In the two regions under discussion, exclusive of the islands and coastal marshes of James Bay, apparently only four species of ducks

THE PALAEOZOIC BASIN OF ONTARIO BETWEEN PAGWA RIVER AND FORT ALBANY.

| SPECIES OBSERVED | | | | | | | | | Total | | |
|-------------------|---------------|--------------------|-------------------|---------------|------------------|-------------------|---------------|-----------------|----------|---------------|--|
| Golden-eye | | American Merganser | | | Hooded Merganser | | | Number Observed | Per cent | Per 100 Miles | |
| Per cent of Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | | | | |
| 56 | 44 | 3 | 12 | 9 | 2 | 8 | 6 | 25 | 100 | 78 | |
| 30 | 54 | 20 | 46 | 83 | 5 | 12 | 21 | 43 | 100 | 179 | |
| 36 | 9 | 5 | 36 | 9 | 0 | 0 | 0 | 14 | 100 | 25 | |
| 42 | 16 | 18 | 58 | 22 | 0 | 0 | 0 | 31 | 100 | 38 | |
| 100 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 100 | 14 | |
| 0 | 0 | 18 | 72 | 23 | 0 | 0 | 0 | 25 | 100 | 32 | |
| 36 | 16 | 64 | 43 | 19 | 7 | 5 | 2 | 146 | 100 | 44 | |

breed at all commonly: the black duck, American golden-eye, hooded merganser and American merganser. A few other species occur in migration, chiefly the scoters which are common on the Albany River in late May and early June.

Data presented in tables 2, 3 and 4 indicate that the total nesting duck population on the lakes and rivers of the Pre-Cambrian Shield east and southeast of James Bay is roughly 70 per cent greater than that along the rivers of the Palaeozoic Basin west and southwest of James Bay. Accounting for most of the difference in the size of the waterfowl populations in these two regions is the American merganser. Traverses of the muskeg country of the Palaeozoic Basin on foot and extensive cross-country flights at low elevations revealed that only a meagre black duck population is found on the innumerable sphagnum bogs and lakes that lie off from the main rivers.

In addition to the species treated here, nearly the entire Mississippi valley flyway population of Canada geese nests in the interior lake country of the Palaeozoic Basin, fig. 4. This population is the subject of a separate report (Hanson and Smith, 1949).

LIST OF SPECIES

Black Duck

Anas fulvigula rubripes.—In the Palaeozoic Basin the observed occurrence of black duck

varied from 0—21 individuals per 100 miles of travel and averaged 7; on the Pre-Cambrian Shield their observed frequency in 1947 varied from 0—33 per 100 miles and averaged 11. In 1948, the computed frequency varied from 0—33 and averaged 20 individuals per 100 miles. In the Palaeozoic Basin this species composed about 16 per cent of the duck population; on the Pre-Cambrian Shield, 14 or 20⁷ per cent of the observed population.

The local occurrence of black ducks in the Palaeozoic Basin correlated in part with the presence of a few seemingly ideal nesting lakes which lie close to the rivers. These lakes, small in size, lack the extensive sphagnum development of the interior muskeg lakes and are bordered by tall grasses and sedges and are generally surrounded by dense stands of aspen or spruce. The distribution of black ducks on the main rivers also partially coincided with quiet stretches of water. The black duck was conspicuously absent between The Forks and Ogoki where the Albany River is particularly swift and where no lakes lie close by. Bell (1887) reported the dusky (black) duck as being numerous on the Attawapiskat River. Macoun and Macoun (1909) reported a few breeding on the Missinaibi River. Williams (1921) recorded black ducks

⁷ It should be kept in mind that 6 and 11 percent of the ducks observed on the Pre-Cambrian Shield were not identified. Hence these and subsequent figures on this area are approximate only.

TABLE 3. — NUMBERS OF WATERFOWL OBSERVED IN 1947 ALONG WATER ROUTES ON

| Section of Route | Dates of Travel | Mileage | Black Duck | | | Arr |
|---|--------------------|---------|-----------------|-------------------|---------------|-----------------|
| | | | Number Observed | Per cent of Total | Per 100 Miles | Number Observed |
| | | | | | | |
| Oskelaneo River* | June 8-9 | 12 | 3 | 100 | 3 | 0 |
| Gouin Reservoir | June 9-13 | 56 | 7 | 19 | 12 | 24 |
| From Gouin Reservoir to Post Bay, Lake Mistassini | June 14- July 4 | 128 | 8 | 7 | 6 | 26 |
| Lake Mistassini and Lake Albanel | July 4-22 | 90 | 0 | 0 | 0 | 3 |
| Temiscamie River | July 23-24 | 12 | 0 | 0 | 0 | 2 |
| Lake Albanel and Lake Mistassini | August 2-5 | 52 | 0 | 0 | 0 | 0 |
| From Outlet of Lake Mistassini to Outlet of Lake Mesgouez on the Rupert River | August 7-13 | 100 | 3 | 2 | 3 | 11 |
| From Outlet of Lake Mesgouez to Hudson Bay Co., Lake Nemiska | August 14-21 | 72 | 24 | 30 | 33 | 0 |
| Lake Nemiska to Rupert House | August 21-31 | 105 | 23 | 64 | 22 | 1 |
| Total or Average | | 627 | 68 | 14 | 11 | 67 |

* From Oskelaneo to Gouin Reservoir.

only in the estuary of the Albany River between August 18 and 20.

From traverses on foot and plane flights it is concluded that relatively few black ducks breed on muskeg ponds and lakes that lie away from the main rivers and coastal marsh areas of the Palaeozoic Basin. Only one pair was noted during two five-hour walking trips in the small lake country 25 miles up the Lawapiskau River in early July, and none was seen in the course of two foot trips in the lakeland muskeg about 40 miles up the Albany River during the last week of July, fig. 4.

The aerial survey in mid-July, 1947, covered the following flights over the muskeg: Fort Albany to Ogoki and return; Fort Albany to Weenusk; York Factory to Fort Severn and Fort Severn to Weenusk via inland routes, a total of about 1,054 miles. Although 150 Canada geese, adults and goslings combined, were tallied from a population of approximately 55,000 geese believed to have returned to the muskeg breeding grounds that spring (Hanson and Smith, 1947), black ducks were observed only twice: a pair, and a flock of about 40, the latter presumably drakes which had banded together after the nesting season.

Both black duck observations were made in the 35-mile wide area of lakeland muskeg that lies between the Albany and Atikameg rivers approximately 25 miles inland from the west coast of James Bay⁸.

Data from the Pre-Cambrian Shield country suggest that the most favorable nesting conditions for black duck are found along the smaller rivers. Low (1896) records the black duck as being uncommon throughout the interior of the Labrador Peninsula. Faribault et al. (1911), however, reported seeing many black ducks in the Chibougamau region, especially on Rush Lake. The species is a common breeder in the Lake St. John region (Godfrey and Wilk, 1948). In Algonquin Provincial Park, MacLulich (1938) found black ducks mainly near marshy creeks. In the lake Abitibi region (Snyder, 1928) black ducks are reported to nest along flooded creek beds and shallow

⁸ On August 5, 1949, another transect was flown in the Palaeozoic Basin by Hanson. This transect began in the Winisk River country 15 miles inland from the south coast of Hudson Bay and terminated a few miles north of Lake River on the west coast of James Bay. The flight, a distance of 100 miles, was made at a 200-ft elevation and the strip observed was approximately one-eighth mile wide. In this 16-square-mile sample, only one duck, a black duck, was noted.

PRE-CAMBRIAN SHIELD IN QUEBEC.

| SPECIES OBSERVED | | | | | | | | Total | | |
|------------------|---------------|--------------------|-------------------|---------------|-----------------|-------------------|---------------|-----------------|----------|---------------|
| Golden-eye | | American Merganser | | | Unidentified | | | Number Observed | Per cent | Per 100 Miles |
| Per cent Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 100 | 20 |
| 62 | 43 | 7 | 19 | 12 | 0 | 0 | 0 | 37 | 100 | 67 |
| 23 | 20 | 73 | 68 | 57 | 1 | 2 | 1 | 108 | 100 | 84 |
| 5 | 3 | 52 | 93 | 58 | 1 | 2 | 1 | 56 | 100 | 62 |
| 40 | 20 | 3 | 60 | 25 | 0 | 0 | 0 | 5 | 100 | 42 |
| 0 | 0 | 17 | 53 | 33 | 15 | 47 | 29 | 32 | 100 | 17 |
| 9 | 11 | 107 | 85 | 107 | 5 | 4 | 5 | 126 | 100 | 126 |
| 0 | 0 | 53 | 67 | 74 | 2 | 3 | 3 | 79 | 100 | 110 |
| 4 | 1 | 8 | 25 | 8 | 2 | 7 | 2 | 34 | 100 | 32 |
| 14 | 11 | 320 | 66 | 51 | 26 | 6 | 4 | 481 | 100 | 76 |

bogs; in the vicinity of Lake Nipissing, they were frequently noted on small lakes and ponds as well as on Lake Nipissing itself (Ricker and Clarke, 1939).

A female black duck with a newly hatched brood of eight was encountered among the willow covered islands in the estuary of the Lawapiskau River on July 3, 1947. Black duck broods were observed in the Pre-Cambrian Shield only in 1948, table 6.

American Golden-eye.

Bucephala clangula.—Along the rivers of the Palaeozoic Basin, 9-54 golden-eyes were sighted per 100 miles of travel and the average for all rivers travelled was 16 birds per 100 miles. On the Pre-Cambrian Shield the rate of occurrence of this species in 1947 was 0—43 individuals per 100 miles and the average number was 11. In 1948, 3—33 individuals per 100 miles were tallied and the average was 13. This species accounted for 36 percent of the duck population in the Palaeozoic Basin and 14 and 19 per cent of the population on the Pre-Cambrian Shield.

It is difficult to associate the number of observations of this species with any particular feature of the land. In the Palaeozoic Basin

the golden-eye was most abundant along the lower Pagwa River and upper portions of the Kenogami River. The levees along these sections are bordered by extensive stands of spruce, whereas the section of the Kenogami River below Mammattawa and the Albany River where golden-eyes were less numerous is bordered by aspen. Williams (1921) recorded only seven golden-eyes on his trip down these rivers. Two were observed at the mouth of the Pagwa River and five were seen about 16 miles below The Forks of the Albany River on August 5 and 14 respectively.

On the Pre-Cambrian Shield, the American golden-eye was most common on the small to medium sized lakes, on the lake-like expansions of the upper Rupert River, and notably so on the Gouin Reservoir in both years. Although their numbers in the latter locale might be related to the large number of dead trees which border the shores of this impoundment and which presumably supply abundant cavities for nesting, Munro (1939) states that the nesting lakes of the Barrows golden-eye are selected first on the availability of food and secondly on the abundance of nesting sites. Low (1896) has recorded the American golden-

TABLE 4. — NUMBERS OF WATERFOWL OBSERVED IN 1948 ALONG WATER ROUTES ON

| Section of Route | Dates of Travel | Mileage | Black Duck | | | American |
|--|-----------------|---------|-----------------|-------------------|---------------|-----------------|
| | | | Number Observed | Per cent of Total | Per 100 Miles | Number Observed |
| Gouin Reservoir* | June 17-18 | 24 | 1 | 7 | 4 | 8 |
| From Gouin Reservoir to Post Bay, Lake Mistassini** | June 19-July 4 | 128 | 8 | 8 | 6 | 29 |
| Lake Mistassini and Lake Albanel | July 5-20 | 90 | 2 | 3 | 2 | 3 |
| Temiscamie River, Tournemine River and Lake Tournemine | Aug. 1-14 | 49 | 16 | 41 | 33 | 5 |
| Lake Albanel and Lake Mistassini | Aug. 21-Sept. 4 | 90 | 22 | 70 | 25 | 3 |
| Total or Average | | 381 | 49 | 20 | 20 | 48 |
| From Post Bay Lake Mistassini through Lake Obatogamau | Sept. 5-13 | 72 | 31 | 59 | 43 | 8 |
| From Lake Obatogamau to Gouin Reservoir*** | Sept. 14-22 | 68 | 86 | 59 | 126 | 15 |
| Gouin Reservoir | Sept. 22 | 56 | 1 | 10 | 2 | 0 |
| Oskelaneo River**** | Sept. 23-25 | 12 | 64 | 52 | 533 | 6 |
| Total or Average | | 298 | 204 | 56 | 68 | 32 |

* From Obijuan, Hudson Bay Co. post, to mouth of river at northeast end of Bay Verrau.

** Includes approximately 22 miles of travel on creeks and small rivers connecting various lakes.

*** Via Lakes Malo, Jourdain, Ducharme, River Scatsi, Lakes Potricourt, Buade and Normandin.

**** From Gouin Reservoir to Oskelaneo.

eye only from the upper Hamilton River and at Lake Mistassini. Macoun and Macoun (1909) write that none was seen in the interior of Labrador. At Lake St. John this species is outnumbered only by the black duck (Godfrey and Wilk, 1948).

An adult female weighing 2 lbs. 4 oz. was shot on the Kenogami River near its juncture with the Current River. This bird was without fat, had an open oviduct, and the five largest follicles of the ovary measured 3 mm. in diameter.

After this paper was completed, an interesting account of bird distribution along the Peace, Slave and Little Buffalo rivers appeared (Eaton, 1948). Of eight species of ducks observed, the American golden-eye was second in abundance only to the mallard. Eaton's

data (p. 348) are comparable to those presented here if the number of adults observed is converted to the number observed per 100 miles of river travel. On the section of the Peace River cutting through the Alberta Plateau, the tally was 24 adults per 100 miles; from Fort Vermilion to the juncture of the Peace and Slave rivers, 14 adults per 100 miles; on the Slave from its confluence with the Peace to Fitzgerald, 38 per 100 miles; and from Fitzgerald to Grand Detour, on the Slave River, 25 per 100 miles. None was seen on the Little Buffalo River. The observations from which these data were calculated were made from June 15 to July 8, 1940. The average number observed on these three rivers, 19 per 100 miles, suggests that the populations of American golden-eye are somewhat higher in suitable habitat in the interior plain of Canada than on the Pre-Cambrian Shield.

THE PRE-CAMBRIAN SHIELD IN QUEBEC.

| SPECIES OBSERVED | | | | | | | | | Total | | |
|-------------------|---------------|--------------------|-------------------|---------------|-----------------|-------------------|---------------|-----------------|----------|---------------|--|
| Golden-eye | | American Merganser | | | Unidentified | | | Number Observed | Per cent | Per 100 Miles | |
| Per cent of Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | Number Observed | Per cent of Total | Per 100 Miles | | | | |
| 58 | 33 | 3 | 21 | 12 | 2 | 14 | 8 | 14 | 100 | 58 | |
| 30 | 22 | 49 | 51 | 38 | 11 | 11 | 8 | 97 | 100 | 75 | |
| 5 | 3 | 51 | 77 | 57 | 10 | 15 | 6 | 66 | 100 | 73 | |
| 13 | 10 | 17 | 43 | 35 | 1 | 3 | 2 | 39 | 100 | 80 | |
| 10 | 3 | 3 | 10 | 3 | 3 | 10 | 3 | 31 | 100 | 35 | |
| 19 | 13 | 123 | 50 | 32 | 27 | 11 | 7 | 247 | 100 | 65 | |
| 16 | 11 | 4 | 8 | 6 | 9 | 17 | 13 | 52 | 100 | 72 | |
| 10 | 22 | 38 | 26 | 56 | 8 | 5 | 12 | 147 | 100 | 217 | |
| 0 | 0 | 9 | 90 | 16 | 0 | 0 | 0 | 10 | 100 | 18 | |
| 5 | 50 | 14 | 11 | 117 | 40 | 32 | 334 | 124 | 100 | 1,032 | |
| 9 | 11 | 68 | 19 | 23 | 60 | 16 | 20 | 364 | 100 | 122 | |

American Merganser

Mergus merganser. — In the Palaeozoic Basin between 0—83 American mergansers were tallied per 100 miles of canoe travel and the average for the three rivers travelled was 19 individuals per 100 miles. The rate of occurrence on the Pre-Cambrian Shield in 1947 varied between 8 and 107 birds per 100 linear miles of lakes and rivers and averaged 51. In 1948, between 3 and 57 individuals and an average of 32 were observed per 100 miles. In the Palaeozoic Basin this species composed about 43 per cent of the nesting duck population; on the Pre-Cambrian Shield, 50 and 66 per cent of the population. Most notable densities of these birds were on the Kenogami River and on the upper third of the Rupert River.

The higher population of American mergansers on the waters of the Shield than along the

rivers of the Basin corresponds with the greater fish population present in the rivers and lakes of the former region. No mergansers were found on the muskeg lakes of the Palaeozoic Basin—probably because most of these lakes are shallow and freeze solid in the winter, thereby precluding the survival of most fish.

Macoun and Macoun (1909) report this species common and breeding along two other large rivers of the Palaeozoic Basin, the Missinabi and the Moose, but also express the belief that in Ontario this merganser prefers inland lakes bordered by woods and not large expanses of open water. Low (1896) says that it is common throughout the interior of the Labrador Peninsula; Faribault *et al.* (1911) found this species widespread along the waterways of the Lake Chibougamau region; Godfrey and Wilk (1948) found it fairly common on Lake St. John in 1946, and in 1947, Godfrey

TABLE 5. — BROODS OF AMERICAN MERGANSERS OBSERVED ON LAKE ALBANEL AND THE RUPERT RIVER, QUEBEC, 1947.

| Locality | Date | Size of Brood | Estimated Age |
|--------------|---------|---------------|-------------------------------|
| Lake Albanel | July 22 | 3 | 1 week old |
| Rupert River | Aug. 8 | 14 | 3-4 " " |
| " | " 8 | 6 | 3-4 " " |
| " | " 10 | 4 | 2 " " |
| " | " 10 | 1 | 3-4 " " |
| " | " 11 | 6 | 3-4 " " |
| " | " 11 | 4 | 3-4 " " |
| " | " 12 | 6 | 3-4 " " |
| " | " 12 | 5 | 3-4 " " |
| " | " 12 | 2 | Nearly ad. size, wings stubby |
| " | " 13 | 2 | " " " " " |
| " | " 15 | 3 | " " " " " |
| " | " 16 | 6 | Nearly able to fly |
| " | " 17 | 1 | Nearly ad. size, wings stubby |
| " | " 17 | 2 | " " " " " |
| " | " 17 | 4 | " " " " " |
| " | " 20 | 6 | Flying stage |
| " | " 20 | 5 | " " |
| " | " 22 | 3 | 2-3 weeks old |
| " | " 25 | 2 | 3-4 " " |
| Average | | 4.3 | |

and his party observed a total of 23 individuals between June 26 and August 8 in the Lake Mistassini region.

A yearling male weighing 3 lbs. 2 oz., was collected 18 miles below the juncture of the Pagwa and Kenogami rivers on June 3, 1947, by Hanson. The bursa of this male was open and its testes measured 15 x 5 mm. Two downy young about one week old were collected from a brood of six on the Albany River near the head of the islands on July 28. A canoe party that reached Ft. Albany on July 27, also via the Pagwa, Kenogami and Albany rivers, reported seeing only five broods; four were sighted on the Kenogami River and one on the Albany River. Broods observed in Quebec are summarized in tables 5 and 6.

Hooded Merganser

Mergus cucullatus.—The hooded merganser was noted only along the Pagwa and Kenogami rivers where field observations indicated an abundance of 0—21 individuals per 100 miles of travel. The average rate of occurrence was two per 100 miles. This merganser made up about five per cent of the duck population in the Palaeozoic Basin.

Macoun and Macoun (1909) credit Spreadborough with finding the hooded merganser breeding from the Missinabi River to Cape Henrietta Maria. They also report that a pair was observed by Spreadborough in the interior of Labrador on July 16, 1896, although this record is omitted by Low (1896) in his list of the birds of the interior of the Labrador

TABLE 6. — BROODS OBSERVED IN QUEBEC IN 1948.

| Species | Locality | Date | Size of Brood | Estimated Age |
|---------------------|------------------------------------|----------|---------------|-------------------------------------|
| Black Duck | Nemenjish River | June 24 | 6 | About 2 weeks |
| American Golden-eye | Temiscamie River | July 20 | 7 | About 1 week |
| " " | " " | Aug. 1 | 5 | About 1 week |
| Black Duck | " " | Aug. 5 | 7 | With female, capable of flight |
| American Golden-eye | Tournemine River | Aug. 6 | 11 | Nearly mature |
| American Merganser | " " | Aug. 6 | 9 | Nearly mature, stubby wings |
| " " | Lake Tournemine | Aug. 7 | 1 | Nearly mature |
| " " | " " | Aug. 7 | 6 | About 4 weeks |
| " " | Temiscamie River | Aug. 12 | 12 | About 5 weeks |
| Black Duck | " " | Aug. 14 | 1 | 5-6 weeks |
| American Merganser | Lake Albanel | Aug. 26 | 5 | _____ |
| " " | Lake Mistassini | Aug. 27 | 6 | 5 weeks |
| " " | " " | Aug. 27 | 8 | 5 weeks |
| " " | Lake Chibougamau | Sept. 9 | 12 | Nearly full-grown |
| " " | Lake Obatogamau | Sept. 13 | 7 | Nearly full-grown |
| " " | Portage route from Lake Obatogamau | Sept. 15 | 6 | Nearly full-grown |
| " " | Lake Ducharme | Sept. 16 | 11 | About one half of brood able to fly |
| " " | Lake Ducharme | Sept. 16 | 7 | About one half of brood able to fly |

Peninsula. Gabrielson (1938) observed a female and four half-grown young near Maniwaki, Quebec, on July 29, 1937. A. L. Wilk (Godfrey and Wilk, 1948) collected a yearling male at Lake St. John on August 14, 1946. W. Earl Godfrey (*in litt.*) informs me that this species has been reported in the summer from Anticosti Island and that Comeau (1909) reported it near Godbout on September 4, 1885, and on September 10, 1889. In 1947, on July 22, Godfrey and his party saw two females apparently accompanied by young on Lake Mistassini. The meagerness of these records and the failure of Murray and Edward Rogers to find it on their traverses of the Pre-Cambrian country is indicative of its rareness in Quebec north of the St. Lawrence River, a fact also alluded to by Cooke (1906). The centre of abundance of the hooded mer-

ganser in Canada is northern Manitoba, according to Macoun and Macoun (1909).

A fully grown juvenile, one of a pair observed, was collected by Hanson at the mouth of the north branch of the Albany River on July 31, 1947.

OTHER SPECIES

Several species of ducks, other than those listed above, were observed. These were either migrants or rare breeders.

Mallard

Anas platyrhynchos.—A drake was flushed from the Kenogami River below Mammamat-tawa. There are no data to indicate that this species breeds in the interior of the section of the Palaeozoic Basin west of James Bay although it is a common nesting duck on the coastal marshes.

Green-winged Teal

Anas crecca.—A single drake was noted a few miles from the mouth of the Pagashi River on June 18. When this river was descended on the following day, this bird was again sighted at the same place and hence may have had an incubating mate nearby.

Buffle-head

Bucephala albeola.—Two drakes of this species were observed by Murray and Edward Rogers: one on Pike Pond on June 19, 1947; and one on a portage route to Lake Chibougamau on September 12, 1948.

Greater Scaup Duck

Aythya marila.—Three female scaup, identified as greater, were observed by the Rogers' on Lake Chibougamau on September 12, 1948.

Ring-necked Duck

Aythya collaris.—Two drakes and a hen were observed on May 26 on the Pagwa River at the village of Pagwa River. These individuals were evidently still in migration. In Ontario, the ring-neck is known to nest with certainty only in the southern Kenora and Thunder Bay districts (Baillie and Harrington, 1936). There is one record of an adult male, observed on June 29 in the Sault Ste. Marie region (Snyder, Logier and Kurata 1942).

American Scoter

Melanitta nigra.—In late May and early June, large numbers of American scoters congregate along the lower Kenogami River and on the Albany River, particularly near The Forks. These birds are migrants only through this area and by the end of the first week in June the migration is largely over. A total of seven drakes and one hen was tallied during the periods of observations listed in table 2.

The Indians, while en route from their winter trapping camps to the various posts, kill fair numbers of American scoters for food. At camp sites along the lower Kenogami River, scoter wings often littered the ground or were festooned on bushes and small trees, a custom no doubt related to the superstitions of the local Indians.

Skins of four drakes were obtained from specimens shot by the Indians at The Forks. The bursas of these four birds were closed; each had badly worn tail feathers; and all were fat, or moderately fat, according to the categories proposed by McCabe (1943). Their weights were as follows: 2.0 lbs., 2 lbs. 4 oz., 2 lbs. 4 oz., and 2 lbs. 6 oz. [Kortright (1942) gives 2 lbs. 8 oz. as an average for seven

males.] The testes of all four were enlarged, the members of each pair being unequal in size. The measurements of two pairs were as follows: 23 x 10 and 15 x 8; 25 x 10 and 17 x 7 mm. Only one female was recorded out of 12 individuals shot and observed, a fact suggesting that the stragglers in the spring flight may be largely unmated males.

Surf Scoter

Melanitta perspicillata.—This species occurs less commonly in migration on the Kenogami and Albany rivers than does the black scoter. A drake shot by Indians at The Forks on June 7 was made up into a skin. This specimen had a closed bursa, was moderately fat and weighed 2.0 lbs. The tail feathers, excepting one central one (the other was missing), of this bird were unworn with entire tips.

On the morning of June 14 a courting party of three adult drakes and one hen was observed in a quiet bay of the Albany River about five miles below the mouth of the Gander River. Apart from these four birds were three drakes whose plumages indicated that they were yearlings.

OTHER SECTIONS OF THE SHIELD AND BASIN

In the two regions traversed by the authors, non-game ducks, the American golden-eye, the hooded merganser and the American merganser, constitute roughly 80-85 per cent of the total duck population. Black duck make up the remainder. Although scattered sparsely, in the aggregate the black ducks from these two areas may account for a considerable portion of the total population of this species on the continent.

Pertinent data from the literature regarding duck populations in other sections of the Palaeozoic Basin and of the Pre-Cambrian Shield are briefly summarized here.

Newfoundland-Labrador

The black duck is the only common breeding species of game duck in this section of the Pre-Cambrian Shield. Other non-game species breeding in the interior are the American golden-eye, the eastern Harlequin duck and the red-breasted merganser. While the status of the American merganser in Newfoundland-Labrador appears to be questionable it doubtless occurs there (from Austin 1932).

Quebec

The forested areas of the Pre-Cambrian Shield in Quebec contain few game ducks o'her



Fig. 4. Lakeland muskeg just north of the Albany River. 40 miles in land from the coast of James Bay.

than the black duck. The pintail is a rare summer resident in the Lake St. John region (Godfrey and Wilk, 1948) but it is believed to breed in considerable numbers in the Povungnituk region and on the King George and Sleeper Islands in Hudson Bay (Manning, 1946), localities which lie well north of the limit of trees.

The green-winged teal is not uncommon and breeds at Lake St. John (Godfrey and Wilk, 1948). This teal is said by the local residents to breed regularly in the vicinity of Fog Island along the north shore of the St. Lawrence River (Lewis, 1927). It also may reappear in a few scattered but favorable localities near the limit of trees, as fully fledged young females were collected by Turner (1885) in late July at Fort Chimo.

The ring-necked duck is a scarce breeder, being known from the Lake St. John region, and having been recorded as breeding at Lake St. Edward, 16 miles north of Quebec City, at Rush Lake, Frontenac Co., and at Messines, Gatineau Co. (Cayouette, 1945).

Ontario

Mallards have been recorded as breeding in the Cat Lake (Wilson, 1902) and Lac Seul region, in western Ontario adjacent to the Manitoba border (Baillie and Harrington, 1936), and in the western Rainy Lake district (Snyder, 1938). A few pairs of wood duck and green-winged teal nest in the Lake Nipissing area (Ricker and Clarke, 1939) and small numbers of wood duck breed in Algonquin Provincial Park (MacLulich, 1938). Blue-winged teal occasionally breed on the edge of the Shield and north to Lake Nipissing in Ontario (Baillie and Harrington, 1936), although not recorded in the latter locality by Ricker and Clarke (1939). There is one record for the Sudbury district (Baillie and Hope, 1947) and it occurs sparingly in the southern part of extreme western Ontario. Soper (1923) noted only the American merganser, black duck and American golden-eye in portions of the Nipissing and Timiskaming districts in 1922.

In contrast to the scarcity of game ducks in the interior of the Pre-Cambrian Shield and the Palaeozoic Basin of Ontario is the relative abundance of game ducks on the coastal marshes of Hudson and James bays, fig. 5. In order of abundance, the species that occur are: pintail, black duck, green-winged teal, mallard, baldpate and blue-winged teal. On a flight along the coastal marshes between Ft. Severn and Attawapiskat on July 18, 1947, Queneau

and Hanson identified the following ducks: pintail, 1,300; black duck, 260; green-winged teal, 115; and mallard, 40. However, a check of some estimates made from the air with photographs of the same flocks indicated considerable underestimation, at least in some instances.

In the autumn of 1940, Lewis and Peters (1941) found the last four named species in the marshes of James Bay in the same order of abundance. On June 24, 1947, Hanson collected an adult male baldpate near the mouth of Chickney Channel. Comeau (1914) also reported the pintail to be the most abundant duck on Hudson Bay, and judging from his account, he found the green-winged teal to be second in abundance. O'Sullivan (1905) wrote: "black ducks by the thousand breed in the southern part of Hannah Bay, [Quebec] and the pintail and teal [presumably green-winged] in even greater number, breed north of the Albany." Observations by Spreadborough (in Macoun and Macoun, 1909) and records made in the summer of 1947 by Hanson and by Lemieux and Kelsall (personal communication) substantiate the occurrence of pintail mainly north of the Albany River. Two adult male pintails were collected by Hanson at the mouth of Chickney Channel on June 26, 1947, and flocks of pintails and black ducks totaling many hundreds were observed trading up and down the tide zone during that evening. A female pintail and six five-week-old young were encountered near the mouth of Partridge Creek by Hanson on July 28, 1946.

The duck decline of late decades may have resulted in a thinning out of some species in areas that might be considered marginal range in the light of more recent data. Thus, Survey Party No. 1, of the survey and exploration teams that worked northern Ontario in 1900 (Speight, 1901), found the "black, wood, buff (?) and buff-head" (presumably the buff-head) ducks and the mergansers between lakes Abitibi and Kesagami. Survey Party No. 3 found mallard, wood duck, bluebill (scaup), widgeon and shoveller along with the American and hooded merganser and American golden-eye abundant in the region between Lake Temagami and the Montreal River. At least one female and a brood of each of these species were observed. Survey Party No. 8 found the mallard in the country west of Lake Nipigon; Party No. 10 found mallards well represented among the ducks in the country between the C.N.R. line and Lac Seul and the English River, west to the western border of the province.



Fig. 5. Coastal marsh of Hudson Bay, 15 miles northwest of the Kaskattama River.

From the data presented above it is obvious that, with the exception of the black duck, game ducks as breeding birds are generally absent from the interior of the eastern half of the Pre-Cambrian Shield.

Are the wooded western portions of the Palaeozoic Basin and Pre-Cambrian Shield more productive of game ducks than the eastern sections? A perusal of the literature relating to these sections indicates not. In fact, they are apt to be considerably less productive since the number of black ducks thins out as the species reaches the western periphery of its range, although to some extent in western Ontario it is replaced by the mallard.

Manitoba

The abundance of game ducks in the prairie potholes and marshes bordering lakes Manitoba, Winnipeg and other lakes in southern and western Manitoba is well known (Thompson, 1890, Shrott and Waller, 1937, Hochbaum, 1944, Williams et al., 1948, the best and most comprehensive account of duck populations in regions south and west of the Pre-Cambrian Shield) but on the Pre-Cambrian Shield and in the Palaeozoic Basin north and

west to the limit of trees, markedly fewer ducks are found. There are again a few exceptions to this general picture, i.e., pockets of attractive habitat are found interspersed in this country which is otherwise unsuitable for most kinds of game ducks. Mallards apparently breed along the Hayes River between Oxford House and York Factory (Preble, 1902), and Bell (1880) reported that in 1879 the mallard was the most common duck along the Nelson and Little Churchill rivers where it was found breeding in considerable numbers.

An extremely sparse breeding population of game ducks evidently occurs in the wooded country of extreme northeastern Manitoba and adjacent Keewatin within 200 miles of the limit of trees. During a month of field work in that region, Manning (1948) noted only 7 baldpate, 5 pintail and 4 shoveller.

Like other sections of the coastal marsh of Hudson Bay, the portion lying within the province of Manitoba also produces considerable numbers of game ducks. Between York Factory, Manitoba, and Fort Severn, Ontario, Queneau and Hanson tallied from the air approximately 720 black ducks, 220 pintails and 14 green-winged teal. Preble (1902)

wrote of green-winged teal being killed for food by Indians at Churchill and of seeing large flocks on ponds between Churchill and Cape Churchill in late August. He reported seeing also large numbers of pintail between Cape Eskimo (District of Keewatin) and Churchill. Taverner and Sutton (1934) state that pintail, black duck, baldpate and green-winged teal all nest in the Churchill region, their remarks indicating that these species occur in the above order of abundance. The greater scaup "breeds occasionally and perhaps regularly" and the lesser scaup may also nest there occasionally. Gadwall (Preble, 1902), blue-winged teal and shoveller (Taverner and Sutton, 1934) rank either as rare or occasional breeders in the Churchill district.

Saskatchewan

The distribution of game ducks in Saskatchewan, judging from Mitchell's account (1924) and Williams et al. (1948), does not differ materially from that found for Manitoba. Most species are present in the southern sections, but only a few species (green-winged teal and mallard) are found in the northern part of the province and on the Pre-Cambrian Shield and then only in relatively small numbers.

Buchanan's (1920) records of waterfowl in northern Saskatchewan and an adjacent portion of the Shield in Manitoba made in 1914 are notable for their complete listing of dates and localities, and in many cases of numbers observed. The American merganser and the red-breasted merganser were reported from a number of localities along the Churchill River and from Reindeer Lake, where the latter apparently outnumbered the former. Buchanan also noted the red-breasted merganser along the Cochrane River and on Lake Du Brochet, localities from which he failed to observe the American. His data suggest that as the limit of trees is approached, the red-breasted merganser gradually replaces the American merganser.

The mallard was the game duck most commonly observed by Buchanan. This duck was evidently quite numerous along the Churchill River between Ile à la Crosse Lake and Sandy Lake, localities near the periphery of the Shield; a number of nests were found. Between Sandy Lake and Reindeer Lake, mallards were only occasionally noted, although three nests were found on an island above Kettle Falls on the Churchill River. This species was reported as being scarce on Reindeer Lake, only one brood being noted. On Buchanan's

ascent of the Cochrane River to Lake Du Brochet, a distance of about 60 miles, six females, three of which were accompanied by broods, were observed. The pintail was the only other species of game duck observed for which nests or broods were reported. One brood of pintail was noted above Kettle Falls on the Churchill River, and a flock of 18, adult and young combined, were observed on Lake Du Brochet. Occasional records of other game species reported by Buchanan between Ile à la Crosse Lake and Lake Du Brochet include the widgeon, green-winged teal, blue-winged teal, shoveller, greater scaup and white-wing scoter.

Of the country between Lake Athabaska and the Churchill River, Tyrell (1896) writes: ". . . except along the banks of the Churchill River, where ducks breed in great numbers, birds are not at all numerous in the district explored. With the exception of one or two species of merganser, but few ducks were seen, as there is very little food for them in the clear lakes and rivers." The latter remark would not apply to the ubiquitous mergansers as Tyrell also remarks that, "Fish seem to be everywhere abundant in the lakes and streams, but the number of species is very limited."

Alberta

There are no data of consequence regarding waterfowl for that section of the Pre-Cambrian Shield which lies in extreme northeastern Alberta. However, in the low deltaic lands within or just adjacent to the Shield (at lakes Claire, Mamawi, Baril, and the Slave, Peace, Athabaska and Birch River deltas) waterfowl populations (mallard, pintail, shoveller, golden-eye, green-winged teal and baldpate) are reported by Soper (1934) to be of considerable size. On the Birch River delta, Soper estimated that he saw 10,000-15,000 ducks in 1933, but on a canoe trip down the Peace, Slave and Little Buffalo rivers in 1940, Eaton (1943) reported seeing only the mallard, baldpate and golden-eye in appreciable numbers. In 1947 Smith (Williams et al. 1948) found the waterfowl populations in this general area disappointing. Seton (1908) reported the green-winged teal and the American golden-eye to be common along the Slave River down to its delta.

District of Mackenzie

West of the perimeter of the Shield in the District of Mackenzie and from the Alberta border to the arctic coast, particularly in the Mackenzie Delta (Preble, 1908; Porsild, 1943), mallard, pintail and baldpate breed abundantly in suitable habitat. However, reports of the

occurrence of these species in appreciable numbers, from the interior of the wooded portions of the Shield in this district, are lacking. Fairbairn (1931) found only the red-breasted merganser breeding on Great Slave Lake and reported no ducks from surrounding areas of the Shield⁹.

Wooded country, per se, does not seem to be a deterrent to the presence of nesting populations so long as pockets of suitable habitat exist. This is demonstrated by the present or former abundance of game ducks in the wooded portions of the interior plains of Canada, while the wooded sections of the Shield support relatively few game ducks as suitable habitat is usually lacking. For example, the pintail which is abundant west of the Shield but absent from the forested portions on the Shield, reappears as a common breeder in the Thelon marshes (Clarke 1940) which lie adjacent to the northern limit of trees. It also breeds by the thousands in the Perry River marshes near the arctic sea coast according to Gavin (1948)¹⁰.

DISCUSSION

The range of the American merganser seems to be regulated only by the presence of suitable trees or snags for nesting and an ample fish supply. Escape cover is not needed as the juveniles flee by diving or literally running across the top of the water at great speed. The red-breasted merganser, not requiring trees to nest in, has filled the American merganser's predatory niche north of the limit of trees.

⁹ Dr. William MacDonald of Yellowknife, a geologist and acute amateur naturalist who has travelled extensively over the western arctic and sub-arctic regions of Canada, furnished the following notes on duck distribution (personal communication May 1949). In the Snowdrift River country, the pintail is the most common breeding duck. The lesser scaup occurs throughout much of the country east of Yellowknife as does the green-winged teal and widgeon, both of which are said to be quite plentiful. (The range of the lesser (?) scaup also extends for some distance into the Barrens. Although it is scarce there, trapper Mathew Murphy (personal communication May 1949) reported it to be the most common breeding duck in the Musk-ox Lake area.) The white-winged scoter and the surf scoter breed in the Yellowknife district and on the Barrens (also see Clarke 1940), the surf scoter being the more abundant of the two species. The red-breasted merganser breeds on Great Slave Lake and on the Barrens; the American merganser breeds along the rivers flowing into Great Slave Lake and presumably on many of the islands. Flocks of moulting American mergansers, as large as 1,000, have been noted on Great Slave Lake by MacDonald, but he has not observed this merganser on the Barrens.

¹⁰ Field studies in the Perry River area in 1949 by Peter Scott and the senior author indicated that although considerable numbers of drake pintail come into this region to moult, probably very few pairs actually nest there. One Eskimo questioned said it did not breed there; another reported that a few nested there each year.

In respect to habitat requirements, the golden-eye seems to occupy an intermediate position between the fish-eating ducks and the game ducks. It nests in trees but is a versatile feeder, eating aquatic insects, amphipods, isopods, aquatic weeds and molluscs (Munro, 1939). These foods occur far less abundantly in the relatively sterile, acid waters of the lakes and sphagnum bogs of the Shield and Basin than in the waters of the interior plains of Canada. Seton (1908), for example, noted golden-eye along the Slave River but not in the country (Pre-Cambrian) east of it.

The waters of the prairie and parkland areas of the interior plains of Canada generally meet all of the requirements of the game ducks: nesting and escape cover are usually plentiful, unless eradicated by man, and food in the form of aquatic plants and small invertebrates is present in surplus quantities. The shallow bays in the Delta marshes, Manitoba, literally swarm with small crustacea and other organisms in the summer; whereas cursory observations indicated that the waters of the muskeg lakes in the Basin are nearly sterile in this respect. The late thawing and breakup of muskeg lakes probably accounts in part for their sterility. During the first few days in July, 1947, traverses on foot of the lake-land muskeg in the Lawapiskau River country revealed that solid ice prevailed from 15 to 18 inches below the open surface of the smaller ponds and beneath the floating sedge mat which covers extensive water areas. Aquatic plants are scarce and emergent vegetation suitable for some nesting ducks is nearly absent.

Pre-Cambrian Shield lakes are unattractive to game ducks as they have relatively little shallow water, and they are generally deficient in plant nutrients and organic soils necessary to support a rich invertebrate population and the kinds of aquatic and emergent vegetation important to many ducks. Exceptions no doubt exist but it is doubtful that they would alter this general appraisal. The deficiency of food suitable for young ducklings, probably more than any other factor, explains the scarcity of game ducks in the lakes and ponds of the Pre-Cambrian Shield and the Palaeozoic Basin.

In brief, the distribution of nesting ducks insofar as lakes are concerned conforms to the general distribution of the three primary types recognized by the limnologists (Welch 1935): the *dystrophic* type, as exemplified by the

sphagnum bogs and lakes of the Palaeozoic Basin, support a meager population of ducks of the dabbling variety (the mergansers and golden-eyes being restricted to the rivers of the Basin), and Canada geese which feed mainly on nearby grasses and sedges and to a lesser extent on the direct biological products of these lakes; the *oligotrophic* type, as typified by the majority of the lakes of the Pre-Cambrian Shield which characteristically support a fair-sized population of American mergansers; and the *eutrophic* type, which is common to most areas south of the Pre-Cambrian Shield and which is capable of supporting a large and varied duck population. A more exacting and satisfactory limnological classification of the water areas of Canada and the United States in relation to nesting ducks is needed to help implement the management program.

The data presented here suggest the need of a classification of the breeding ranges of our waterfowl to suit modern management needs. In the future it would seem desirable to recognize three kinds of ranges and to specify which type is being discussed. They are the *general breeding range*, the *main breeding range* and the *known breeding range*.

In practice, the general breeding range has been used largely in the past. Cooke (1906) writes about the mallard: "The northern half of the United States west of Pennsylvania, and the whole of Canada west of Hudson Bay, constitutes the principal breeding range in the Western Hemisphere of the mallard." This, of course, is roughly the *general breeding range* of the mallard—not the *main* or "principal" range. The *main breeding ranges* of our waterfowl are in part satisfactorily presented by Kortright (1942) but in many species the ranges given are shown to extend over large areas of western sections of the Pre-Cambrian Shield, where to illustrate, such species as pintail and mallard are altogether lacking or are present in relatively small numbers. The *main breeding range* of the pintail, on the other hand, should be shown as including the west coast marshes of Hudson and James bays south to the Albany River and excluding the forested parts of the Pre-Cambrian Shield lying between Hudson and James bays and the interior plain of Canada.

The *known breeding range* should attempt to include all localities in which a species is known to breed with any regularity, even though in relatively small numbers. For example, a map of the known breeding range of the mallard would show portions of the Churchill River and small scattered pockets in western Ontario as part of the productive range.

CONCLUSIONS

Although relatively large numbers of game ducks breed on or just adjacent to the periphery of the Palaeozoic Basin and the Pre-Cambrian Shield — notably in the coastal marshes on the south and west coast of James and Hudson bays, in the region of Lake Winnipeg, along the Athabaska and Slave rivers and their deltas—it appears that the major part of the interior of an enormous area of

Canada, bounded on the north by the limit of trees, and on the east, south and west by the perimeter of the Pre-Cambrian Shield, fig. 1, must, with the exception of the black duck and in a few places the mallard, be considered an area relatively unproductive of game ducks.

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OCCURRENCE OF ECHINOCOCCUS GRANULOSUS IN ELK (CERVUS CANADENSIS NELSONI), BANFF NATIONAL PARK¹

HUBERT U. GREEN

Banff National Park, Banff, Alberta

DURING the past four winters, 1944-45 to 1947-48, one thousand, one hundred and thirty elk in Banff National Park were non-selectively destroyed by gunfire by the Park warden service. Over-utilization of the Bow range by elk necessitated this action in order to balance winter population with range-carrying capacity. One thousand and ninety-three carcasses were salvaged and taken to Park headquarters at Banff for dressing, storage, and disposal as ration meat to the Department of Indian Affairs.

The author, a member of the Park warden service, carried out autopsies on these carcasses to determine current productivity, primary sex ratio, evidence of disease, and the incidence of endo- and ecto-parasites. The lungs of 1,073 of the carcasses were examined for parasitic infection.

This article deals with the occurrence of the larval stage (hydatid cyst) of the cestode, *Echinococcus granulosus*, in the samples examined each year.

Both single and multiple infections were discovered. Single cyst infections were common, and two or three cyst infections occurred frequently. Infections of more than three cysts were comparatively rare, although there were seven cysts on one infected lung and five on another.

The cysts varied in diameter from 2 mm. to 90 mm. They were either round or roughly ovoid in shape. In all cases of multiple infection, the cysts were small.

Lung infection was confined to the dorsal portion of the right and left anterior lobes, largely in the mediastinal region. Large and medium-sized cysts protruded slightly from the tissue in which they were firmly embedded. Small cysts were not visible but their presence was readily detected by palpation.

The effect of parasitism of lung tissue by *E. granulosus* seemed negative. No loss of flesh, functional impairment, or deterioration of the lung tissue was evident.

INTERMEDIATE AND TERMINAL HOSTS

Echinococcus granulosus is an intestinal parasite of the dog, wolf, coyote, and other members of the family Canidae. It is universal in distribution and seems to be common in certain forms of North American mammals in some sections of the continent. (Augustine, 1938).

Hydatid cysts were first recovered from elk of the Rocky Mountain system of National Parks by Cowan (1944), when four adult females were found to be infected in Jasper

¹ Received for publication December 6, 1948.

TABLE 1.
Sex and Age Composition of Elk Examined for *E. granulosus*

| Season | Number examined | Over 2 years | | Rising 2 years | | Calves | |
|---------|-----------------|--------------|-----|----------------|----|--------|----|
| | | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| 1944-45 | 180 | 28 | 104 | 9 | 15 | 4 | 20 |
| 1945-46 | 352 | 56 | 198 | 24 | 19 | 30 | 25 |
| 1946-47 | 297 | 50 | 152 | 19 | 17 | 36 | 23 |
| 1947-48 | 244 | 13 | 165 | 16 | 11 | 21 | 18 |

TABLE 2.
Sex and Age Composition of Elk Infected

| Season | Number infected | Over 2 years | | Rising 2 years | | Calves | | Incidence |
|---------|-----------------|--------------|----|----------------|---|--------|---|-----------|
| | | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ | |
| 1944-45 | 3 | 1 | 2 | — | — | — | — | 1.7% |
| 1945-46 | 24 | 7 | 16 | 1 | — | — | — | 6.8% |
| 1946-47 | 18 | 11 | 7 | — | — | — | — | 6.06% |
| 1947-48 | 12 | 10 | 1 | 1 | — | — | — | 4.9% |

National Park. Hydatid cysts were first recovered from Banff National Park elk by the author in 1944.

Cowan (1945) removed six hydatid cysts from the lungs of a mule deer (*Odocoileus hemionus*) in Jasper National Park. The author (1944-47) examined the lungs of seven mule deer and one moose (*Alces americana*) in Banff National Park. All were negative to the presence of *E. granulosus*.

Cowan (1943-45) examined one mountain lion (*Felis concolor*), six coyotes (*Canis latrans*), and one wolf (*Canis* sp.) in Jasper National Park. The wolf was moderately infected with *E. granulosus*, and the other species were negative.

The terminal host (or hosts) of *E. granulosus* in Banff National Park has not yet been established. Before 1945, the only canid, other than the domestic dog, in and about the Bow range was the coyote. Since then, the occurrence of wolves has been noted by the Park Warden service. By the winter of 1947-1948, the number of wolves on the Bow range was estimated at between nine and twelve. They apparently belonged to one family group.

CONCLUSIONS

The incidence of *E. granulosus* among elk in Banff National Park is confined mostly to the higher age groups. The lungs of only two yearlings (rising 2 year olds) were positive. All of the 177 calves examined were negative.

Vesiculation of the infected organ occurs about two weeks after ingestion of the onchosphere (or onchospheres) and the resulting hydatid usually reaches a diameter of about 1 cm. within five months. Thus, it appears that calves are temporarily immune from infection and that yearlings are largely immune.

The fact that *E. granulosus* was found in elk before the appearance of wolves on the Bow range in any appreciable numbers indicates that the coyote may be the major terminal host.

Observation indicates that the coyote does not prey upon mature elk. However, infection by *E. granulosus* might be accomplished in an elk-coyote cycle by devouring infected lungs as carrion.

If carrion is the medium of infection, the viability of *E. granulosus* exceeds the life of the host.

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